Taymā' I

Archaeological Exploration
Palaeoenvironment
Cultural Contacts

Edited by

Arnulf Hausleiter, Ricardo Eichmann, Muhammad al-Najem

الهيئة العامة للسياحة والتراث الوطني
Saudi Commission for Tourism & National Heritage
مستقبل وطن.. نبنيه معاً

Taymāʾ I

Archaeological Exploration
Palaeoenvironment
Cultural Contacts

Taymāʾ

Multidisciplinary Series on the Results of the Saudi-German Archaeological Project

Edited by

Arnulf Hausleiter, Ricardo Eichmann, Muhammad al-Najem

Deutsches Archäologisches Institut, Orient-Abteilung

Saudi Commission for Tourism and National Heritage

Taymāʾ I

Archaeological Exploration
Palaeoenvironment
Cultural Contacts

Edited by

Arnulf Hausleiter, Ricardo Eichmann, Muhammad al-Najem

with contributions by

Ariel M. Bagg, Helmut Brückner, Michèle Dinies, Ricardo Eichmann, Max Engel, Peter Frenzel, Andreas Ginau, Matthias Grottker, Arnulf Hausleiter, Benjamin Heemeier, Patrick Keilholz, Nicole Klasen, Harald Kürschner, Reinder Neef, Arno Patzelt, Martin Patzke, Anna Pint, Gunnar Sperveslage, Peter Voß, Kai Wellbrock

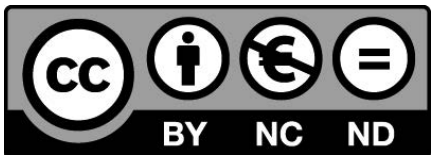
ARCHAEOPRESS PUBLISHING LTD
Summertown Pavilion
18-24 Middle Way
Summertown
Oxford OX2 7LG

www.archaeopress.com

ISBN 978-1-78969-043-9
ISBN 978-1-78969-044-6 (e-Pdf)

Cover: DAI Orient Department, A. Hausleiter.

Page setup: Dörte Rokitta-Krumnow and Susanna Wittmann-Gering,
DAI Orient-Abteilung Berlin



Print copies of this book are available direct from Archaeopress; electronic copies can be downloaded from the Archaeopress website www.archaeopress.com, or from the DAI website www.dainst.org.

Table of Content

Foreword

The archaeological excavations at Taymāʾ are part of a larger initiative of the Saudi Commission for Tourism and Heritage (SCTH) to systematically explore the rich history and cultural heritage of the Kingdom of Saudi Arabia. In addition to the activities of Saudi teams, SCTH's program addressed international research institutions and universities to participate to archaeological joint projects investigating sites all over the country.

The Saudi-German expedition by the SCTH and the German Archaeological Institute started in 2004, and in the meantime, there are almost 30 Saudi-international collaborative projects operating in the Kingdom. The efforts of these projects significantly contributed to a better understanding of the relationship between humans and their environments on the Arabian Peninsula from earliest times until today.

In order to intensify the international scientific exchange, SCTH held the 1st Saudi Archaeology Convention in 2017, combined with the "Roads of Arabia" exhibition, which displays numerous objects from Taymāʾ. It is planned to continue this forum on a biannual basis.

Archaeological and palaeoenvironmental research of the joint Saudi-German expedition at Taymāʾ led, amongst other, to the discovery of earliest oasis cultivation at the site more than 6,000 years before today. It was at that time when the foundations for a successful economic strategy were laid, resulting in Taymāʾ being one of the major hubs of the trans-Arabian communication networks.

The Saudi-German project at Taymāʾ put a significant emphasis on local cultural developments at Taymāʾ and within Northwest Arabia. This viewpoint contrasts previous views mainly considering external cultural, political and economic factors. It substantially adds to existing knowledge of the region as a highly dynamic area connected to neighbouring regions throughout all periods, highlighting the role of Arabia at the interface between both Africa and Asia and the Mediterranean and the East.

It is therefore, that we welcome the publication of this first volume of the Taymāʾ publication series. We express our thanks to all contributors to this volume for their immense work.

HRH Prince Sultan bin Salman bin Abdulaziz al-Saʿud
President of the Saudi Commission for Tourism and National Heritage

Introduction

The present volume it the first one of a series dedicated to the publication of the results of the joint Saudi-German expedition at Taymāʾ. The collaborative project by the Saudi Commission for Tourism and Antiquities (SCTH) and the German Archaeological Institute (DAI) in Berlin, since 2004, has been conducting multidisciplinary research at one of the major sites in Northwest Arabia. Until now more than 20 seasons of fieldwork have been carried out.

Information by early Arab historians and geographers provided an image of Taymāʾ as a wealthy oasis during the early Islamic period. For the preceding periods, it were mainly sources from neighbouring areas, such as Assyria and Babylonia, underlining the role of this important site for the 1st millennium BCE incense trade between South Arabia and the Mediterranean.

However, based on the work of the Saudi-German joint expedition, it is now clear that the relevance of Taymāʾ and the Hejaz goes far more back in time. Already in the 3rd millennium BCE the oasis was surrounded by an impressive mud brick wall and was involved in pottery production. Subsequently, bronze objects of Syro-Levantine character are attested at the site, once again illustrating the involvement of this oasis into the known Bronze Age exchange networks attested elsewhere in the Near East. Throughout the periods the oasis was engaged with the Arabian trading networks, the incense road being only a part of it.

This book of the new Taymāʾ publication series not only informs about the exploration strategies of the Saudi-German project but provides results on palaeonvironmental research. Based on proxy-data from the sediments of Taymāʾ's sabkha located north of the present-day oasis, new hypotheses on the Early Holocene climate and environment are drawn. The foundations of early oasis agriculture become increasingly visible. Fruit cultivation was significant from the beginning, whereas the date palm seems to be restricted to later periods. Hydrology and water management play a significant role for Taymāʾ's subsistence strategies, and pertaining research is part of the scientific program of the project. Taymāʾ always had sufficient groundwater supply which was mainly exploited by wells.

Last, but not least, two contributions deal with most relevant neighbours of Northwest Arabia with regard to culture, politics and economy, *i.e*. Egypt and Assyria. Especially the relationship between the latter and Arabia oscillates between trade and conflict, and it is the new excavations at Dumat al-Jandal which will shed further light on this particular scenario.

This first volume of the Taymāʾ publication series offers a collection of stimulating contributions to the research into the cultural heritage of Arabia, and we wish many more volumes to come, informing us about the history and archaeology of ancient Taymāʾ.

Professor Ali al-Ghabban
General Supervisor of the Custodian of the
Two Holy Mosques Program for Caring of
the Kingdom's Cultural Heritage

Preface

It is with great pleasure that we present the first volume of the publication series of the Saudi-German joint archaeological project at Taymāʾ, Northwest Arabia. Over the years, the multi-disciplinary investigation, starting in 2004, produced a large quantity of new results, with the potential of changing previous views on the cultural development and the history of Northwest Arabia in general and on that of the oasis of Taymāʾ in particular. Thus, the Joint Saudi Arabian – German project at Taymāʾ, carried out by the Saudi Commission for Tourism and National Heritage (SCTH), Riyadh, and the Orient Department of the German Archaeological Institute (DAI), Berlin, has not only advanced archaeological research but at the same time enriched the academic bilateral relations.

The first volume of the new series on Taymāʾ is aimed at contextualising the research at Taymāʾ by providing, on the one hand, new data on the ancient and modern environments and, on the other hand, reflections on cultural interaction with regard to Northwest Arabia; the latter was for many years impacted by the analysis of external sources. In the coming years our series will concentrate on the local cultural matrix of this large oasis, and, as expressed elsewhere, it is expected that the view on Taymāʾ through lenses from abroad will be increasingly replaced by an autochthonous perspective. Thus, connectivity, adaptation and exchange at this oasis will be considered under auspices quite different from those before. By uniting the contributions of this volume under the headlines archaeological exploration, palaeo-environment and cultural contacts, we not only emphasise that there is an interaction between these spheres, but also express our understanding of archaeology as historical scholarship.

The volume consists of three parts:

A synthesis of the archaeological exploration of Taymāʾ, relying on the data provided by the Saudi-German project is offered by A. Hausleiter and R. Eichmann, aimed at contextualising research strategies and results from a mainly archaeological perspective.

The second part contains contributions on palaeoenvironment, vegetation and hydrology: New data on palaeo-environment, in particular observations on climatic change at Taymāʾ, as based on the deposits in the *sabkha,* formerly an ancient palaeo-lake north of the oasis, is discussed by the geo-archaeological research unit mainly based at University of Cologne (formerly Marburg University) and composed of Helmut Brückner, Max Engel, Peter Frenzel, Andreas Ginau, Nicole Klasen, Martin Patzke and Anna Pint.

The lake sediments constitute an important geo-archive providing significant data for the reconstruction of Early-to-Mid Holocene climatic and environmental conditions. The research group on the history of vegetation and archaeobotany, *i.e*., Harald Kürschner, Reinder Neef and Michele Dinies at Berlin's Free University, respectively at the Scientific Division at the DAI's head office, offers the first data from Taymāʾ and its surroundings, including aspects of ancient and recent vegetation.

A further substantial contribution dedicated to the primary resources framing human life in an oasis is presented in a first synthesis on the water management at Taymāʾ, authored by the hydrological project group based at Lübeck's University of Applied Science, *i.e*., Matthias Grottker, Benjamin Heemeier, Patrick Keilholz, Arno Patzelt, Peter Voß and Kai Wellbrock.

The third section presents contributions on contacts and exchange in the context of archaelogical and textual sources: The relations between Egypt and Arabia are discussed by Gunnar Sperveslage. Ariel Bagg, with special regard to toponomastics, investigates the Assyrian – Arabian history. The contacts with the political entities in both regions have impacted the scholarly debate on Northwest Arabia for many years. Dealing with these two neighbouring regions, the particular cultural and geographical location of the Arabian Peninsula between Africa and Asia is emphasised.

The joint project would not have been possible without the support of several individuals and institutions in Saudi Arabia, to which we express our warmest thanks for generously supporting the project in person and with their staff:

- The President of the Saudi Commission for Tourism and National Heritage (SCTH), HRH Prince Sultan bin Salman bin Abdulaziz al-Sa'ud;
- The General Supervisor of the Custodian of the Two Holy Mosques Program for Caring of the Kingdom's Cultural Heritage, Professor Ali al-Ghabban;
- The Vice-President of STCH, Mr Jamal S. Omar;
- SCTH's Antiquities and Museums Sector Director General of Research and Survey, Dr Abdullah al-Zahrani;
- Former Deputy Ministers of Antiquities and Museums, Professors Dr Sa'ad al-Rashid and Dr Muhammad al-Ruweishid;
- Former Vice-President of SCTH, Dr Hussein Abu al-Hassan;
- Former Directors General of Research and Survey, Professors Dr Daifallah al-Talhi, Dr Abdulaziz al-Ghazzi, Dr Khalid Eskoubi, Mr Jamal S. Omar and Dr Abdullah Alsaud;
- The Director of the Antiquities Office at Taymāʾ, Mr Muhammad H. al-Najem;
- The Dean of the King Abdullah Institute for Research and Consulting Studies, King Saud University, and former head of the College of Archaeology and Tourism, Professor Dr Said F. al-Said.

In Germany we received strong support for conducting the then first German archaeological project in the Kingdom, and we would like to express our gratitude to the following individuals:

- The current and former presidents of the German Archaeological Institute (DAI), Professors Dr Friederike Fless, Dr Hans-Joachim Gehrke and Dr Hermann Parzinger;
- The chairman for ancient cultures at the German Research Foundation (DFG), Dr Hans-Dieter Bienert, Bonn;
- The current and former ambassadors of the Federal Republic of Germany in Riyadh, Mr Dieter W. Haller, Mr Boris Ruge, Dr Volkmar Wenzel, Dr Volker Krieghoff and Dr Gerhard E. Schrömbgens and their staff, in particular the German Cultural Attaché as well as representatives of the administration;
- The current and former German Consuls General at Jeddah, Mr Holger Ziegeler, Ms Annette Klein, Dr Michael Zickerick, Dr Hubert Lang; special mention deserve the former Robert-Bosch Cultural Managers at the Consulate in Jeddah, Ms Miriam Seyffarth and Mr Christian Strob.

Our particular thanks go to the German Research Foundation (DFG), Bonn, as main sponsor of the German component of the project. Next to our Saudi colleagues, we are deeply indebted to all our staff in the field as well as in Berlin, contributing to the success of the project. We also thank the DAI administration for its efficient work all over the years.

We are very grateful to the reviewers of this publication for their valuable recommendations. Dr Dörte Rokitta-Krumnow typeset the entire volume; this work was completed by Susanna Wittmann-Gering. In the final stage, Dr Sebastiano Lora, Leticia Fernandez Michel and Ezel Güneş provided substantial help. Dr Anja Fügert, head of the editorial office of the DAI's Orient Department, successfully managed the publication process. Dr Peter Baumeister, head of the editorial office at the DAI's Head Office, provided valuable information regarding to the processing of the Open Access publication. The collaboration with Dr David Davison of Archaeopress was swift and pleasant. To all of them we are indebted in gratitude.

We would not like to conclude this preface without thanking the authors for their patience, since the present volume appears later than originally scheduled. They contributed with their great expertise to the success of the project.

Arnulf Hausleiter, Ricardo Eichmann

Archaeological Exploration

Date palm and citrus tree in the oasis of Taymāʾ
(DAI, Orient Department, A. Hausleiter)

نخل التمر وأشجار الحمضيات في واحة تيماء
(معهد الآثار الألماني، قسم الشرق ، أ. هاوسلايتر)

The archaeological Exploration of the Oasis of Taymāʾ

Arnulf Hausleiter and Ricardo Eichmann

Die Oase Teima liegt in einer tiefen von Süden nach Norden sich senkenden Mulde, deren unterirdische, jedenfalls weit ausgreifende Wasserzuflüsse in dem schon oben erwähnten Brunnen el-Haddâg emporquellen. Sie wird überdies von einem für gewöhnlich trockenen Bachbett (Scha'ib) durchschnitten, durch welches die Gewitterregen und winterlichen Tagwasser sich nach Norden ergiessen. Auf drei Seiten wird die Ansiedlung durch künstliche Erd- und Steinwälle d.h. alte Befestigungen, umsäumt.

J. Euting 1914

There is (...) the cultural and historical dimension of the Kingdom of Saudi Arabia, which is largely unknown outside the circle of specialists in the fields of ancient Arabian pre-Islamic civilizations and Islamic culture, and which is preserved in archaeological sites and artefacts of cultural heritage. The time has now come for the world to become acquainted with this dimension.

A. al-Ghabban, 2013

Civilization, if we are to retain that term, should then refer to the historical outcomes of exchanges and borrowings between *societies rather than to processes or attributes that set one society apart from another.*

D. Wengrow, 2010

The quintessential settlement of the desert is the oasis.

T. J. Wilkinson 2003

1 Introduction

Over the last ten years, our knowledge of the archaeology and history of oases in Northwest Arabia has considerably increased. Several new research projects have been launched at various sites in Saudi Arabia, a number of which with an interdisciplinary approach furnishing not only new fundamental data for the reconstruction of the region's history, economy, and social life, but also new information on the local impact from environmental factors on human adaptation processes, social responses, and cultural innovations.

From an outside perspective, the image of Arabia was for long dominated by interpretations of Biblical, Assyro-Babylonian, Latin, Greek, and finally Arabic sources, as well as by issues relating to the aromatics trade (Avanzini 1997) which for the most draw on oral traditions, including myths and legends. Ground data from landscapes and sites were supplied by either early Arab historians and geographers (Buhl – Bosworth 2000) or commonly by 19th/20th century Western travellers and researchers, who visited locations relevant for the cultural history of the region

(Doughty 1888; Huber 1891; Euting 1896/1914; Jaussen – Savignac 1909/1922; Philby 1957; Altheim – Stiehl 1973; cf. Eichmann 2011; Potts 2011; Magee 2014; Loreto 2017). Whereas impressive amounts of primary data kept coming in from spectacular sites in Syro-Mesopotamia, the Levant, Anatolia, Iran, and Egypt as well as the Gulf, South Arabia, and Oman, large parts of the almost 3 million km^2 large Arabian Peninsula chiefly located within the actual borders of Saudi Arabia stayed uncharted.

Facing this situation, the Council of Ministers of the Kingdom of Saudi Arabia convened in 1963 on the foundation of a department of archaeology within the Ministry of Education, and in 1972 a royal decree approved the creation of a Supreme Council of Archaeology (al-Ghabban 2010). In 1976, the Kingdom's Directorate General of Antiquities for the first time launched a countrywide survey project to register archaeological sites over the entire country, starting in the northern and eastern provinces (al-Khowaiter 1977; al-Masry 1977b). Excavations began at many of the recorded sites, among them at Qaryat al-Faw, Thaj, Tarut, and Taymāʾ, to mention a few. Many produced spectacular results witnessing the country's several millennia-old past. Over the years, archaeological investigations continued and expanded into the kingdom's other provinces (for the North-western Province cf. Ingraham *et al.* 1981), while their results were made public in the journal ATLAL (al-Masry 1977a) and various monographic publications, of which the first was "An introduction to Saudi Arabian Antiquities" (1975).

Foreign research teams began work as early as in the 1960s, but they concentrated mainly on limited, though significant epigraphic and archaeological surveys (F. V. Winnett, W. L. Reed [1970], and P. J. Parr, G. L. Harding, J. E. Dayton [1970; 1972]). The 1980s saw a nationwide project to construct regional museums, and in 1999 the current National Museum hosting a large and impressive archaeological collection was inaugurated. Presently, an initiative aiming at modernising existing and building new regional museums is being implemented.

At the beginning of the 21st century, a number of foreign expeditions were invited to team up with the archaeological, epigraphic, and palaeo-environmental exploration of Saudi Arabia, and today the number of Saudi Arabian and Saudi-international joint expeditions is still on the rise (Loreto 2017). The major oases at Mada'in Salih/al-Hijr, Dadan/al-Khuraybah, Qurayyah, and Tema/Taymāʾ in the peninsula's northwest are presently being investigated, as well as the one at Dumat al-Jan-dal/al-Jawf farther north, and Thaj in the east. Regional studies are moreover underway in the Tabuk region, the Wadi Aynunah district, as well as the areas of Jubbah and Rajajil. Underwater probes are also being conducted near the coastal sites in the Jeddah region. Nonetheless, numerous sites identified in the surveys and with promising archaeological prospects yet remain unexplored.

A government decision in 2003 stipulated that archaeological projects in the country were now under the supervision of the Saudi Commission for Tourism and Antiquities (SCTA), which today has been renamed to Saudi Commission for Tourism and National Heritage (SCTH). This led to an emphasis on the importance of archaeology for the public and addressing issues of sustainable research and preservation strategies for sites embodying the cultural heritage of this part of the world. Most pertinent for the international recognition of the significance of Saudi Arabian archaeology was (and still is) the exhibition "Roads of Arabia" (al-Ghabban *et al.* [Eds.] 2010; Franke – Gierlichs [Eds.] 2011), which reflects a change of perspective and at least on a programmatic level, explicitly taking in account the cohesion of the Arabian Peninsula, its landscapes and populations through various forms of exchange and trade. Moreover, the sites at Mada'in Salih, ancient Diriyah, the old town of Jeddah, the rock-art sites in the Ha'il region, and the al-Ahsāʾ oasis have been added to the UNESCO world heritage list, hence raising further public awareness. Next to the "Seminar for Arabian Studies", recently published conferences and workshops, be they organized under regional, in this case Northwest Arabian, or overall perspectives (the entire Arabian Peninsula), have also contributed to the dissemination of new findings from archaeological expeditions (Luciani [Ed.] 2016).

In a wider, supra-regional context it is of highest interest to contrast and integrate the results from such recent archaeological investigations with existing historical and environmental issues

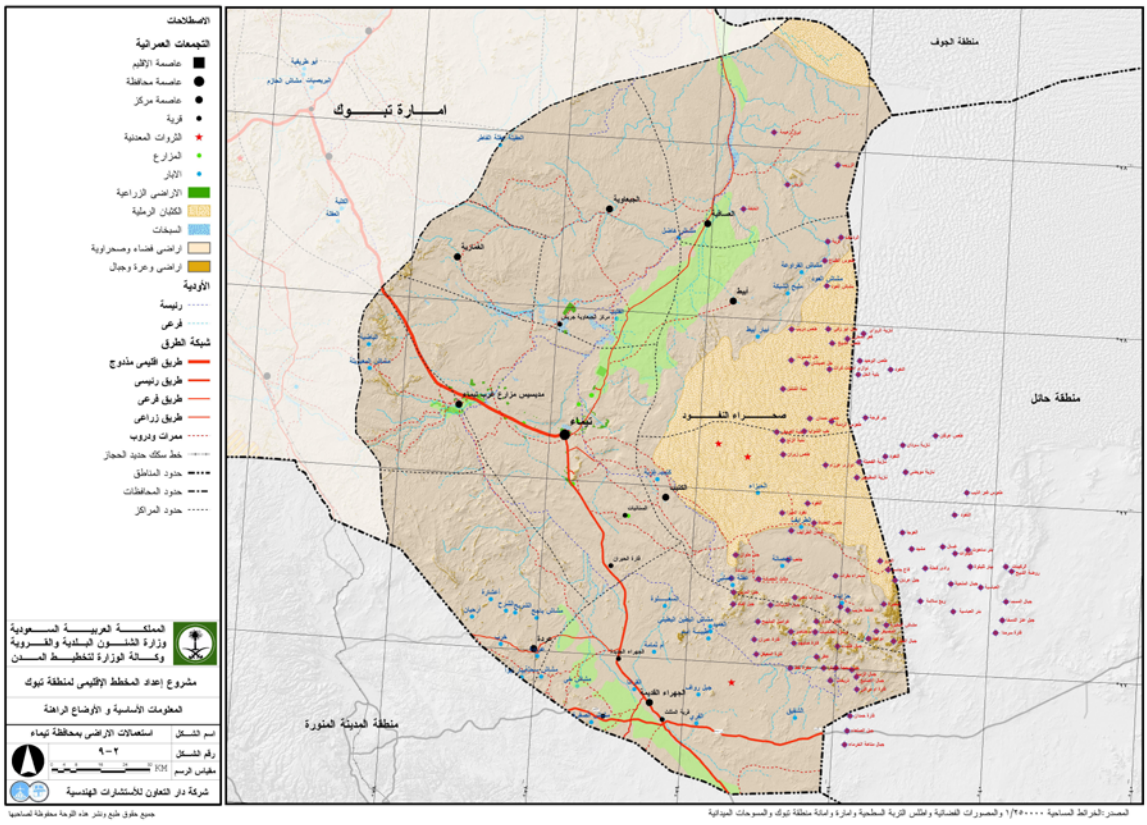


Fig. 1 *Map of the Taymāʾ region (Courtesy SCTH, Antiquities Office Taymāʾ).*

الشكل ١ خريطة منطقة تيماء (بإذن من الهيئة العامة للسياحة والتراث الوطني، متحف تيماء)

relating to the neighbouring regions, in other words Eastern Africa, Syro-Mesopotamia, the Levant, as well as the peninsula's southern and eastern fringes. Accordingly, new reconstructions become feasible for one of the largest and most intense contact zones of the Middle East, often referred to as the so-called Old World Arid Belt. From this stand, exploring oases within such "landscapes of survival" (Wilkinson 2003) becomes essential for understanding the lifestyle and subsistence strategies of their largely sedentary populations. It is the task of regional surveys going beyond the limits of such places (Figs. 1–2) to investigate the vestiges of mobile communities outside these agricultural centres, of which some have probably by their sheer dimensions been considered as urban.

Ever since the emergence of humans, the Arabian Peninsula has served as a transit region *par excellence*, due to its location between the African continent in the southwest and Asia in the northeast, both having played a key role in the evolution of mankind (Petraglia *et al.* [Eds.] 2015; Breeze *et al.* 2016; Inglis *et al.* 2014). The region is part of a large contact zone, normally referred to as the Near or Middle East, the location where human civilisation made a number of essential strides. As a "critical biogeographical landbridge" (Petraglia 2017) throughout human history and separated from the surrounding land mass mostly by sea, the Arabian Peninsula facilitated contacts to far-reaching regions, such as India and South-East Asia through sea routes. While in the northwest, the borderlands between the Red and the Mediterranean Sea were easily reached, the vast expanses of the Arabian Shield territory sanctioned overland routes throughout the peninsula.

Before the ancient routes were opened for pilgrimage to the holy Islamic sites at Mecca and Medina, communication networks and exchange systems were basic components of human society in Arabia. However, little has been told about the ancient settlement patterns and social organisation, or about the livelihood and subsistence strategies of mobile groups in the light of

Fig. 2 *Dromedaries in the desert area south of Taymāʾ (DAI, Orient Department, A. Hausleiter).*

الشكل ٢ جِمالٌ في الصحراء الواقعة إلى الجنوب من تيماء (معهد الآثار الألماني، قسم المشرق ـ أ. هاوسلايتر)

changing environmental conditions, which apparently much favoured the presence of human communities (Gebel 2016). As a matter of fact, "oases play a crucial role in the desert landscape and social systems because they provide not only support for their inhabitants but also supplies and form centers of exchange or markets from bedouin groups from the desert" (Wilkinson 2003).

Amidst a zone of extreme climatic conditions, for the most sedentary oasis populations practising irrigation agriculture and horticulture were perpetually involved in consolidating their assets through local exchange, for that matter with surrounding pastoralists, but also on regional or supra-regional levels. Inside the oasis there was a need to maintain the balance between the exploitation of the available natural resources and the challenges from a yet volatile environment, such as droughts, sand dune movements, and desertification on the one hand and flash floods on the other.

Archaeological research focusing on the reconstruction of the palaeoenvironment has contributed to a dramatic data increase to an extent, by which the term "frankincense road" now merely appears as a synonym for the diversified and intense overland communication throughout the region. Also other concepts like *Arabia deserta* or *petraea* (as opposed to *Arabia felix*) are in the needs to be modified or replaced ("Green Arabia"), at least for the periods of early hominin movements.

Similar reconsiderations may have to be applied with respect to the eastern part of Arabia during the Mesopotamian Ubaid period, where sites like Dosariyah have shed new light on the relationships between Arabia and the Land between the two Rivers (Drechsler 2011; Kainert – Drechsler 2014). In view of this recent research, ancient historical agents seem to move into a new angle, according to which the old centre-periphery model (with Arabia as the periphery) is increasingly replaced by a sense of an autonomous region in terms of culture, economy, and politics.

Fig. 3 *The walled ancient settlement of Taymāʾ from South (DAI, Orient Department, A. Hausleiter).*
الشكل ٣ منظر من الجنوب لمستوطنة تيماء الأثرية المسوَّرة (معهد الآثار الألماني، قسم المشرق ـ أ. هاوسلايتر)

Aims

The Saudi-German project at Taymāʾ did not depart into uncharted territory. Much archaeological fieldwork by the Saudi Arabian Directorate of Antiquities had been carried out at Qasr al-Hamra, Qasr al-Radm and the cemetery areas as from 1979 (Eichmann *et al.* 2006b, 92–95; Abu Duruk – Murad 1985; 1986; 1988) and thus laying the foundations for all future work at the site. In the central area and focus of the Saudi-German activities, locally known as Qrayyah (Fig. 3), three soundings had been dug by G. Bawden, Ch. Edens and R. Miller in 1979. More work had also been done at Qasr al-Hamra and Qasr al-Radm (Bawden *et al.* 1980; Bawden 1981) and in the cemetery areas of Sana'iye (Abu Duruk 1989; 1990; 1996; al-Hajri 2006) and Rujum Sa'sa' (al-Hajri 2001; al-Hajri *et al*. 2005; al-Taimā'i 2006).

The strategy of the interdisciplinary research at the oasis of Taymāʾ concentrates around the following four main issues which interact with the aims of the previous research conducted there:

- Reconsidering and re-defining the role of the oasis as nodal point for cultural and economic exchange within the Egyptian-Syro-Levantine-Mesopotamian and Arabian communication networks;
- The impact of this exchange on life and economy in the oasis;
- Environmental conditions (climate, botany and fauna) and social responses at the site and in the region (economy, demographic trends and subsistence strategies: mobile and sedentary groups);
- Spatial and temporal aspects of the dynamics of occupation history of the oasis from the Neolithic through to the beginnings of Islam.

As for the spatial and chronological integration of these issues, it was decided that Taymāʾ was to be a stratigraphic reference site for the region and that in a first step the dynamics of settlement within the large walled areas of the 9.2 km^2 large oasis were to be investigated.

Fig. 4 *The Bir Hadaj in the center of the old town of Taymāʾ (DAI, Orient Department, A. Hausleiter).*

الشكل ٤ بئر هدّاج الواقع في مركز مدينة تيماء القديمة (معهد الآثار الألماني، قسم المشرق ـ أ. هاوسلايتر)

Foundations

For archaeologists, historians, and local inhabitants, Taymāʾ's legacy founds on the accounts by Arab geographers that furnish much information on its former wealth. But it also founds on the indications by the legendary Jewish-Arab poet Samawal bin ʻĀtiyā (Euting 1914; Moreh 1972; Bauer 1995), who was said to have resided in a building known as 'Qasr al-Ablaq' (cf., Northedge 2008). The Bir Hadaj, an impressive well in the centre of the old town (Fig. 4), has been a symbol for the irrigation culture established on the richly available ground water resources. In the early 1950s water was still drawn here by camels (Philby 1957). Taymāʾ's renown was further reinforced by its role as one of the major trading posts along a branch of the incense road, as mentioned in Biblical records, and as residence of the last Babylonian king Nabonidus in the decade between 552 and 542 BCE (Beaulieu 1989; Schaudig 2001).

The discovery of Taymanitic inscriptions in the vicinity of Taymāʾ mentioning the king's name (Müller – al-Said 2002; al-Said 2009) and of a petroglyph representing a riding horseman (Jacobs – Macdonald 2009) fuelled a debate on the nature and the impact of the 'Babylonian intermezzo' on the oasis and its region. Another relief with an inscription of the same king at the site of al-Hayit (al-Ghabban 2013, 70; Hausleiter – Schaudig 2016) suggests that his stay in Arabia was well-planned, that involved the compilation of an ideologically meaningful imagery. The relief and inscription from al-Hayit led to the suggestion that Nabonidus paid respect to the local deities by including them into the text and the imagery, thus adding to a new dimension of the conquering king's image. He yet kept "a stranglehold on all the important sections of the caravan road" (Potts 2011, 91), which probably resulted in the kings of the entire region (Egypt, the Arabs, and the Medes) to request his peace.

The emphasis on the enigmatic 'Arab sojourn' of this Mesopotamian ruler with respect to Taymāʾ for one led to the literal interpretation of a passage of the "verse account", by which the king had built a palace at Taymāʾ like in Babylon and renovated the oasis walls, regardless of the text being a pamphlet directed against Nabonidus dated to the Achaemenid period (Beaulieu 1989; Schaudig 2001; Eichmann *et al.* 2006a). It likewise motivated an erroneous 'Babylonian' attribution of the famous Taymāʾ Stone, although it too, is of a later, Achaemenid date (Briquel Chatonnet – Robin 1997; Stein 2014; Stein in press). The well-known al-Hamra Cube with its carved representations of cultic activities dates to the same period (Bawden *et al.* 1980; Dalley 1985; Hausleiter 2012b).

The increase of imagery, possibly as a reaction to the Babylonian occupation, may be understood in the light of Achaemenid art and the oasis's uninterrupted contacts with the north-east, but also be more closely connected with developments inside the region than previously thought (Rohmer – Charloux 2015; Rohmer 2016).

A regional component of the political and economic history emerged through the mention of the dynasty of Liḥyān on the al-Hamra stela (Livingstone *et al.* 1983; Beyer – Livingstone 1987; Stein in press). This dynasty is thought to have been based at Dadan (modern al-Khuraybah) where it probably had been in power since the late 6th century BCE; a 'war' between Taymāʾ and Dadan, mentioned in at least five of the inscriptions of Jabal Ghunaym (Winnett – Reed 1970) prompted a number of hypotheses on the relation between both oases. In 1973, F. Altheim and R. Stiehl illustrated the body fragment of a monumental statue identified at the surface at Taymāʾ, which was very similar to the specimens found at al-Khuraybah by Jaussen and Savignac (1909/1922) and is now considered to be part of the royal iconography of the Liḥyānite dynasty (see, however, al-Said 2010a).

Further back in time, Assyrian-Arabian relations seem more indirect, at least as far as the oasis of Taymāʾ is concerned. Textual evidence from Assyria (namely the Assyrian state archives) and Babylonia point to an oscillating relation between maintaining mutual trade interests while attempting to control as much as possible political, economic, and territorial affairs at the empire's southern fringes (Eph'al 1982; Hoyland 2001; Retsö 2003; Potts 2011; Bagg, this volume). Nevertheless, a contextualisation of individuals and tribes with territories and places, such as the Arabs mentioned by the Assyrian king Shalmaneser III (858–823 BCE) as enemies in the battle of Qarqar, remains problematic.

The same can be said for the Arabian queens, most notably Samsi, whom Tiglathpilesar III (745–727 BCE) claims to have defeated or forced to pay tribute, although it appears that his interests too, by maintaining trade relations, were oriented towards the northwest of Arabia. Neither can all of the mentioned tribes (Massa, Tema, Qedar and Nabayot) be precisely allocated to specific geographic areas. The military campaigns of his successor Ashurbanipal (668– ca. 627 BCE), which included the seizure of large amounts of camels and momentary abduction of divine statues, were directed towards the land of Bazu and Adummatu (Bagg, this volume), the "fortress of the Arabs" and most northern of the large Arabian oases (Hausleiter 2012a).

A cuneiform text discovered in the late 1970s in Iraq that furnished important information on ancient caravan trade shed new light on the composition of an 8th century BCE caravan operated by "people of Tema and Saba" between Assyria and Arabia (Cavigneaux – Khalil Ismail 1990; Frame 1995, 294–300; Macdonald 1997). A text from the reign of Sargon II (722–702 BCE) concerns Arab merchants involved in the metal trade in Northern Syria (Radner [Ed.] 2014). Under King Sennacherib, the so-called Desert Gate at the Assyrian capital Nineveh bore the designation "gate where the presents of the people from Tema and Sumu'el come in". Groups of Arabs are recorded to have lived in South Mesopotamia in the 6th century BCE as part of the local population (Eph'al 1982).

The economic contacts between Assyria and Arabia may however have started as early as the turn from 2nd to 1st millennium BCE (Bagg, this volume). In addition to the well-known South

Arabian ostraca in the Levant, single finds from areas deep inside Assyria, such as a sealing with Arabian letters from Tell Sheikh Hamad/Dur-Katlimmu (Sass 2015) offer additional substance to the reconstruction of the networks of relations. Combining this evidence with information about contacts between the Assyrian court and South Arabian rulers, i.e. between Sargon II and Sennacherib with Karib-il and Ita'amra from Saba (Eph'al 1982; Nebes 2007; 2016), it appears that the relations between Assyria and Arabia were much more wide-ranging than previously thought. Contact zones such as the Middle Euphrates played a key role in these contacts, which since that time emerged as an actor at the interface between both north and south and east and west (Masetti-Rouault – Rouault 2016).

Recent research on incense burners from the oasis of Taymāʾ by means of residue analysis pointed not only towards the use of specific aromatics in different functional contexts in antiquity but also to the role of the oasis as customer within the trading network known as "Incense Road" (Huber *et al.* 2018).

Attempts to connect numerous tribal names mentioned in Biblical and Assyrian sources with landscapes, sites, and archaeological remains strongly impacted the interpretative framework of the archaeological evidence from Northwest Arabia, the Southern Levant, as well as Egypt. Most noteworthy in this respect is the case of Midian and the so-called "Midianite Pottery", now known as the Qurayyah Painted Ware (QPW; see Chan in preparation). New excavations at the site of Qurayyah, west of the modern city of Tabuk (Luciani – Alsaud 2018), and archaeometric evidence from this site and Taymāʾ suggest that this pottery was produced locally at both sites (Hausleiter 2014; Daszkiewicz 2014; Intilia 2016) rather than centrally. As for the epigraphy, the term 'Thamudic' had been used for designating an ancient North Arabian language and script, which in the case of Taymāʾ, has now been replaced by a less interpretative terminology ("Taymanitic"; Macdonald 2004), stressing the significant role of the oasis within the wider context of North Arabian oasis scripts (cf. also Robin 2008).

The discovery of a cartouche by the Egyptian pharaoh Ramesses III (13th/12th century BCE) in the environs of Taymāʾ led to a revision of the Egyptian-Arabian relations (Somaglino – Tallet 2013; Sperveslage – Eichmann 2012; Sperveslage 2013; 2014; 2016). The inscription, besides testifying to Egyptian interests in the region, is most probably also a consequence of at least Taymāʾs participation in networks established during the preceding Middle Bronze Age. The 'Egyptian Paradigm', which had been developed and was sustained for many years as from the excavations at Timna', affected the interpretation of the Late Bronze and Early Iron Age econo-mic history of Taymāʾ and the related pottery groups. The latest excavation results from the oasis, however, suggest the existence of commercial activities at Taymāʾ as early as around 4,000 BCE, most probably followed by similar activities during the entire Bronze Age (see below).

All excavators at Taymāʾ had to deal with this enormous amount of information profoundly influenced by non-local perspectives in terms of both historical reconstruction and the interpretation of material culture. Based on a discussion of pottery styles at Taymāʾ and beyond (resulting in the postulated "Taymāʾ Painted Ware" and including the Qurayyah Painted Ware and the al-'Ula Painted Ware; see also Bawden – Edens 1988; Parr 1988; 1989), the 1979 excavations on behalf of the Directorate General of Antiquities (Bawden *et al.* 1980), led to a debate on the continuity of settlement and subsistence strategies. A seminal contribution by Ch. Edens and G. Bawden (1989) on the Late Bronze-Iron Age transition in the light of economic contacts of the Hijaz region, suggested an uninterrupted settlement continuum at Taymāʾ, while stressing the local perspective of the oasis settlement within a regional context. Although the material basis (i.e. their ceramic chronology and typology) has been since revised, the hypothesis of a continuous occupation of the oasis can now be considered as confirmed. P. J. Parr linked his observation of a break in the pottery production between the late 2nd and early 1st millennium BCE with a proposed return to mobility and pertaining subsistence strategies. In the meantime, the discovery of an early 1st mil-

lennium BCE painted and plain pottery production at Taymāʾ (Hausleiter 2014; Tourtet *et al.* in press) has closed this gap in the material culture.

Next to adding considerably to the information on the burial customs at the oasis (Abu Duruk 1989; 1990; 1996; al-Hajri 2002; 2006; al-Hajri *et al.* 2005; al-Taimā'i 2006), the Saudi excavations at the cemeteries of Taymāʾ at Sana'iye and Rujum Saʿsaʿ, also led to the definition of the Middle Iron Age "Sana'iye Pottery" (Hashim 2007; Maritan *et al.* in press; Hausleiter 2014; Tourtet *et al.* in press), which largely coincides with the aforementioned "Taymāʾ Painted Ware".

Plain pottery and that of the later periods had only been dealt with on an eclectic level. Surface sherds were published by F. V. Winnett and W. L. Reed (1970) and supplemented with material from Qasr al-Hamra excavated by Bawden *et al.* 1980 (see also Abu Duruk – Murad 1985; 1986; 1988) and ceramics from the site of Qasr al-Bujidi (Hashim 2000).

Environment

In arid environments, availability of water constitutes a prerequisite for human sustainability in oases (Fig. 5). Therefore, right from the project's launch, an archaeo-hydrological research unit was established (Wellbrock *et al.* 2017). The oasis lies in a 600 km^2 large catchment area, and geological conditions specific to Taymāʾ (the so-called Taymāʾ *graben*) allowed for an easy access to groundwater through wells sapping the upper aquifer. Due to the reduced transmissivity of the siltstone layer, the water was pressurized towards the surface, thus assuring for sufficient supplies for human and animal consumption as well as for irrigating the cultivated lands and gardens. The location of the oasis at the almost deepest point in the region favoured the access to the available aquifers (Wellbrock *et al.* 2012; 2017).

Fig. 5 *Irrigated agricultural area of the modern palm oasis (DAI, Orient Department, A. Hausleiter).*

الشكل ٥ المنطقة الزراعية المروية في الواحة الحديثة (معهد الآثار الألماني، قسم المشرق ـ أ. هاوسلايتر)

Fig. 6 *The sabkha of Taymāʾ after heavy rainfall in 2008 (DAI, Orient Department, J. Kramer).*
الشكل ٦ سبخة تيماء بعد هطلٍ مطري غزير في عام ٢٠٠٨ (معهد الآثار الألماني، قسم المشرق - ي. كرامر)

Valuable information about the climatic and environmental history of Taymāʾ was expected from the exploration of the *sabkha*, a geological *playa* constituted of a former palaeolake of almost 20 km^2 extension (Fig. 6). The *sabkha* is located immediately north of the oasis, at a considerably lower level than any settlement remains from the historical periods.

Geo-archaeological investigations in combination with ^{14}C-dating supplied data about regional and local climate and landscape developments through space and time. Covering the periods of the saltwater lake, i.e., from approx. 9,300 calBP until 4,800 calBP of approx. 4,500 years (Dinies *et al.* 2015; 2016), it is now possible to begin with the reconstruction of the long-term changes of the local climate in light of the overall developments known from the Arabian Peninsula (Engel *et al.* 2012; Brückner *et al.* 2013; Dinies *et al.* 2015; 2016). In the meantime, the CLEAR-project (Holocene CLimatic Events in Northern ARabia) based at the University of Cologne continues investigating the Holocene climatic conditions at Taymāʾ and its surroundings.

The relevant, four-stepped model allows us to trace general trends in lifestyle and subsistence at the oasis's emergence at around 4,600 BCE (M. Dinies, personal communication). Oasis cultivation began under possibly slightly moister conditions following a long dry period that had set out at around 8,000 calBP and that was characterized by a retreat of grassland and pastures, whilst desert shrubs thrived.

As to the related socio-economic issues, other archaeological projects in the region propose a transition from pastoralist herding societies to ones of oasis cultivation at the turn from the 5th to the 4th millennium BCE (Gebel – Mahasneh 2012). In the coming years it is further expected that both local and regional data will lead to a refined reconstruction of wider developments and ensuing solutions on local scales in response to them.

Methodologies

The Saudi-German project encompasses a wide spectrum of approaches aimed at reconstructing the dynamics of subsistence strategies of the area's former communities, be they predominantly mobile or sedentary. Since the boundaries between both types livelihood are thought to have been highly permeable, it is also aimed to investigate the causes, mechanisms, and the outcomes of resulting cultural transfers. It was hence decided to conduct the archaeological investigations through an interdisciplinary approach, including a number of disciplines from both the human and natural sciences. The team is composed of specialists from the fields of archaeology, geoarchaeology, epigraphy, history, bioarchaeology (archaeobotany, history of vegetation, zooarchaeology, and physical anthropology), hydrology, and archaeometry. It was thus intended to create a platform large enough to sanction the pursuit of the individual research aims of each discipline, while simultaneously encouraging dynamic interaction between each team member in order to attain more differentiated and complex levels of analysis and interpretation.

The reconstruction of the human activities needs to be put in perspective with significant changes in the regional climate and environment during the Holocene. This stand meets with the general research agenda set by the German Archaeological Institute and its particular involvement with the study of the different forms of sedentism. As one of the region's major settlements occupied by sedentists, that while remaining in persistent exchange and probably even competition with their pastoralist and apparently mobile counterparts, the oasis at Taymāʾ outstandingly exemplifies this interaction between both types of subsistence.

For the project's systematic collection and recording of data, a method was adopted combining established excavation and survey methods with state-of-the-art recording techniques and continuously developed during the project. In addition to the excavations using stratigraphic units (SU) as interpretive base for reconstructing depositional processes, a number of non-destructive investigation methods (ground penetrating radar, geomagnetic prospection, electric resistivity), as well as remote sensing techniques (satellite imagery, aerial photography by plane or unmanned aerial vehicles) were applied. Traditional documentation techniques (such as photography and drawing) of contexts and objects were supplemented by the application of leading-edge digital recording technologies, including tachymetric surveying, 2D- and 3D-photogrammetry (structure from motion, SfM) and 3D-modelling of contexts, as well as reflectance transformation imaging (RTI), and 3D-scanning for objects. A web-based relational database connected with a geographic information system (GIS) was created to collect, manage, and analyse the project's data.

As part of the scientific research and exploration, a number of analytical methods have been applied, such as ^{14}C-AMS and optically stimulated luminescence (OSL) for dating archaeological contexts. Stable isotope analysis was used for models pertaining to climatic reconstructions as well as for anthropological investigations. A variety of scientific analyses, such as XRF (x-ray fluorescence analysis), MGR (matrix group by refiring), and LIA (lead isotope analysis) were used in the field of archaeometry, especially in pottery and archaeometallurgical studies.

Since the beginning of the project, the investigations of archaeological remains at Taymāʾ have been conceived as part of a larger conceptual framework aimed at acquiring an understanding of the cultural heritage of this historically significant place. Therefore, an integrated strategy for preventive conservation and restoration of objects and building remains has been developed and implemented in collaboration with conservators, restorers, and building archaeologists. Objects excavated by the Saudi-German project are stored according to a long-term storage concept defined by the requirements of conservation. Methodology and outcome of these works are part of the project's publication and outreach program (Hausleiter *et al.* in press c; Hausleiter 2015b; 2016a).

It is in this context that three training programs in archaeological conservation have been carried out at the National Museum, Riyadh in collaboration with (the then) SCTA and the

Fig. 7 *The oasis of Taymāʾ with archaeological areas (graphics: S. Lora, DAI, Orient Department).*

الشكل ٧ واحة تيماء مع المناطق الأثرية (غرافيك: س. لورا، معهد الآثار الألماني ـ قسم المشرق).

King Saud University, with the objective of sharing knowledge on preservation strategies with the local female and male staff members and students. In addition to the field work at Taymāʾ, programs of this kind prove suitable tools for developing sustainable and long-term strategies for the preservation of archaeological remains as part of the cultural heritage (DAI [Ed.] 2012, 291–292).

2 The site and its topography

The site of Taymāʾ is located approx. 265 km southeast of the provincial capital Tabuk at 27°37'37" N/38°32'60" S. Currently, more than 30 archaeological areas have been fenced off by the local antiquities office, and the largest of these areas (74 ha) is known as Qrayyah (or Qrayyan), a name referring to a former residential mudbrick quarter adjacent to this area, just south of the old town and the oasis of Taymāʾ (Fig. 7).

Today, the oasis is characterized by six major ecological, geographical, and socio-cultural topographic zones (from north to south): (1) The *sabkha*; (2) The oasis, consisting of irrigated cultivation areas in the north and inhabited areas in the south (old town of Taymāʾ); (3) The ancient centre of the walled oasis and settlement (Qrayyah); (4) The cemetery area south of Qrayyah; (5) The expanding modern settlement, located mainly west and east of Qrayyah and increasingly impacting the cemetery area; (6) The area of Tuwayil Saʿid north of the *sabkha* (cf., Parr *et al.* 1970) with a large building of public character and a cemetery.

Qrayyah is the main area under archaeological investigation by the Saudi-German project and consists of several sectors separated from each other by walls. Based on the then visible wall remains, Bawden *et al.* (1980) identified altogether seven compounds labelled as A, A_1, B-E, plus another in the north-western part of the walled area called Compound W. The remaining areas of the oasis were not labelled. As stated earlier, it was possibly the effortless access to water that may have influenced not only the choice for the oasis's location, but also the shapes and dimensions of these compounds.

In addition to historical and more recent water management constructions related to agriculture, ancient water supply structures have been detected at several locations in the oasis. Apart from the famous Bir Hadaj in the present-day old town of Taymāʾ(cf. al-Taimāʾi 2005), the wells of Qasr al-Radm and the ones within Compound B had been identified prior to the work of the Saudi-German project. The location of the 'Wadaj well' (Doughty 1888) may correspond to that in Compound B.

Within Qrayyah, hydrological investigations of the Saudi-German team (Wellbrock *et al*., this volume) led to the identification of a spring-lake south of the central zone of the ancient settlement, which is located on a sandstone outcrop, hence at the southern end of Compound E, next to the inner wall. The well excavated in Area E is so far the only ancient water source to be identified inside this area. It certainly served the supply of the temple to the west (Building E-b1), with which it was connected through a tunnel. It is uncertain whether it supplied the residents in the adjacent living quarter.

The Early to Mid-Iron Age irrigation system extending over the southern part of Compound A (excavation area H), located immediately north of the compound's perimeter wall, must have been fed by an important well inside a large rectangular enclosure (Building H-b1); the well itself has not been excavated. The chronological sequence of the excavated wells at Taymāʾ has not yet been precisely established. It seems evident, however, that the major compounds were each supplied individually. Deep cuts into the bedrock have been detected at some locations, such as in Area O and Area Q, possibly to serve as provisional water reservoirs.

The location of the production areas within the walled settlement is less clear, since little of them has been preserved. Disc-shaped carnelian (chalcedony) beads were manufactured in

the area east of the present-day *sabkha* at around 4000 BCE (Haibt 2013; 2018), as based on the concentration of micro-drills and to a significantly lesser extent on production rejects. The whereabouts of the production areas, e.g. of pottery, in the subsequent periods remain, however, unknown. Some small-scale fireplaces of undetermined function have been found in Area A (Eichmann *et al.* 2006b), whereas a large pyrotechnical installation in Building E-b1 may have been linked amongst others to the production of charcoal (Huber 2015). A cluster of small-scale horse-shoe-shaped furnaces have been identified within the Early Iron Age building complex of Area O. Metal smelting areas remain equally unidentified. The fireplaces or furnaces identified by J. Euting (1914) at the surface in the south-western districts during his visit to Taymāʾ have not been located with certainty.

As from the 3rd millennium BCE onwards, the entire oasis was apparently enclosed by a system of walls, which through time was repeatedly modified (Schneider 2010; 2016; Klasen 2011; Hausleiter 2018). The construction of this highly diversified system of built structures impacted the settlement over the following millennia and implies an organized, complex social and administrative system run by a sedentary population that required and commissioned the construction of this wall system. Remains of an earlier wall in the eastern *sabkha*, probably relating to the production area of beads, suggest that at least at Taymāʾ, walls may have been an essential part of an oasis from the very beginnings.

Whereas in the 3rd millennium BCE, the wall's main building material was mudbrick (resting on sandstone/siltstone foundations), the later phases saw exclusively the use of quarry stones. In all, these walls enclosed an area of up to 9.23 km^2 or 923 hectares. Altogether, the maximum length of the wall system amounts to 18.2 km (20.9 km, including the reconstructed total length of the *sabkha* wall), and in combination with the enormous investment into the area, this may induce the utilisation of such ambiguous terms as 'urban'. However, it is expected that as today, wide expanses of the walled area were not densely inhabited but rather irrigated grounds for agriculture and possibly even pasture. This consideration may be relevant in considering the oasis's role as a stopover for large caravans, provided the above mentioned 8th century BCE text from the Middle Euphrates (200 camels, 100 men) is taken as plausible. An aerial photograph from 1956 shows an approx. 90 ha large area under oasis cultivation, 120 ha of irrigated fields in the north-western part of the oasis (southeast of Qasr al-Hamra), the 74 ha large area of Qrayyah, and a zone of almost 640 ha without any visible remains from either settlement or cultivation, i.e. an area of the size of ancient Nineveh during the Neo-Assyrian period. This situation may differ from that in antiquity or early Islamic times when Taymāʾ was described as a wealthy and flourishing oasis.

The ancient inhabited nucleus at Taymāʾ was Qrayyah (Figs. 8–9) and formed as the oasis's core in terms of political, administrative and religious functions. Although visibility is obstructed through modern occupation, the northern part of the centre had a clear-cut border and did not extend into the oasis. On the other hand, important public buildings, such as Qasr al-Hamra or the substantial remains at Tuwayil Saʿid (Parr *et al.* 1970), were respectively located at the periphery outside the core area. Central to the ancient settlement and nodal point of the wall system was a tower, known as Burj Badr ibn Jawhar that overlooked the settlement, the entire oasis, and its surroundings. Numerous towers or tower-like buildings had been attached to the outer oasis wall. So far, only one has been partly excavated (Square W41; Schneider 2010). Remains of watch towers have been identified on the ridge north of the *sabkha* and have been considered as part of the oasis's defensive system, the Mintar bani Attiya being one of them (Parr *et al.* 1970).

Taymāʾs walls as mentioned by early Arab historians and geographers were impressive, and until today, some of them have survived at heights exceeding 8 m. This is the case for the outer, or "oasis wall" (Hausleiter 2018) surrounding Compounds C, D, and E, as well as for its eastern and western branches. It is still uncertain whether these walls were free-standing at these heights. The approx. 3.2 km long retaining wall was significantly lower and built as an earthwork separating the cultivated areas in the northern part of the oasis from the *sabkha* (Bawden *et al.* 1980). It may

Fig. 8 *The central part of the settlement (Qrayyah) (DAI, Orient Department, S. Lora).*

الشكل ٨ القسم المركزي للمستوطنة (قريّة) (معهد الآثار الألماني، قسم المشرق ـ س. لورا)

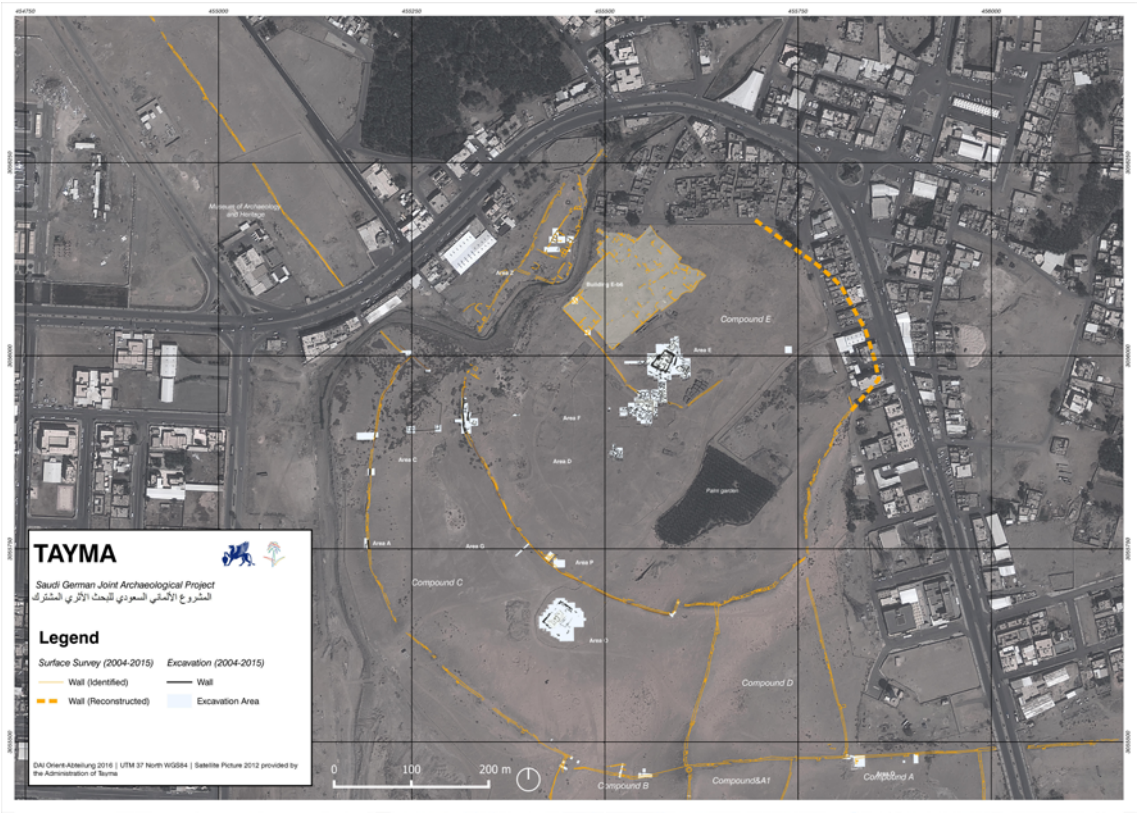


Fig. 9 *The northern part of the settlement area (DAI, Orient Department, S. Lora).*

الشكل ٩ القسم الشمالي من منطقة المستوطنة (معهد الآثار الألماني، قسم المشرق ـ س. لورا)

have protected the agricultural areas from erosion into the *sabkha* but also have prevented saline deposits from entering the arable land. The latter hypothesis has in fact been been verified by the analysis of sediments from both sides of the wall. The settlement's inner wall defining Compound E (and separating it from Compounds C and D) was built later, probably in the mid-1st millennium BCE (see below). Its construction diminished the core area of the ancient settlement to not much more than 22 hectares. On top of the remains of its early building stage, a double-shell wall was added in the later part of the Nabataean period.

At the same time, a large ditch (500 m long, 12 m wide and probably 6 m deep) was dug into the bedrock along the wall's exterior face, while the excavated material was used for filling in the cavity between the two wall shells. The ditch may have served for flood control during heavy rainfall, whilst also preventing easy access to the site's central part.

As observed at other Arabian oases, like Dumat al-Jandal or Qurayyah, the walls and enclosures at Taymāʾ allowing for a highly differentiated functional subdivision of large areas, seems to have played a significant role. This refers both to the scale of the compounds as well as that of the individual public buildings, of which many are characterized by surrounding enclosures (Buildings E-b1, E-b6; O-b1, but also wells, such as those of H-b1, Qasr al-Radm [Northedge 2008], and on a much smaller scale, the one east of Building E-b1).

Gates, access points, and communication systems within the oasis are currently less in evidence. While it appears possible that major access points (gates?) were located where the current Tabuk-Medina road cuts the course of the outer wall, there is nothing left of the ancient structures that might confirm this (cf. Abu Duruk 1988). Probable remains of passageways have been identified between Compounds A and D (by excavations in Square W9 and W10), between Compounds C and E (through GPR prospection), as well as between Compounds B and C (excavations at

Area L and GPR prospection; see Eichmann *et al.* 2010). In Area C remains of a passageway between Compounds C and E may have been identified for the early building stage of the inner wall. This context may be substantiated by an Imperial Aramaic inscription found next to it in secondary deposition (TA 964), mentioning construction work at a wall by a governor of the dynasty of Liḥyān at Taymāʾ (Stein in press; see below). Foundations of two towers of the Nabataean wall have been identified in the same area, but nothing has survived from the up-going parts of these towers.

In addition to the oasis walls and wells, architecture of public character has mainly been identified in the centre of the settlement (Area E), as well as in an area between the outer and subsequent inner wall (Area O). The latter is a building complex (Buildings O-b1 and O-b2) within a massive enclosure, possibly destroyed by fire, whereas the former (Building E-b1) is a temple founded at some stage during the Liḥyān dynasty and in use throughout the Nabataean period. The discovery of cuneiform texts and a stela by King Nabonidus (556–539 BCE) in fill deposits suggests that this area was of significance during the period of the Babylonian occupation. Deposits with architectural remains and an associated pottery sequence dated to the early 3rd to early-to-mid 2nd millennium BCE (E-b5, E-b13, E-b14, E-b15) suggest that this area may have been highly significant for the settlement from that time onwards, although much of these early remains have been destroyed by later construction activity.

The temple in Area E may have changed function during the Late Roman period (3rd/4th century CE), as inferred from the massive alterations to its layout (Lora 2017). An extended complex covering 1.8 hectares north of Area E (Building E-b6) and roughly of the same date (2nd to 4th century CE) was built at a quite different scale in comparison with the architecture from the previous periods. This enormous complex has for the most been traced by aerial photograpy and surface scraping, even though stratigraphic soundings have been carried out at two locations (Squares E28 and E29), thus furnishing evidence for the date of its construction.

A residential quarter extends to the south of Area E (Area E-South/F), with the pre-Nabataean to Late Antique periods so far representing the best preserved deposits. Farther south (Area D) one comes across partly elaborately built domestic architecture dating to approximately the same period. Other buildings, especially those attached to the walls (Area A, Square W10/Q3) may have had specific functions, some of which were linked directly to the wall.

Whereas public and residential areas as well as agricultural zones were inside the walls, this was not the case for the cemeteries. Until Taymāʾ's settlement area was considerably reduced, probably after the mid-1st millennium BCE (see above), built and visible funerary architecture concentrated mainly in the areas south of the walled oasis. A number of graves east of an apparently public building at the site of Tuwayil Saʿid have been identified on the ridge north of the *sabkha*.

During the later parts of the 1st millennium BCE, at a time when the southern and western compounds (A, A_1, B, C, and most probably D) had been abandoned, extended burial grounds were laid out in areas formerly located within the outer walls (and outside the new inner wall). Yet, only the graveyard in Area O has been excavated systematically, while its date can safely be attributed to the 4th–3rd centuries BCE. There are also earlier inhumation graves from the 7th to 6th centuries BCE near the outer wall in Area Q; west of them a yet unique multiple burial with more than 9 inhumations has been found.

Graves with stone rubble walls built onto the bedrock have according to the presently available evidence been exclusively identified outside the walled areas. So far, there is evidence of a variety of circular structures, sometimes with associated buildings, which had been used from at least the 3rd millennium BCE through almost the entire 2nd millennium BCE. The tradition of using such circular structures for burials may even go back to earlier periods (Hausleiter – Zur 2016; Zur – Hausleiter 2018). Subsequently, large chambers had either been added to circular graves or built in isolated positions. The latter types were in use between the 9th and the 5th centuries BCE (Eichmann 2009), and have mainly been excavated at Sana'iye (Abu Duruk 1989; 1990; 1996) or Talʿa (Beuger 2010; Lora *et al.* 2010).

Taymāʾ Occupation Period	Chronology and archaeological / historical periods	Oasis subsistence: Key events
Taymāʾ 1	Contemporary (from 19th century CE)	
Taymāʾ 2	Islamic period (7th to 18th century CE)	The oasis as a flourishing settlement (Early Islamic period)
Taymāʾ 3a	Late Antiquity (4th – 6th century CE)	Intensive exploitation of dromedary
Taymāʾ 3b	Roman / Late Roman (2nd to 4th century CE)	
Taymāʾ 4	Nabataean (2nd century BCE – early 2nd century CE)	Increase of dromedary in the diet
Taymāʾ 5	Period of the dynasty of Liḥyān (5th century to 2nd century BCE)	Abandonment of the irrigation system in the southern part of settlement, probably because of changing groundwater table
Taymāʾ 6	Mid to Late Iron Age (9th to 5th century BCE)	
Taymāʾ 7	Early Iron Age (12th to 9th century BCE)	Beginning of exploitation of domesticated dromedary Irrigation system in the southern part of settlement
Taymāʾ 8	Late Bronze Age (Mid to late 2nd millennium BCE)	Oasis agriculture with date palms (end of 2nd millennium BCE)
Taymāʾ 9	Middle Bronze Age (Early 2nd millennium BCE)	
Taymāʾ 10	Early Bronze Age (3rd millennium BCE)	
Taymāʾ 11a	Late 5th and 4th millennium BCE (Chalcolithic)	
Taymāʾ 11b		
Taymāʾ 11c		Beginning of oasis cultivation (c. 4,600 BCE) with grapevine and figs
Taymāʾ 12	Neolithic	Cultivation of cereals as based on palynological evidence (pollen of *Cerealia* type) from the deposits of the Tayma palaeo-lake

Tab. 1 *Synthesis of the chronostratigraphy of Taymāʾ.* **الجدول ١** تركيب التسلسل الطبقي الزمني الخاصّ بتيماء

3 History of occupation

In view of the nature and scope of this volume of the Taymāʾ publication series and the current stage of research, we shall in the following discuss the major results obtained so far from the archaeological excavations (for the preliminary reports, cf. Eichmann *et al.* 2006b; 2010; 2011; 2012; Hausleiter *et al. 2017;* in press a–g). Thus, at least from a general methodological perspec-

Archaeological correlates	Extramural remains / Cemeteries
Modern occupation	
Shift of settlement towards the oasis; construction of public buildings northwest of the former centre of the settlement	
Internal reorganisation of settlement, including the residential area; large public building north of former temple E-b1; destruction of statues and inscriptions of the dynasty of Liḥyān	
Partial reconstruction of temple E-b1 and construction of water-related installations; Nabataean royal inscriptions Affinities with contemporary pottery in the Southern Levant	Built stone cists with single burials
Reduction of size of the central part of settlement (by 2/3); transformation of large areas into burial grounds; inscription of a Liḥyānite governor of Taymāʾ; monumental sculpture; construction of a temple in the central part of settlement (E-b1) at a site with a long building tradition; residential quarter south of it (Area E-South/F)	New tradition of graves cut into the bedrock within the former area of the walled settlement (5th to 3rd century BCE), partly reusing tomb stones with the representation of human faces and Aramaic inscription
552-542 BCE: Babylonian king Nabonidus at Taymāʾ and other NW Arabian oases; stele and cuneiform inscriptions; no corresponding remains of public buildings Sana'iye Painted Ware (SPW) and pottery with Syro-Mesopotamian and Levantine affinities Contacts between Assyria and Arabia	Built rectangular tombs with collective burials (9th to 5th century BCE) with SPW; single child graves were attached to these chambers; inhumation burials next to the outer wall
Public building O-b1 (probably a temple) with Taymāʾ Early Iron Age Ware (TEIAW) and Egyptian and Syro-Levantine artefacts (Area O); repair of outer wall and attachment of buildings to it (Area A)	Circular tombs probably still in use; little evidence of pottery (TEIAW)
Continuous occupation in the central part of settlement evidenced by Qurayyah Painted Ware (QPW)	Circular tombs probably still in use; little evidence of pottery (QPW)
Continuous occupation in the central part of settlement evidenced by Red Burnished Ware (RBW); no unequivocal architectural remains	Circular tombs with single inhumation burials; ceremonial bronze weapons of Syro-Levantine EBA/MBA type; pottery outside the graves (RBW)
Remains of permanent occupation in the central part of settlement; public building set onto the bedrock (E-b5); monumental wall enclosing the oasis and other large areas resulting in the almost largest extension of the oasis in pre-modern times; pottery: Reddish Coarse Ware (RCW) (late 4th / early 3rd millennium BCE) and Gritty Ware (GW) (mid-to-late 3rd millennium BCE)	Cairns south of the oasis
Architectural traces in the centre of the settlement (pre-early 3rd millennium BCE) and beneath the outer wall (pre-late 4th / early 3rd millennium BCE); probable beginning of pottery production: Reddish Coarse Ware (RCW)	Large stone structures on sandstone rock outcrops in the surroundings of the oasis (25 – 40 km distance)
Waste deposit of flint drills and production refuse of disc-shaped Carnelian beads (c. 4,000 BCE); wall in the eastern part of ***sabkha***; wall and probable remains of agricultural irrigation	
Surface findings of lithic tools (probably late 7th / early 6th millennium BCE)	

tive, we contextualise the contributions with decidedly palaeoenvironmental character (Engel *et al.*, Kürschner *et al.*, Dinies and Neef, and Wellbrock *et al.* this volume) as well as the historical contributions (G. Sperveslage, and A. Bagg) with the overall trends of occupational history, whose results will be published in detail in the coming years within this series.

Based on the results obtained so far, the archaeological evidence from periods of major human impact have been labelled as *Occupation Periods* and until now, twelve such periods have been identified within the oasis of Taymāʾ (Tab. 1). It is possible that some of these periods will be amended through subdivisions, e.g., occupation phases represented by occupation levels and

stages in different areas. Although we must bear in mind that the impact from the general Near Eastern historical framework on Northwest Arabia may be subject to variations, historical factors and events nevetheless participated in the process of subdividing the Occupation Periods in the oasis, archaeology after all, being part of the historical sciences.

As part of the chronostratigraphy the pottery sequence, being one of the major results of the Taymāʾ project, can be followed from the late 4th millennium BCE through to Late Antiquity (Tourtet *et al.* in press; in preparation). In the present volume, the major types of Bronze to Mid-Iron Age wares are depicted (see Figs. 11–13).

7th to 6th millennia BCE (Neolithic)

The "Neolithic of Arabia" (ca. 10,000–4,000 cal BCE) has been the object of investigations ever since the early visits by for instance Gertrude Bell (1927) or Hans Rhotert (1938), and in different parts of the peninsula, since 1977. Several conflicting views on the origin of the Neolithic are currently under discussion, as for example whether it was home-grown or influenced through the spread of the far better known Levantine Neolithic (for an overview see *e.g.* Crassard – Drechsler 2013). Aside from its origin, issues also pertaining to chronology, lifestyle, states of domestication, and social organisation yet remain ill-founded.

At Taymāʾ, the Neolithic is evidenced through arrowheads and flint tools gathered as surface stray finds (*Taymāʾ Occupation Period 12*). Even though in limited amounts, the remains point to the so far earliest known human presence at the later oasis as early as the late 7th/early 6th millennium BCE, in other words the Late Neolithic (Middle Holocene), whilst indicating to contacts with the Southern Levant (Purschwitz 2017).

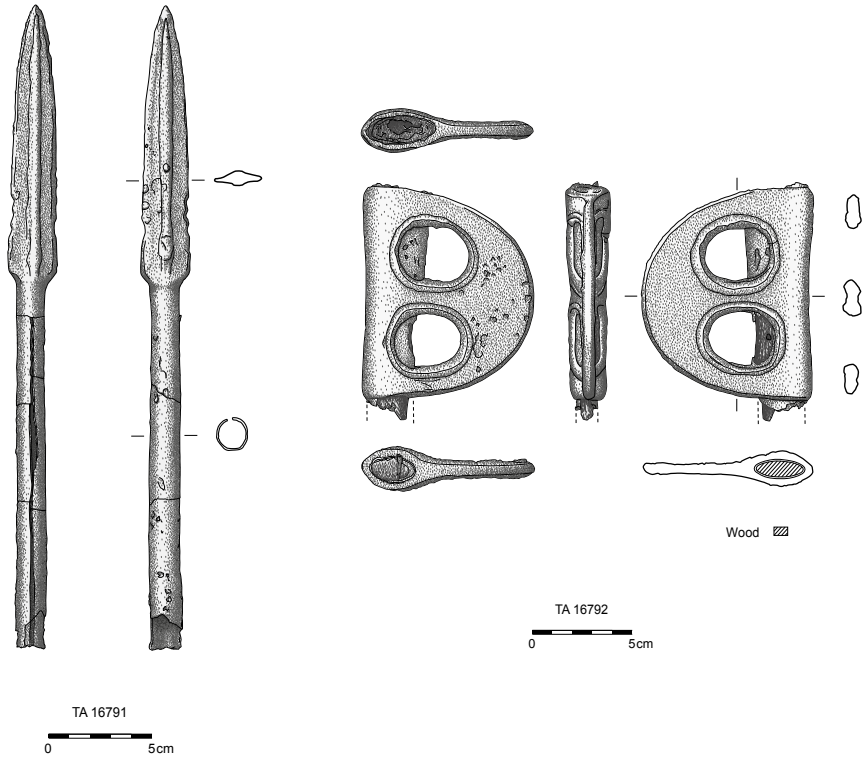
5th and 4th millennia BCE (Neolithic to Chalcolithic)

The reconstruction of early Taymāʾ may have to be put in context with recently discovered, large circular stone structures located at some distance south and southwest of Taymāʾ (between 25 and more than 40 km; Hausleiter – Zur 2016). At Kilwa similar structures have been found (D. Rokitta-Krumnow, personal communication); as yet, none of them have been excavated or dated. In the entire region such built stone structures are not unknown. Located on volcanic rock formations in the *harrat*s, which reach from Syria through Jordan to the Arabian Peninsula, they have been interpreted as burials (Kennedy 2011; Magee 2014) suggesting that they are part of alleged 'ancestral pastures' (Wilkinson 2003; Wilkinson *et al.* 2014; Luciani 2016) in desert landscapes. They appear to be different to the Late Neolithic (Rollefson *et al.* 2016), Chalcolithic, and EBA Mesas or Wisad Pools found in the Eastern Desert of Jordan, of which one had been re-used as a burial site in the Late Bronze Age (Rowan *et al.* 2015). Examples of 'desert-kites' have not been identified in the immediated vicinity of Taymāʾ, but rather south of it (Magee 2014).

Recent research on so-called tower-tombs and structures not related to funerary activities in the Tabuk-al-Jawf-Region shed new light on the regional development of burial customs between the Neolithic and the Bronze Age, probably to be associated with mobile pastoralists (Fujii 2016).

Archaeobotanic data suggest a beginning of oasis cultivation at Taymāʾ at around 4,600 BCE, according to the occurrence of palynological evidence from *Vitis vinifera* and probably also *Ficus* (M. Dinies, personal communication; cf., Dinies *et al.* 2016). Cultivated grapevine does not necessarily imply the presence of a permanent sedentary occupation, but it can be considered as key element for the transformation of a site into an oasis (this fundamental step is being subsumed to *Taymāʾ Occupation Period 11c*). Most notably, there is no evidence for the date palm in these early palynological records, and the occurrence of the latter at Taymāʾ is not attested before the

a



b

Fig. 10 *Spearhead and fenestrated axe made of bronze from al-Nasim, Grave E-g2 (a: DAI, Orient Department, I. Wagner; b: DAI, Orient Department, H. Kosak).*

الشكل ١٠ نصل سهم وفأس منوفذة مصنوعان من البرونز اكتُشفا في النسيم، القبر E-g2 (a: معهد الآثار الألماني، قسم المشرق ـ إ. فاغنر، b: معهد الآثار الألماني، قسم المشرق ـ هـ. كوزاك)

very end of the 2nd millennium BCE. It is also within this time horizon that Gebel and Mahasneh (2012) and Gebel (2016) proposed a model for the emergence of oasis-based garden cultures in Northwest Arabia based on water sources, for that matter wells.

The earliest ^{14}C-sample from an excavated context pertaining to a large-scale production of disc-shaped carnelian beads at the eastern margins of the *sabkha* indicates a date in the 5th to 4th millennium BCE (4,223–3,964 calBCE). At the present stage of analysis, including comparisons from other sites and regions such as Anatolia (Eichmann *et al.* 2006a), it is appropriate to apply the term Chalcolithic period for the chronological context of this industry (Eichmann *et al.* 2006a). The remains have been attributed to *Taymāʾ Occupation Period 11b*. Micro-drills made from chert ridge flakes were used in the bead production. Both raw materials were apparently available locally (Haibt 2013; 2018; Purschwitz 2017). The production site(s) may have been located somewhere near the north-eastern margins of the *sabkha*, as suggested by the surface survey and soundings.

However, no archaeological traces of permanent settlements within the oasis have been identified for this period, nor for most of the entire 4th millennium BCE. Remains of a stone rubble wall have been traced south of the supposed production site area and this wall may possibly be of an earlier date. In this context the traces of possible channels identified by geophysical prospection need to be verified and dated (Hausleiter 2018).

Further architectural remains, probably of a late 4th millennium BCE date, have been identified beneath the 3rd millennium BCE outer wall south of the central part of Qrayyah. This chronological attribution results from a sample dated to the late 4th/early 3rd millennium BCE (^{14}C) from the layer above it (see below). Similarly, in the center of the settlement, a wall underneath the early 3rd millennium BCE building (^{14}C), may belong to late 4th millennium BCE occupation in the area, thus potentially redating the first settlement activity in Qrayyah (*Taymāʾ Occupation Period 11a*). The function of the wall is, however, unclear.

Initially, flint drills and bead fragments which had been detected within the settlement were attributed by Bawden *et al.* 1980 to the Iron Age – probably because Taymāʾ was then considered as mainly an Iron Age site. The hypothesis that bead fragments and discarded drills found on the surface within the compounds had arrived from the *sabkha* with the mud used for mudbrick production in the late 3rd millennium BCE has been confirmed through the discovery of drills and bead fragments inside the mudbricks of the outer wall. Hence, the presence of these artefacts in Qrayyah results from an erosion of the mudbrick walls.

3rd to mid-2nd millennium BCE (Early to Middle Bronze Age)

Whereas only little archaeological evidence has been recorded for the 4th millennium BCE, fundamental socio-political developments may have taken place during the 3rd millennium BCE (*Taymāʾ Occupation Period 10*). At this time which elsewhere is known as the Early Bronze Age, the construction of a large system of walls from siltstone and mudbrick was undertaken. Likewise, the so far earliest known built graves or cairns south of the walled oasis can be dated to this period. Furthermore, most recent stratigraphic data from the centre of the ancient settlement indicate to a contemporary occupation by a pottery producing community. This evidence may possibly be connected with a yet little known oasis settlement established by a sedentary population which, while interacting with surrounding mobile groups involved in hunting (cf., Magee 2014), may have emerged as early as the mid-5th millennium BCE. This involved besides the availability of the requisite administrative and personnel resources also the necessity of erecting such walls. With the construction of this oasis wall, Taymāʾ reached almost immediately its largest extension, only to be surpassed in the Early Iron Age with the addition of Compound A (the construction date of Compound W currently remains unknown; Schneider 2010).

The foundation of the oasis wall can be associated with a late 4th–early 3rd millennium BCE *terminus post quem* (Hausleiter – Zur 2016; Hausleiter 2018; for an even older structure see above); in the relevant deposits a coarse pottery with predominantly mineral temper has been identified (Reddish Coarse Ware, RCW; formerly Very Coarse Mineral Tempered Ware; Fig. 11a). This pottery is in context with the structural remains of a room and subsequent fill deposits in the very centre of Qrayyah (Area E), from where a series of consistent, early to late 3rd millennium BCE ^{14}C-dates have been obtained (Hausleiter – Zur 2016; Lora 2017). To the later part of this chronological horizon belongs a greyish pottery, known as Gritty Ware (GW), characterized by grit as its main temper (Fig. 11b). It is also attested in very small quantities on the surface at Rujum Saʿsaʿ (Hausleiter – al-Najem 2016; Hausleiter 2017). A similar ware has been identified in the cairns at Jabal Khraymat at Mada'in Salih (Abu-Azizeh 2015; Tourtet *et al.* in press), suggesting a late 3rd millennium BCE occupation of this area.

Until now, circular graves with associated rectangular multi-chamber structures at Jabal Khraymat provided a late 3rd/early 2nd millennium BCE ^{14}C-date (W. Abu-Azizeh, personal communication). Based on their similarity to the evidence at Taymāʾ, Abu-Azizeh (2015) postulated a regional burial tradition. Whether the variety of built graves at Taymāʾ represents a chronological phenomenon or rather an expression of social differentiation or a combination of the two cannot be answered on the basis of currently available information. There are large circular graves with (or without) stepped section (up to 5.5 m diameter); circular graves with cross-shaped chamber (up to 3.7 m diameter); circular graves with large rectangular multi-chamber structures (ca. 3 x 12 m); the latter occur also isolated, i.e. without being associated with circular graves. The circular graves with cross-shaped interiors are so far only attested at Taymāʾ. As to their predecessors, these graves are free-standing and individually built on top of the bedrock. Dated to the turn of the 2nd millennium BCE, which in other regions refers to the EBA-MBA transition, and located within the cemetery area south of the oasis (Sana'iye, Rujum Saʿsaʿ, al-Nasim), these graves display funerary objects comprising fenestrated axes and a variety of cutting or thrusting weapons (Fig. 10) (Hajiri 2011; Hausleiter 2015c; Hausleiter – Zur 2016; Zur – Hausleiter 2018).

This phenomenon has been associated with so-called warrior or status burials attributed to sub- or semi-elites of the ruling class (Philip 1995; D'Andrea 2014) mainly in Syria and the Levant, but also in Mesopotamia, Anatolia, Egypt and Iran at the turn from the 3rd to 2nd millennium BCE (Gernez 2008). It is therefore conceivable that the oasis of Taymāʾ was for the least connected with the region's larger Bronze Age centres, if not even closer than previously assumed ties to this cultural and political horizon had existed (Hausleiter – Zur 2016; D'Andrea 2014). These circular graves continued to be used during the mid-2nd millennium BCE.

Raw materials of two of these weapons had been provided from either the Arabah valley (Höppner *et al.* 2011) or from Oman (M. Renzi, personal communication), but yet nothing is known about the production place. In this context, the recent discovery of rectangular chambers with multiple burials and bronze weapons at the site of Qurayyah, dated to the same period (late 3rd/early 2nd millennium BCE; Luciani *et al.* 2018) adds significant information on both local/regional burial practices and cultural contacts. Trade and exchange of this period, as is the case with other regions in the Near East, may have probably been dominated by mobile groups using the donkey as a pack-animal (Eichmann *et al.* 2006a; Luciani 2016; cf. Fedele 2014), already depicted in prehistoric rock art and attested in the faunal remains of Umm an-Nar sites in eastern Arabia (Magee 2014; cf. Rossel *et al.* 2008).

This phase saw the introduction of a new pottery ware at Taymāʾ – the so-called Red Burnished Ware (RBW; Fig. 11c, 12a; Hausleiter 2014; Tourtet *et al.* in press). This handmade and wheel-made pottery occurs not only in association with dated circular graves of the younger type, but has also been detected within stratified settlement contexts, either next to the outer wall (Area Q, Square W41) or inside the settlement centre (Area E). Its chronological range covers at least the early 2nd millennium BCE to the mid-2nd millennium BCE (*Taymāʾ Occupation Period 9*).

a – Reddish Coarse, formerly Very Coarse Mineral Tempered Ware (DAI, Orient Department, J. Kramer).

a ـ الفخّار الخشن المائل إلى الحُمرة، سابقاً خشن جداً وذو خلطة معدنية (معهد الآثار الألماني، قسم المشرق ـ ي. كرامر)

b – Gritty Ware (DAI, Orient Department, F. Tourtet).

b ـ الفخّار المبرغل (معهد الآثار الألماني، قسم المشرق ـ ف. تورتيه)

c – Red Burnished Ware (DAI, Orient Department, F. Tourtet).

c ـ الفخّار المصقول الأحمر (معهد الآثار الألماني، قسم المشرق ـ ف. تورتيه)

Fig. 11 *Ceramics from Taymāʾ (a–b: late 4th to 3rd millennium BCE; c: Early-to-mid-2nd millennium BCE).*

الشكل ١١ فخّار من تيماء (a-b : الألف الثالث ق.م.، c: من بداية وحتى منتصف الألف الثاني ق.م.)

a – Red Burnished Ware with Barbotine decoration (DAI, Orient Department, A. Zur).

a ـ الفخّار المصقول الأحمر ذو زخرفة الباربوتين (معهد الآثار الألماني، قسم المشرق ـ أ. تسور)

b – Qurayyah Painted Ware from Taymāʾ (DAI, Orient Department, J. Kramer).

b ـ فخّار قريّة الملوّن من تيماء (معهد الآثار الألماني، قسم المشرق ـ ي. كرامر)

c – Taymāʾ Early Iron Age Painted Ware (DAI, Orient Department, J. Kramer).

c ـ فخّار تيماء الملوّن من عصر الحديد المبكّر (معهد الآثار الألماني، قسم المشرق ـ ي. كرامر)

Fig. 12 *Ceramics from Taymāʾ (a: Early-to-mid-2nd millennium BCE; b: Late 2nd millennium BCE; c: Early Iron Age, 11th to 9th century BCE).*

الشكل ١٢ فخّار من تيماء (a: من بداية وحتى منتصف الألف الثاني ق.م.، b: نهاية الألف الثاني ق.م.، c: عصر الحديد المبكّر، القرنان ١١ - ٩ ق.م.)

a – Taymāʾ Early Iron Age Plain Ware (beakers) (DAI Orient Department, J. Kramer).

a ـ فخّار تيماء البسيط من عصر الحديد المبكّر (أكواب) (معهد الآثار الألماني، قسم المشرق ـ ي. كرامر)

b – Sana'iye Painted Ware (DAI, Orient Department, I. Wagner).

b ـ فخّار الصناعية الملوّن (معهد الآثار الألماني، قسم المشرق ـ إ. فاغنر)

c – Ceramics similar to 7th / 6th century BCE Syro-Mesopotamian pottery (DAI, Orient Department, I. Wagner).

c ـ فخّار شبيه بالفخّار السوري ـ الرافدي العائد للقرنين ٦/٧ ق.م. (معهد الآثار الألماني، قسم المشرق ـ إ. ڤـاغنر)

Fig. 13 *Ceramics from Taymāʾ (a: Early Iron Age, 11th – 9th century BCE; b: Early-to-mid-1st millennium BCE; c: 7th / 6th century BCE).*

الشكل ١٣ فخّار من تيماء (a: عصر الحديد المبكّر، القرنان ١١ ـ ٩ ق.م.، b: من بداية وحتى منتصف الألف الأول ق.م.، c: القرنان ٦/٧ ق.م.)

Some RBW vessels are decorated with white kaolinitic clay and have been labelled Barbotine Ware. The cemeteries south of the oasis display a wider spectrum of decorative patterns on the RBW than the specimens from the centre and hence potentially indicate to a broader chronological range than the latter, even though this requires further study.

Saudi excavations in the cemetery of al-Nasim revealed certain pottery sherds which may represent a transition between Red Burnished and Qurayyah Painted Ware (QPW, see below). The latter is a significant Late Bronze Age pottery style known from the entire region. RBW decorative techniques were 'imitated' through painting, and decorative patterns of QPW were used mainly on red-painted sherds. The occurrence of RBW, Barbotine Ware, and QPW in some of these burial complexes may either inform about the occupation history of these graves or indicate that these pottery groups at least occurred for a limited concurrent period.

Second half of the 2nd millennium BCE (Late Bronze Age)

During the Late Bronze Age, known as the International Period in Egypt, Syro-Mesopotamia, Anatolia, and Elam (Pfälzner – al-Maqdissi [Eds.] 2015), the local pottery production at Taymāʾ integrated regional stylistic elements attested to elsewhere in Northwest Arabia (such as Qurayyah Painted Ware/QPW; Chan in preparation; Hausleiter 2014; Intilia 2016; Tourtet *et al.* in press). This has recently been interpreted as a sign of a certain cultural autonomy within Northwest Arabia, most probably stimulating Egypt's interest in the region (see below) after its retreat from the Levant. This second part of the 2nd millennium BCE represents *Taymāʾ Occupation Period 8*.

However, except for the continuous occupation of the graveyards south of the oasis, little is known in terms of settlement organisation and related remains, even though the pottery evidence nevertheless points to a continuous Bronze Age occupation, as also in the central part of Taymāʾ. Archaeometric analysis on QPW sherds from Taymāʾ and Qurayyah (Daszkiewicz 2014) evince that QPW was produced at both sites following a known technological and decorative pattern in the region, that most probably needs to be put in context with Eastern Mediterranean painted ceramic traditions of the MBA/LBA. Scientific analyses carried out on metal slag from the oasis of Qurayyah suggest far-reaching contacts for the procurement of the raw materials, since the used copper originated, at least partly, from mines in the Arabah, the Arabian Shield, and Oman (Liu *et al.* 2015). This suggests that Northwest Arabian oases maintained relations with neighbouring areas for the safeguard of a steady and possibly century-old flow of raw materials.

In this context, an inscription mentioning Pharaoh Ramesses III (12th century BCE) found some 60 km northwest of Taymāʾ, besides attesting to an Egyptian expedition to the Taymāʾ region (Sperveslage – Eichmann 2012; Sperveslage 2013; 2014; 2016), possibly also discloses Egypt's interests in this economically attractive region – if not in Taymāʾ itself. Although the political and economic circumstances in Northwest Arabia during the Late Bronze Age and its palace-based system of exchange are not really well-known, it may be hypothesised that the inclusion of the Arabian Peninsula to the interests of Egypt may reveal a readjustment of the latter's foreign policy.

As to the archaeological remains of late 2nd millennium BCE occupation, it was a sequence of deposits at the outer wall (Area Q) that provided larger quantities of stratified Qurayyah Painted Ware (QPW; formerly labelled Midianite Pottery; Fig. 12b; see above), which is characteristic for the later centuries of the 2nd millennium BCE (Hausleiter 2014; Intilia 2016; Tourtet *et al.* in press). At Taymāʾ QPW had already been identified by Bawden *et al.* (1980), but it had been subsumed to the general tradition of a "Taymāʾ Painted Ware" identified for the oasis by the authors (Bawden – Edens 1988; see above). At least at Taymāʾ, there is evidence suggesting a slightly wider chronological range for QPW than previously assumed, i.e. from the 15th to 11th centuries BCE (Intilia 2016). QPW is also known from other locations at Taymāʾ, such as Area H/Compound A, Area A, and in the central part of the settlement (Area E). In all

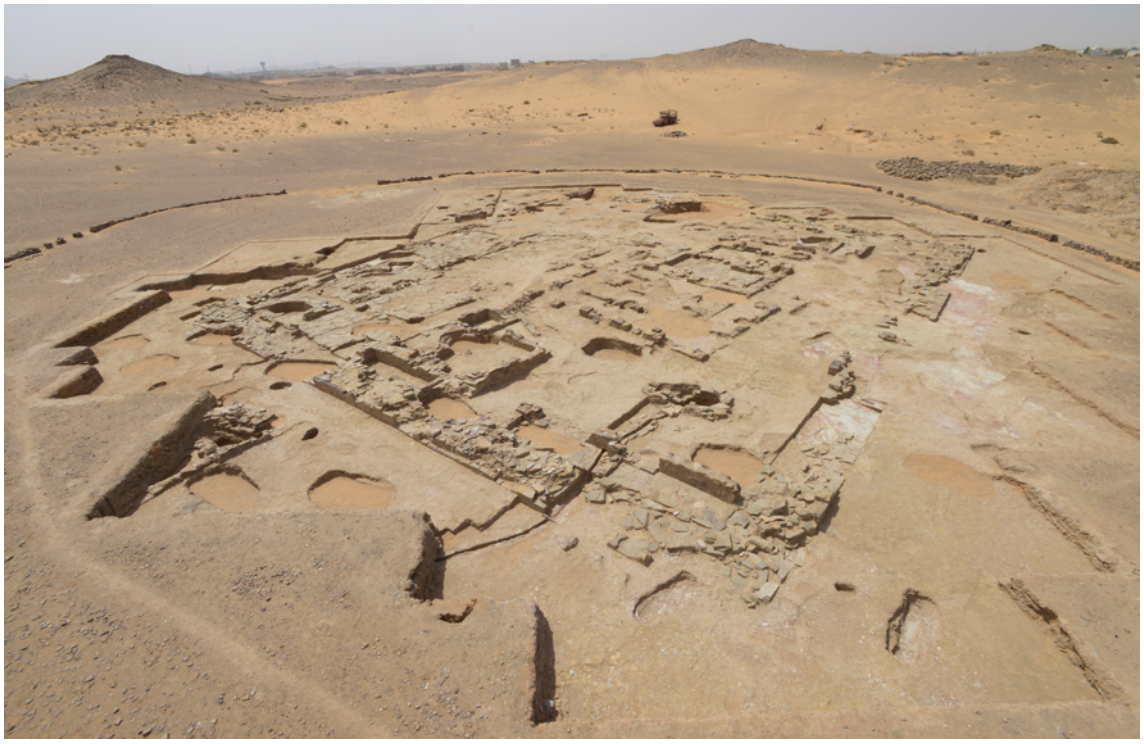


Fig. 14 *Early Iron Age (11th – 9th century BCE) public building in Area O (DAI, Orient Department, I. Wagner).*

الشكل ١٤ مبنى عام في القطّاع O يعود لعصر الحديد المبكّر (القرنان ١١ ـ ٩ ق.م.) (معهد الآثار الألماني، قسم المشرق ـ إ. فاغنر)

cases the presence of this pottery did not contribute to more than a general *terminus post quem* of the pertaining deposits since it was associated with younger material. QPW has also been identified within the cemeteries south of the oasis, but it is currently unclear to which type of built graves it is linked.

11th to 7th century BCE (Early to Mid-Iron Age)

At the turn of the 1st millennium BCE, the oasis continued to acquire raw materials from diverse origins for its own metallurgical production, an activity attested to already for the preceding Late Bronze Age. Its relations reached as far as the Arabian Shield and Oman, possibly even Cyprus and Lavrion/Greece, as established from chemical fingerprinting of Early Iron Age metal objects (Liu *et al.* 2015; Renzi *et al.* 2016). This alludes to a certain continuum in the oasis' functioning economy and apparently also to a certain measure of independence from the events at the end of the Eastern Mediterranean Late Bronze Age marked by the collapse of the city-based palace economies and an ensuing period of regional instability.

Whereas Arabia already during the late 2nd millennium BCE apparently entered the Assyrian mental and economic spheres (Bagg, this volume), not much historical information is available predating the 9th century BCE. This was when 'Arabs' appear among the fighting troops facing an Assyrian coalition (see above). There followed a number of military incidents which, although ending in the payment of tribute or even in the defeat of some 'Arabian queens', hardly resulted in lasting conquests of sites or regions (Macdonald 1995; Hausleiter 2012a).

At Taymāʾ, stratified deposits now reveal ceramics of Syro-Mesopotamian style, underpinning the idea of settlement continuity, but there is no evidence for the caravan trade as illustrated by the famous text of a local ruler from the Iraqi Middle Euphrates (see above).

In the excavation, the period known as Early Iron Age is best exemplified by an isolated and walled architectural complex of 1,200 m^2 (Area O; Fig. 14) possibly representing a temple or shrine. The radiocarbon dates suggest the complex's functional period to have lasted between the 11th and 9th centuries BCE, with a peak in the 10th century BCE (*Taymāʾ Occupation Period 7*). The central building was bounded by pillars, one of which had collapsed and is now preserved in its full length reconstructed at approx. 2.8 m. The building itself was most probably higher. The fact that its layout differs from contemporaneous counterparts in neighbouring regions may indicate the development of an independent Northwest Arabian building tradition.

In addition to the central building, there are several rooms, of which one containing a fire installation. A cistern in the north-western part of the enclosed area built of large stone blocks resting on the bedrock and with a subterranean water supply, was identified to have been accessed by stairs. Numerous organic remains from artefacts were recovered from the building's interior. Among them were bone and ivory combs, tokens, reed baskets, bone and wood inlays, the latter of which displaying the so-called *guilloche*-motive, as known from the Eastern Mediterranean during the late 2nd millennium BCE. Remarkable are small faïence figurines of Egyptian goddesses (Isis, Bastet/Sakhmet), a glazed figurine of a bull (Sperveslage 2013; 2014), as well as a mask-pendant typical for the Levant (cf. Peltenburg 1977).

From the excavations in Area O a characteristic painted and plain pottery was recovered (Taymāʾ Early Iron Age Ware, TEIAW; Figs. 12c, 13a). Medium-sized bowls and few closed shapes had been painted with bi-chrome, geometric and figurative patterns (mostly birds and rarely humans) on a white slip, thereby indicating an own local style evolved from the regional painted decoration of the preceding Late Bronze Age (Hausleiter 2010b; 2014; Tourtet *et al.* in press). Cylindrical beakers recorded in large quantities, thus suggesting the consumption or use of liquids, were unpainted.

Whereas the complex in Area O may have been destroyed by fire, an identified small building attached to the outside of the oasis wall (Area A) shows a continuous occupation lasting from early to mid-1st millennium BCE. Built on sand dunes that had accumulated up to heights around 8 m on either side of the wall, a small building revealed a two-phase occupation covering the same period as Area O, but unmistakably delivering Sana'iye Ware (Hashim 2007; Hausleiter 2014; Tourtet *et al.* in press) in the upper levels. This pottery group is attested in larger quantities in the cemeteries of the oasis, such as at Sana'iye, Talʿa, and al-Nasim (see above).

In addition to the stratigraphic dating of the pottery in Area A, ^{14}C-dates from fireplaces at the cemetery of Talʿa cover a period between the 9th and 5th centuries BCE (Eichmann 2009; see Beuger 2010; Lora *et al.* 2010), which is largely within *Taymāʾ Occupation Period 6*. In the settlement centre, Sana'iye pottery (Fig. 13b) has been discovered in fill layers beneath the residential area and in the areas surrounding the large temple building E-b1. The area within the oasis yet falls short of revealing undisturbed primary contexts from this period, probably due to a massive removal of earlier remains during the Nabataean period (see below).

An up to 8 ha large irrigation system discovered in the area of Compound A is probably among the oasis' latest compounds (see above; Schneider 2010) and may have evolved from the Early Iron Age onwards, as suggested by the presence of Early Iron Age ceramics as well as ^{14}C-dates (Weigel in press). Contrary to Area O and similar to Area A, QPW is attested to as well, but not from undisturbed contexts. The system which shows a number of canals and basins for the collection, distribution, and drainage of water, had been modified during the time of its use. Parts of this system had been sealed at least at one location by a small building with a 7th to 6th century BCE pottery inventory (Fig. 13c), probably specifying a phase when the system began to fall into disuse. The occupation by a graveyard of parts of the western area of the irrigation system (Hausleiter – Zur 2016; see also below), however, seems to be of considerably later date. Probably, the well located in H-b1 (see above) was no longer capable of supplying the system with water, due to a falling groundwater table during these centuries.

Outside the walls, the burial grounds which had been in use since the late 3rd millennium BCE, if not earlier (see above), remained operative. Contrary to the circular graves of the Bronze Age, the funerary architecture now displayed clusters of rectangular stone chambers, either attached to circular graves with cross-shaped interiors, or leaning on each other in rows (cf. Abu Duruk 1989; 1990; 1996). There are also narrow grave chambers attached with their long sides to the circular structures. Although Early Iron Age ceramics have occasionally been identified in context with such graves, it is uncertain whether specific grave types can be connected to pottery styles from the settlement. It appears as if circular and rectangular structures were repeatedly re-used; the rectangular chambers at Talʿa point to the practice of collective burying (Lora *et al.* 2010).

6th to 2nd century BCE
(Late Iron Age, the Babylonian occupation and the dynasty of Liḥyān)

In the later part of the 1st millennium BCE, the oasis of Taymāʾ receives mention in Biblical records along with numerous tribes attributed to Northern Arabia (Eph'al 1982; Macdonald 1995). Contrary to the sources provided by the Assyrian Empire, there are only few signs of Assyrian-Arabian relations within the archaeological record from Taymāʾ. This situation changes with the mid-6th century BCE, when the last Babylonian king Nabonidus (556–539 BCE) took residence at the oasis for a period of ten years (Beaulieu 1989; Schaudig 2001). His presence at here is witnessed to by an arched stela bearing the representation of the king in front of a triad of astral symbols commonly associated with him (moon, winged sun-disc, star representing the gods Sîn, Šamash, and Ištar; Fig. 15).

Furthermore, several fragments of monumental Neo-Babylonian cuneiform texts have been found, in one case explicitly mentioning the king by his name (Eichmann *et al.* 2006a; Hausleiter – Schaudig 2010a-b; in press). Another text refers to the shrines of Marduk and Zarpanitu, probably in Babylon, but nothing tangible concerning the king's dealings at Taymāʾ or Dadan is preserved, as for instance derived from the Harran stelae (Schaudig 2001).

Whereas a circular-shaped sand stone pedestal from Taymāʾ is preserved referring to the king's image or statue at the oasis, there are no surviving architectural remains that may be associated with him, which also includes his palace mentioned in the 'verse account'. This is a text from the subsequent Achaemenid period, probably aimed at highlighting the king's omissions in his hometown. Among the pottery records from various contexts at the site, bowls and jars of Syro-Mesopotamian character produced with local clay have been identified, including items made from a very fine ware.

A number of Taymanitic inscriptions have been recovered in the surroundings of the oasis, representing a local variant of early Northwest Arabian oasis scripts (Müller – al-Said 2002; al-Said 2009; for the term, see Macdonald 2004). These dedicatory inscriptions by members of his troops mentioning Nabonidus, the king of Babylon, are an echo to the king's sojourn in Northwest Arabia. One of the rock carvings depicts the symbols of the god Nabû, which are the stylus and the tablet.

The recent discovery of a relief and cuneiform inscription naming the same king at al-Hayit (Province of Ha'il) confirms the site's identification with ancient Padakku (Hausleiter – Schaudig 2016) and also suggests the king's systematic attitude regarding the visual representation of its power, at least within these oases.

Little is known about the oasis of Taymāʾ during the Achaemenid period, although one of the major late 1st millennium BCE monuments, the Taymāʾ Stone, has been associated with the Achaemenid Empire (Briquel-Chatonnet – Robin 1997; Stein 2014; in press). Whereas on his Egyptian campaign in 525 BCE, the Achaemenid ruler Cambyses dealt with locations along the Sinai coast and Egypt itself, the actual political involvement of the Achaemenid Empire at Taymāʾ itself remains obscure (Graf 1990; Anderson 2010; Potts 2011; Hausleiter 2012a). The hypothesis

Fig. 15 *Arched stele of King Nabonidus of Babylon (556–539 BCE) (DAI, Orient Department, I. Wagner).*

الشكل ١٥ المسلّة المسنّمة العائدة لنَبونيد ملك بابل (٥٥٦ ـ ٥٣٩ ق.م.) (معهد الآثار الألماني، قسم المشرق ـ إ. فاغنر)

of a dominant influence on Taymāʾ by the Liḥyānite dynasty of Dadan (Rohmer 2016; see Rohmer – Charloux 2015), rather than by the Achaemenids, contrasts with the attribution of the Taymāʾ Stone to the Achaemenid period, an attribution that is based on its palaeography and introductory formula which have parallels only in Achaemenid texts (Stein in press). Consequently, the transition from Achaemenid to Liḥyānite supremacy at Taymāʾ and the ascent of Liḥyānite political and economic influence over the oasis would have taken place during the 5th century BCE, i.e. a century earlier than previously assumed (cf. Eph'al 1982; Buhl – Bosworth 2000). Although the absolute chronology of this dynasty still needs to be resolved, there is consensus that it may have risen to power at Dadan as early as in the 6th century BCE (Macdonald 1995; 1997; Stein, in press).

The arched stela known as the Taymāʾ Stone exhibits 24 lines of text composed in Imperial Aramaic, carved in positive letters. Accordingly, a new god, ṢLM of HGM is introduced, adding to the existing Aramaean deities of Taymā' ṢLM of MḤRM, ŠNGL / Śengala and ʿŠYM / Ašīma (Maraqten 1996; Niehr 2014). ṢLM (at the same time meaning 'image') has been identified as main god of the oasis. The stela was conceived in the style of an Ancient Near Eastern legal document (Stein 2014) and implies that the local administration at Taymāʾ was formally involved in introducing a new god to the oasis on behalf of this ruler. The side of the monument shows a royal figure in Assyro-Babylonian dress beneath a winged sun-disk, whereas in a second panel underneath, a priest named Šalmu-ušēzib is shown venerating a bucranium.

The latter has been associated with the god ṢLM and, based on a sculptured bucranium of the same type from the debris of the temple in Area E, it has been suggested that this as well as the Taymāʾ Stone may have hosted a shrine devoted to ṢLM (Hausleiter 2012b). Similar to the Tay-

Fig. 16 *Temple and residential area (Areas E and F) (DAI, Orient Department, J. Krumnow).*

الشكل ١٦ منطقة المعبد والمنطقة السكنية (القطّاعان E و F) (معهد الآثار الألماني، قسم المشرق - ي. كرومنو)

māʾ Stone, the representation of a riding horseman in the surroundings of Taymāʾ betrays certain Mesopotamian iconographic elements. Although it has been associated with the stay of Nabonidus at Taymāʾ (Jacobs – Macdonald 2009), it may just as well be of later date (cf. Potts in press).

At the western periphery of the site overlooking the *sabkha* and the oasis, one comes across further public buildings that too, date to the early part of the second half of the 1st millennium BCE, among which also Qasr al-Hamra that was built onto a rocky outcrop (Bawden *et al.* 1980; Abu Duruk 1988; Abu Duruk – Murad 1985; 1986; 1988). In Qrayyah, the construction of the temple known as Building E-b1, has been associated with the Liḥyān dynasty (Lora 2017), even though some parts of it may have been built much earlier. Another exposed though not further investigated, potentially public building on the plateau north of the *sabkha* at Tuwayil Saʿid (see Fig. 7), may date to the same range of time.

a

b

Fig. 17 *Heads of statues of the period of the Liḥyānite dynasty (a: TA 489, DAI, Orient Department, M. Cusin; b: TA 14944/14960–14961, DAI, Orient Department, J. Kramer).*

الشكل ١٧ رؤوس تماثيل عائدة لفترة السلالة اللحيانية (a: TA 489، معهد الآثار الألماني، قسم المشرق - م. كوزَن، b: TA 14944/14960/ 14961، معهد الآثار الألماني، قسم المشرق - ي. كرامر)

The above mentioned temple Building E-b1, which measures 500 m^2 remained in use for several hundred years (Fig. 16). The trapezoid edifice consisted of a stone-paved peristyle hall with up to 15 monolithic pillars. The northern wall is divided into three niches on its inner side. A multifunctional fireplace had been part of the building ever since its earliest construction phase (Huber 2015). During its functional period, the temple was several times partially rebuilt, probably after static failure (Lora 2017).

The building was soon enclosed by a *temenos*-wall defining a distance between it and the surrounding architecture; at the same time the area to the east was flattened and covered with a substantial mud layer. Whereas the latter may have extended for approx. 20 m eastwards, the areas north and west of the temple are comparatively narrow (2 to 3 m wide). The main entrance of the building lay in the south. The large platform on the front side was accessed via monumental stairs, probably already at this stage flanked by basins in the east, and a ramp coming from the west. Clear hints to Egyptian iconography and type of representation are attested by the surroundings of Building E-b1, which appears to have been adorned with a number of sandstone sphinxes.

With regard to the reconstruction of both religious topography and iconography, the discoveries from 1979 onwards by the Saudi expedition at the site Qasr al-Hamra are most significant. From a shrine within the building it recovered the socalled al-Hamra Cube and Stela.

Numerous symbols from the Ancient Near Eastern and Egyptian realms found their way into a local expression, together depicting performances of ritual happenings. The al-Hamra Stela suggests that the building once hosted a shrine dedicated to ṢLM RB/D, although there may also have been another shrine, as indicated by the archaeological excavations (Abu Duruk 1988; Hausleiter 2012b).

No later than in the 5th century BCE the size of Taymā's core area was considerably diminished by the construction of an inner wall, which led to the definition of *Taymāʾ Occupation Period 5*. As mentioned, the wall was subsequently modified by the governor Naṭir-Ēl on behalf of a certain king Lawdhan of Liḥyān, whose Aramaic inscription was found in a secondary context next to this inner wall (Stein in press; Intilia 2010). Further Aramaic inscriptions by the Liḥyānite kings, in particular king Tulmay (TLMY), attest to renovations within the large temple building E-b1 in the settlement centre. Tulmay's inscriptions are dated to his regnal years 4, 20, 30, and 40, but other kings are mentioned as well. A number of large fragments of monumental statues similar to the ones found at Dadan (al-Said 2010a-b; Abu al-Hassan 2010) were re-used as building material in subsequent phases. In addition, several smaller items were found.

These display marked differences in style and iconography. The monumental, larger-than-life specimens (at least 3.1 m high) may have adorned the temple as at Dadan, probably embodying aspects referring to both divinity and royalty. The sculptures mix Egyptian and Eastern Mediterranean elements, which for the first time bring to light a recognizable regional style attributable to both Dadan and Taymāʾ (Fig. 17; Hausleiter in press b).

These cultural indicators have been regarded as a corollary of the apparently successful domination of one oasis over the other – almost as if reproducing, on a reduced scale, Nabonidus' economically motivated example of control over large parts of the Hijaz. Taymanitic inscriptions mentioning a war between the oases of Taymāʾ and Dadan (Winnett – Reed 1970; Potts 2011) too, may be a reflection of this conflict. Unfortunately, little is known about the chronology of these events, let alone of the internal sequence of the Liḥyānite rulers. The changes nonetheless offer new insight into local political developments during the late 1st millennium BCE in Northwest Arabia. Imported Attic potsherds recovered from secondary contexts hint to the extent of the contacts the oasis may have continued to nourish with distant regions. The residential quarter south of temple E-b1 may have been occupied from this time onwards. A 225 m^2 large multi-storey building complex (E-b9) may have been founded as early as this time. It was in use until the 1st century CE (see below).

Fig. 18 *Residential quarter (Area F, Building F-b1) (DAI, Orient Department, F. Weigel).*

الشكل ١٨ حى سكنى (القطّاع F، المبنى F-b1) (معهد الآثار الألمانى، قسم المشرق ـ ف. فايغل)

In and around the 5th century BCE significant social changes are mirrored by the archaeological record from a burial ground located within the perimeter of the former outer wall (Area O). Contrary to the hitherto long-lasting tradition of visible funerary architecture arising from the bedrock (see above), grave pits were now dug into the latter. The results from bioarchaeological and anthropological analyses carried out on human remains from this 4th to 3rd century BCE cemetery reveal comparatively healthy diets, high life expectancies, and limited indications for occupational stress. They accordingly suggest that the buried individuals were members of socially privileged groups (Petiti 2013; Petiti *et al.* 2014). Currently, archaeological and historical evidence pointing more articulately to the Hellenistic culture than to Taymāʾ is attested for the eastern, central, and southern parts of the Arabian Peninsula (Potts 2011).

Numerous funerary stelae (or tombstones) depicting stylized representations of faces, sometimes with inscriptions identifying the deceased, are earlier than the cemetery in Area O, as they had been re-used as capstones in the latter (Livingstone *et al.* 1983). A limited number (often with Aramaic inscriptions specifying the filiation of the deceased, among which also women), bear reliefs displaying so-called table scenes also known from other parts of the Near East. They show a central seated figure attended by surrounding individuals associated with palm trunks and clusters of grapes, amphorae, and incense burners, all referring to life in the oasis of the presumed elites of that time. Above one of these representations a bird of prey is depicted in frontal view - similar to a fragmentary stele from Taymāʾ (Hausleiter in press c) and a representation on a stone block discovered in Mada'in Salih (Jaussen – Savignac 1909/1922, 435–439). The associated inscriptions on the other hand fall short of furnishing further details in this respect. One of the earliest monuments discovered at Taymāʾ (published by Euting 1914, 155) and today on display at the Musée du Louvre (AO 29143), can now be attributed to this group (Hausleiter 2012b; in press a).

From the Nabataean period to Late Antiquity (2nd century BCE to 6th century CE)

The central part of Qrayyah continued to be occupied during the Nabataean period. Traces of an imperial Nabataean presence occur here in the form of royal inscriptions, decorative architectural elements, and Nabataean Painted Ware (*Taymāʾ Occupation Period 4*). They occur in the residential quarter as well as in the temple to its northeast. The region's governing political centre during this period was unquestionably Hegra, modern Mada'in Salih (Nehmé *et al*. 2015). While Taymāʾ seems to have played a subordinate role, its commercial importance is undeniable.

Temple E-b1, during the Nabataean period, saw numerous building operations. The monoliths were replaced by pillars in stone masonry. At the same time a basin was installed in the centre of the hall and a more than 15 m long tunnel was dug to connect the temple and this basin with a well to the east. Prior to that, two walls had been attached at a distance of 3.8 m to each other perpendicular to the building's foundations, apparently causing damage to its eastern wall. As for the mentioned tunnel, only the northern of these walls was reused, and a new southern wall was built at 0.8 m distance to the former. The tunnel's corridor was covered with stone slabs of which at least one was a re-used, inscribed funerary stela, while another stela revealed a fully erased Imperial Aramaic inscription.

Afterwards, the south-western part of the temple E-b1 was enlarged. In the building's southern part a 180 m^2 hypostyle-hall with seven columns replaced the pillars and the stone-paved floor was raised. A 6.4 m long monolithic basin was attached to the southern façade (west of the main entrance). A small channel composed of several stone elements running along the façade may have carried water out of the building. As the other basins discovered next to E-b1 it is similar to those found at Mada'in Salih. At the same time, the area south of the temple was enlarged towards south and a new "temenos" wall was built accordingly.

Within the residential quarter south of it, the large building complex E-b9 founded during the 4th/3rd centuries BCE (see above) continued to be occupied. Its agglutinating structure shows nine modules of one or more multi-storey building(s) with food-processing and storage facilities. The upper storey may have been used for habitation purposes but much of it is not preserved any more (Weigel in preparation). The complex was filled in the 1st century CE corresponding to the enlargement of the entrance area of E-b1 with its new "temenos" wall partly covering E-b9.

As for pottery, a few sherds of Nabataean painted ware have been found in the residential as well as in the temple areas (Tourtet *et al.* in press; Maritan *et al*. 2017). The bulk of the material is coarse ware with parallels in north-western Arabia. However, some 1st century BCE to 1st century CE jars have parallels either in Hegra or Petra (Tourtet – Weigel 2015).

Nabataean royal inscriptions mentioning Aretas IV (9 BCE–40 CE) and his successor Malichus II (40–70 CE) come from the same area (Macdonald in press). A number of incense burners bearing Nabataean inscriptions have been found, and a Nabataean inscription has also been discovered, incised on a fragment of a leg of a monumental statue of the period of the dynasty of Liḥyān.

The inner perimeter wall at Qrayyah was rebuilt during the late 1st century CE. During this construction, a 500 m long and 12 m wide ditch was excavated along its exterior face, while the spoil was used for filling the cavity between the wall's two shells. This gigantic construction project may have followed a catastrophic event, possibly a flash flood, as suggested by the meter-thick deposits of silt excavated in Area C (see Wellbrock *et al*., this volume).

Taymāʾ's inclusion in Rome's Provincia Arabia (*Taymāʾ Occupation Period 3b*) led to closer ties with the Levant, at least in terms of architectural and ceramic traditions (Tourtet – Weigel 2015). The buildings of the residential quarter (Purschwitz in press) are characterized by the presence of a courtyard as known from contemporary architecture in the Levant (Fig. 18). However, individual groundplans of different shapes are attested at Taymāʾ: square, rectangular or L-shaped. The average size of these buildings is approx. 115 m^2. From the 2nd century CE on-

wards, a new pottery fabric, Coarse Sandy Ware (CSW), is introduced, replacing the coarse mineral fabric dominating the pottery production in the previous centuries. Significant pottery shapes in the residential area (hemispherical bowls, jars and a 'casserole') correspond to those from the Roman Levant, except for large storage vessels (Tourtet *et al*. in press).

With the Late Roman period (3rd/4th centuries CE, the earlier part of *Taymāʾ Occupation Period 3a*), however, occurs a perceptibly significant break through substantial changes. The temple in the central part of Qrayyah was re-configured as its entrance was reduced and its large hypostyle-hall was divided up into ten small units. Fragments of statues and inscribed pillars from the time of the dynasty of Liḥyān were re-used as building material of the pertaining internal walls. The central basin was dismantled. These changes severely impacted the building's function and use as well as its surroundings. Although a platform was added on the building's eastern side, possibly for public purposes, the open area east of it was considerably reduced through the construction of a massive wall running parallel near its eastern wall. It is assumed that these changes occurred during the course of the 3rd and 4th centuries CE.

At approximately the same time an extensive, up to 1.8 ha large complex with courtyards and large rooms was erected in the lower-lying area north of the temple. Later, this building (E-b6) and the temple were enclosed, thus creating a large new complex. The enclosure reveals an interruption at the border of this new district with the adjacent residential quarters. To this period belongs an early 3rd century CE Nabataean inscription in the shape of a *tabula ansata*, which mentions a 'chief citizen' of Taymāʾ whose name was Jewish, just like those of some of his companions (al-Najem – Macdonald 2009); it was found north of Qrayyah during construction works.

During Late Antiquity, architectural structures in the residential quarter south of E-b1 were replaced by irregular and less carefully built units. Although walls from preceding occupation have been reused, the internal spatial organization underwent changes. Rooms were now mainly aligned in a row rather than grouped around a courtyard. The buildings' average size slightly increases up to 130 m^2. In spite of these apparent changes of layout, continuity has been observed with regard to access and control. As before, it is usually the largest room controlling the access to all the other rooms of the building (Watkins 2018a; 2018b). At least in one case (F-b5) these buildings have been used until the 6th century CE – based on comparative analysis of ceramics and ^{14}C-dating. This is the yet youngest dated occupation attested within Qrayyah. Thereafter the last occupation of the residential area was characterized by pragmatic reuse and adaptation of existing structures in a limited area and was probably short-lived before the area was finally abandoned.

Qasr al-Radm, a large rectangular feature in the northwestern part of the oasis, just inside the western branch of the oasis wall and built around an ancient well, probably dates to the earlier centuries of Late Antiquity (Kennet 2005; Northedge 2008: 3rd–4th century CE). The fortified building remains have been investigated and recorded (Bawden *et al.* 1980; Abu Duruk 1988; Knop – Hausleiter 2016), although thus far without excavation. One of the walls of a subsequent construction within the building contained a spolia stone bearing the Aramaic inscription of a Liḥyānite king named Šahrū (Macdonald – al-Najem in press).

Early Islamic period

The centre of Qrayyah appears to have been abandoned during the Early Islamic period (part of *Taymāʾ Occupation Period 2*, currently comprising the remains of the Islamic period from the 7th century CE onwards), apart from some small farmsteads in the western part of Qrayyah (Area C and within the inner wall). More substantial buildings are found farther west, e.g. in Area C, where a rectangular building of square groundplan may have been a caravanserai. An elongated, possibly public building (Building Z-b1), was identified north of the *wadi* separating Areas Z and

Fig. 19 *Traces of recent camps within the archaeological site (DAI, Orient Department, A. Hausleiter).*

الشكل ١٩ آثار مخيّمات حديثة ضمن الموقع الأثري (معهد الآثار الألماني، قسم المشرق ـ أ. هاوسلايتر)

E. The architecture of this period was built consistently on sand accumulations, for that matter within areas without earlier occupation layers. These buildings are all located at the margins of Qrayyah's former centre, thus virtually 'avoiding' the latter while benefiting from its ruins which served as a quarry for building material. ^{14}C-samples from the foundation deposits indicate construction dates between the 8th and 10th centuries CE.

The northward shift of the settlement in this period seems to repeat a similar phenomenon observed already in the 1st millennium BCE. Several Arabic inscriptions have been found, mostly in Area E, all of which lack archaeological context (except for an incised inscription on the outer wall of Building E-b1). Generally, the written sources on Islamic Taymāʾ outweigh the archaeological evidence from the site's centre, which strongly suggests that the material traces of the otherwise rich and wealthy oasis described by the Arab historians and geographers must be sought elsewhere.

In the 1980s, Saudi-led excavations uncovered the small fortress with towers known as Qasr al-Bujidi inside the the oasis. It may date from the Early Islamic to Fatimid and Ayyubid periods, based on the pottery and coins found (Abu Duruk 2000; al-Salook 2000; Hashim 2000). Systematic investigations of Taymāʾs Islamic period yet remain to be carried out. More recently, numerous salvage operations inside the oasis area have in fact revealed ceramics from the Islamic period.

Modern remains within the archaeological area

The inner walls of the temple Building E-b1, revealing Arabic graffiti dated to 1329 AH, prove that more than a century ago, at least some its remains at Qrayyah were accessible, whilst most of the other ancient ruins, especially in this sector, were buried below massive debris. Somewhat

Fig. 20 *The site of Taymāʾ seen from Rujum Saʿsaʿ south of it (DAI, Orient Department, A. Hausleiter).*

الشكل ٢٠ موقع تيماء كما يُرى من موقع رجوم صعصع الواقع في جنوبه (معهد الآثار الألماني، قسم المشرق ـ أ. هاوسلايتر)

earlier than that, the north-eastern corner of Qasr al-Radm was demolished in order to add a camel draw to the well located inside the building. During his visit to Taymāʾ in 1884, J. Euting (1914) produced a sketch drawing of the building, in which it is depicted in a virtually perfect state of preservation (see also Knop – Hausleiter 2016). The building's dated graffiti from 1362 AH are even more recent than those at Qrayyah.

Remains of mudbrick houses have survived in the traditional settlement bordering the northern part of the site of Qrayyah. Today abandoned, they had nevertheless been occupied until few decades ago. Their remains as well as the other witnesses of the local traditional architecture are still awaiting systematic examination. An ethnographic study of Taymāʾwas first published by M. H. al-Najem (al-Taima'i 1998); subsequently, preliminary investigations focused on Qasr Ibn Rumman, the former residence of the emir east of Bir Hadaj, in Taymāʾs old town. The building's first stage goes back to the mid-19th century CE (1844), whereas substantial changes and an enlargement of the core structure are dated to the early 20th century CE, coinciding with the reign of governor Abdel Karim bin Ali bin Rumman, around 1919/20 (Hausleiter 2015a; cf. Al-Ansary – Abu al-Hassan 2005).

Remains of campsites by mobile groups have been identified within the area of Qrayyah (*Taymāʾ Occupation Period 1*). They correspond to paved areas, sometimes concrete and cinder blocks, pen fences, and a number of moveable objects (Fig. 19). Better preserved remains are attested in Compounds C and D. Coins dated to the late 1960s and early 1970s have been collected from the latter, thus indicating a *terminus post quem* for the use of these areas (Hausleiter 2016b). In 1983, the same year that saw the construction of the Taymāʾ Museum of Archaeology and Ethnography, the site of Qrayyah was fenced-off by the then Directorate of Antiquities, thereby protecting it from inappropriate usage.

4 Perspectives

A number of issues remain to be addressed. Although craft activities including the production of chalcedony beads and a lithic industry have been dated to around 4,000 BCE (Haibt 2013; 2018), most of the 4th millennium BCE occupation at Taymāʾ still lacks archaeological verification.

An apparently unbroken sequence of occupation at Taymāʾ has been confirmed, beginning in the early 3rd millennium BCE, which in the course of the millennium, may even have reached 'urban' dimensions, hence much earlier than previously thought. These most recent results corroborate P. Magee's (2014) observation that "Taymāʾ's canonical entry into Near Eastern archaeology in the 1st millennium B.C. masks a complex Neolithic to Bronze Age trajectory that parallels many developments elsewhere in Arabia". These need to be placed within a wider perspective and put into context with the proposed common cultural background in the Western parts of Arabia (Schiettecatte 2010), including the Early Bronze Age societies in the highlands of Yemen (Edens *et al.* 2000; Wilkinson 2003).

From this angle, the extended burial grounds located chiefly, but not exclusively, south of the oasis emerge as significant markers, as they are the main holders of the remains of the former population. As the threat from the modern expansion of Taymāʾ continues (Fig. 20), systematic exploration is likely to lead to a better understanding of the nature of regional burial customs practiced by populations at the interface between mobile pastoralists and sedentary societies. Moreover, the value of such examinations in providing clues for a better understanding of a transregional diffusion of Bronze Age burial customs cannot be underestimated.

As for the domestication of the camel, commonly thought to have taken place around the turn of the 2nd to the 1st millennium BCE, the evidence currently tends to confirm, or at least not to contradict this general date, as camel bones have been verified in very limited amounts in Early Iron Age contexts (11th to 9th century BCE) at the oasis. Lacking unequivocal data from the later phases of the Iron Age, it is only the remains from Nabataean domestic contexts that reveal a noticeable use of the dromedary. The percentage figures disclose a constant increase of its use to a maximum level in the Late Roman period (Prust – Hausleiter in press).

Although the pottery sequence from the middle part of the Iron Age has now been completed, architectural remains, except for the period's funerary architecture (approx. 9th to 5th century BCE), have not yet been identified. While this applies to the period of Assyrian contacts with Arabia (cf. Bagg, this volume), remains attesting to the presence of the last Babylonian king, Nabonidus (556–539 BCE), have survived in the form of monumental inscriptions and one stela. Taymāʾ has so far failed to provide direct contemporary evidence for the organisation and operation of caravan trade by means of the dromedary, apart from the availability of water and space protected behind walls.

However, the impact of these contacts on material culture, whether as a result of commerce or the transfer of people and ideas, is traceable through the archaeological record of all periods, beginning most notably at the transition from the 3rd to 2nd millennium BCE, and incorporating an area stretching from Syria and the Levant (al-Hajiri 2011; Hausleiter 2015c) to Egypt (see Sperveslage, this volume) and other parts of the Arabian Peninsula.

As evidenced by recent archaeometric analyses (Höppner *et al.* 2011; Liu *et al.* 2015; Renzi *et al.* 2016), Taymāʾ and the oasis of Qurayyah obtained raw materials for metallurgical production from various locations (including the Timna-Feynan area, the Arabian Shield, and the Oman Peninsula), which suggests strategies for the (indirect) exploitation of these resources. Thus, close relations between Northwest Arabia and the Southern Levant, as confirmed by Qurayyah Painted Ware (see Chan in preparation), must be seen as only one of several options available to these oases. Apparently, this advantageous position seems hardly to have been challenged during the transition from the Late Bronze to Iron Age, suggesting that the economic history of Taymāʾ was little affected by the Eastern Mediterranean collapse at the end of the Late Bronze Age.

Lastly, as to the larger context of the oasis and its hinterland, countless images, symbols, and

inscriptions have been and still continue to be discovered. It is the aim of a recently launched epigraphic and multidisciplinary reconnaissance unit to systematically collect and visually document data from rock art sites along former communication routes. In the long term, it is hoped to reconstruct movements of ancient groups with links to the oasis of Taymāʾ and other 'central places', so as to increase our insight into the use of trade routes and the movements of people. Although the general organisation of areas within this walled area seems clear (see above), a detailed history of the entire oasis and its vast surroundings still needs to be written.

Acknowledgments

Michele Dinies, Anja Prust, Dörte Rokitta-Krumnow, Alina Zur, Andrea Intilia, Sebastiano Lora, Christoph Purschwitz, Francelin Tourtet and Friedrich Weigel made valuable comments on this paper. The authors are indebted to Derek Kennet for providing bibliographical reference. Paul Larsen read and corrected the English language. The responsibility for the content of this contribution rests fully with the authors.

Arnulf Hausleiter
Deutsches Archäologisches Institut
Orient-Abteilung
Podbielskiallee 69-71
14195 Berlin
arnulf.hausleiter@dainst.de

Ricardo Eichmann
Deutsches Archäologisches Institut
Orient-Abteilung
Podbielskiallee 69-71
14195 Berlin
ricardo.eichmann@dainst.de

References

Abu al-Hassan, H.
2010 Le royaume de Lihyân, in: A. I. al-Ghabban – B. André-Salvini – F. Demange – C. Juvin – M. Cotty (Eds.), Routes d'Arabie. Archéologie et histoire du Royaume d'Arabie-Saoudite, Paris, 270–285.

Abu-Azizeh, W.
2015 Excavation of a cairn complex in Jabal al-Khraymât, Massif 22, loci 42000, in: L. Nehmé – W. Abu-Azizeh – T. Bauzou – C. Durand – J. Rohmer – I. as-Sabban – N. Delhopital – Kh. Alhaiti – M. al-Musa – Y. Gerber – J. Humbert – R. Douaud – M. al-Hajiri – J. Studer– L. Tholbecq – F. Villeneuve, Report on the Fifth Season (2014) of the Madâ'in Sâlih Achaeological Project, 2015, https://halshs.archives-ouvertes.fr/ halshs-01122002, 171–192 (accessed on July 4th, 2017).

Abu Duruk, H. I.
1988 Introduction to the archaeology of Tayma, Riyadh.
1989 A preliminary report on the Industrial Site excavation at Tayma, first season 1408 AH/1987 AD, Atlal – The journal of Saudi Arabian Archaeology 12, 9–19.
1990 A preliminary report on the Industrial Site excavation at Tayma, second season 1410 AH/1989 AD, Atlal – The journal of Saudi Arabian Archaeology 13, 9–19.
1996 A preliminary report on the industrial site excavation at Tayma, third season 1411AH/1990 AD, Atlal – The journal of Saudi Arabian Archaeology 14, 11–24.
2000 A preliminary report on the excavation and finds of the first Islamic site "Al-Bejidi" in Tayma, 1412 A.H./1992 A.D., Atlal – The journal of Saudi Arabian Archaeology 15, 7–26.

Abu Duruk, H. I. – Murad, A. J.
1985 Preliminary report on Qasr al-Hamra excavations, Tayma. The second season, 1404/1984, Atlal – The journal of Saudi Arabian Archaeology 9, 55–64.
1986 Preliminary report on Qasr al-Hamra excavations, Tayma. Third season, 1405/1985, Atlal – The journal of Saudi Arabian Archaeology 10, 29–35.
1988 Preliminary Report on Qasr al-Hamra excavations and explorations in Tayma‘ during the fourth (last) season 1406/1986, Atlal – The journal of Saudi Arabian Archaeology 11, 29–36.

Al-Ansary, A. – Abu al-Hassan, H.
2005 Tayma – Crossroads of Civilizations, Prominent Cities on the Frankincense Route Series 2, Riyadh.

Anderson, B.
2010 Achaemenid Arabia: A landscape-oriented model of cultural interaction, in: J. Curtis – St. J. Simpson (Eds.), The world of Achaemenid Persia: History, art and society in Iran and the Ancient Near East, London, 445–456.

Altheim, F. – Stiehl, R.
1973 Christentum am Roten Meer, vol. 2. Berlin – New York.

Avanzini, A. (Ed.)
1997 Profumi d’Arabia. Atti del convegno, Rome.

Bauer, Th.
1995 *s.v.* al-Samaw’al b. ʿĀdiyā, in: The Encyclopedia of Islam, New Edition, vol. VIII, Leiden, 1041–1042.

Bawden, G.
1981 Recent radiocarbon dates from Tayma, Atlal – The journal of Saudi Arabian Archaeology 5, 149–153.

Bawden, G. – Edens, Ch.
1988 Tayma Painted Ware and the Hejaz Iron Age ceramic tradition, Levant 20, 197–213.

Bawden, G. – Edens, Ch. – Miller, R.
1980 Preliminary archaeological investigations at Tayma, Atlal – The journal of Saudi Arabian Archaeology 4, 69–106.

Beaulieu, P.-A.
1989 The reign of *Nabonidus*, King of Babylon, 556–539 B.C., New Haven.

Bell, G. L.
1927 The letters of Gertrude Bell, New York.

Beuger, A.
2010 Salvage excavations at the burial site of Talaᶜ (Area S), in: R. Eichmann – A. Hausleiter – M. H. al-Najem – S. F. al-Said, Tayma 2004 (Autumn) and 2005 (Spring) – 2nd Report on the Joint Saudi Arabian-German Archaeological Project, Atlal – The journal of Saudi Arabian Archaeology 20, 133–137.

Beyer, K. – Livingstone, A.
1987 Die neuesten Inschriften aus Taima, Zeitschrift der Deutschen Morgenländischen Gesellschaft 137, 285–296.

Breeze, P. S. – Groucutt, H. S. – Drake, N. A. – White, T. S. – Jennings, R. P. – Petraglia, M. D.
2016 Palaeohydrological corridors for hominin dispersals in the Middle East ~250–70,000 years ago, Quarternary Science Reviews 144, 155–185.

Briquel-Chatonnet, F. – Robin, C.
1997 Catalogue des antiquités arabiques du Musée du Louvre: Objets d'Arabie nord-ouest, in: Y. Calvet – Ch. Robin (Eds.), Arabie heureuse - Arabie déserte. Les antiquités arabiques du Musée du Louvre, avec la collaboration de F. Briquel-Chatonnet et M. Pic, Paris, 260–269.

Brückner, H. – Engel, M. – Klasen, N. – Ginau, A. – Pint, A. – Frenzel, P. – Eichmann, R. – Hausleiter, A. – al-Najem, M. H. – al-Said, S. F.
2013 Late Quaternary environmental change and geochronology at Tayma, NW Saudi Arabia – Current research, in: A. R. al-Ansary – Kh. I. al-Muaikel – A. M. Alsharekh (Eds.), Man and environment in the Arab World in light of archaeological discoveries, Proceedings of the Symposium, 4–6 May 2010 (20–22 Jumada 1 1431 H), al-Jouf, Kingdom of Saudi Arabia, Riyadh, 53–58.

Buhl, F. – Bosworth, C. E.
2000 *s.v.* Taymā', in: The Encyclopaedia of Islam, New Edition, vol. X, Leiden, 401–402.

Cavigneaux, A. – Khalil Ismail, B.
1990 Die Statthalter von Suhu und Mari im 8. Jh. v. Chr., Baghdader Mitteilungen 21, 321–456.

Chan, A.
in preparation A historical perspective on the 'Midianite' question of Qurayyah Painted Ware.

Crassard, R. – Drechsler, Ph.
2013 Towards new paradigms: multiple pathways for the Arabian Neolithic, Arabian Archaeology and Epigraphy 24, 3–8.

Crassard, R. – Petraglia, M. D. – Parker, A. G. – Parton, A. – Roberts, R. G. – Jacobs, Z. – Alsharekh, A. – al-Omari, A. – Breeze, P. – Drake, N. A. – Groucutt, H. S. – Jennings, R. – Régagnon, E. – Shipton, C.
2013 Beyond the Levant: First Evidence of a Pre-Pottery Neolithic incursion into the Nefud Desert, Saudi Arabia, PLOS ONE 8 (7): e68061. doi: 10.1371/journal.pone.0068061.

Dalley, St.
1985 Stelae from Tayma and the god ṢLM (ṣalmu), Proceedings of the Seminar for Arabian Studies 35, 27–33.

D'Andrea, M.
2014 The Southern Levant in Early Bronze IV. Issues and perspectives in the pottery evidence, Contributi e Materiali di Archeologia Orientale XVII, Rome.

Daszkiewicz, M.
2014 Archaeometric analyses of Qurayyah Painted Ware from Tayma and Qurayyah, in: A. Hausleiter with a contribution by M. Daszkiewicz, Pottery groups of the late 2nd/Early 1st millennia BC in Northwest Arabia and new evidence from the excavations at Tayma, in: M. Luciani – A. Hausleiter (Eds.), Recent trends in the study of Late Bronze Age ceramics in Syro-Mesopotamia and neighbouring regions, Orient-Archäologie 32, Rahden/Westfalen, 409–413.

Department of Antiquities and Museums (Ed.)
1975 An introduction to Saudi Arabian Antiquities, Riyadh.

Deutsches Archäologisches Institut/DAI (Ed.)
2012 Deutsches Archäologisches Institut (Ed.), Jahresbericht 2011, Munich (published in 2013).

Dinies, M. – Neef, R. – Plessen, B. – Kürschner, H.
2015 When the desert was green. Grassland expansion during the early Holocene in north-western Arabia, Quarternary International 382, 293–302.
2016 Holocene vegetation, climate, land use and plant cultivation in the Tayma region, Northwestern Arabia, in: M. Luciani (Ed.), The archaeology of North Arabia – Oases and landscapes. Proceedings of the international congress held at the University of Vienna, 5–8 December, 2013, Oriental and European Archaeology 4, Vienna, 57–78.

Doughty, Ch. M.
1888 Travels in Arabia Deserta, Cambridge.

Drechsler, P.
2009 The dispersal of the Neolithic over the Arabian Peninsula. British Archaeological Reports, International Series 1969, Oxford.
2011 Places of contact, spheres of interaction. The 'Ubaid phenomenon in the central Gulf area as seen from a first season of reinvestigations at Dosariyah (Dawsāriyyah), Eastern province, Saudi Arabia, Proceedings of the Seminar for Arabian Studies 41, 1–14.

Edens, Ch. – Bawden, G.
1989 History of Tayma and Hejazi trade during the first millennium B.C., Journal of the Economy and Social History of the Orient 32, 48–103.

Edens, Ch. – Wilkinson, T. J. – Barratt, G.
2000 Hammat al-Qa: an early town in southern Arabia, Antiquity 74, 854–862.

Eichmann, R.
2009 Remains of the pre-Islamic period at Taymā', in: J. Schiettecatte in collaboration with Ch.-J. Robin (Eds.), L'Arabie à la veille de l'Islam. Bilan clinique, Table ronde tenue au Collège de France (Paris) les 28 et 29 août 2006 dans le cadre du projet de l'Agence nationale de la recherche "De l'Antiquité tardive à l'Islam", Orient et Méditerranée 3, Paris, 56–66.
2011 Die archäologische Erforschung der Arabischen Halbinsel. Europäische Beiträge zur internationalen Forschung insbesondere in Zentral- und Nordwestarabien, in: U. Franke – J. Gierlichs (Eds.), in collaboration with S. Vassilopoulou – L. Wagner, Roads of Arabia – The Archaeological Treasures of Saudi Arabia, Berlin, 48–57.

Eichmann, R. – Schaudig, H. – Hausleiter, A.
2006a Archaeology and Epigraphy at Tayma, Saudi Arabia, Arabian Archaeology and Epigraphy 17, 163–176.

Eichmann, R. – Hausleiter, A. – al-Najem, M. H. – al-Said, S. F.
2006b Tayma – Spring 2004, Report on the Joint Saudi Arabian-German Archaeological Project, Atlal – The journal of Saudi Arabian Archaeology 19, 91–116.
2010 Tayma 2004 (Autumn) and 2005 (Spring) – 2nd Report on the Joint Saudi Arabian-German Archaeological Project, Atlal – The journal of Saudi Arabian Archaeology 20, 104–147.

2011 Tayma – 2005 (Spring) and 2006 (Spring and Autumn) – 3rd Report on the Joint Saudi Arabian-German Archaeological Project, Atlal – The journal of Saudi Arabian Archaeology 21, 61–118.
2012 Tayma 2007 – 4th Report on the Joint Saudi Arabian-German Archaeological Project, Atlal – The journal of Saudi Arabian Archaeology 22, 72–117.

Engel, M. – Brückner, H. – Pint, A. – Wellbrock, K. – Ginau, A. – Voß, P. – Grottker, M. – Klasen, N. – Frenzel, P.
2012 The early Holocene humid period in NW Saudi Arabia: sediments, microfossils, and palaeo-hydrological modeling, Quaternary International 266, 131–141.

Eph'al, I.
1982 The Ancient Arabs. Nomads on the borders of the Fertile Crescent 9th–5th centuries B.C., Jerusalem.

Euting, J.
1896 Tagebuch einer Reise nach Inner-Arabien, Theil I, herausgegeben von E. Littmann, Leiden.
1914 Tagebuch einer Reise nach Inner-Arabien, Theil II, herausgegeben von E. Littmann, Leiden.

Fedele, F. G.
2014 Camels, donkeys and caravan trade: an emerging context from Barāqish, ancient Yathill (Wādī al-Jawf, Yemen), Anthropozoologica 49, 177–194.

Frame, G.
1995 Rulers of Babylonia – From the second dynasty of Isin to the end of Assyrian domination (1157–612 BC), The Royal Inscriptions of Mesopotamia, Babylonian Periods 2, Toronto.

Franke, U. – Gierlichs, J. (Eds.) in collaboration with S. Vassilopoulou – L. Wagner
2011 Roads of Arabia – The archaeological treasures of Saudi Arabia, Berlin.

Fujii, S.
2016 Wadi Ghubai and Wadi Mohorak sites: Protohistoric burial fields in the Tabuk Province, Northwestern Arabia, in: M. Luciani (Ed.), The Archaeology of North Arabia – Oases and landscapes. Proceedings of the international congress held at the University of Vienna, 5-8 December, 2013, Oriental and European Archaeology 4, Vienna, 115–134.

Gebel, H. G. K.
2016 The socio-hydraulic foundations of oasis life in NW Arabia: The 5th millennium BCE shepherd environs of Rajajil, Rasif and Qulban Beni Murra, in: M. Luciani (Ed.), The archaeology of North Arabia – Oases and landscapes. Proceedings of the international congress held at the University of Vienna, 5-8 December, 2013, Oriental and European Archaeology 4, Vienna, 79–113.

Gebel, H. G. K. – Mahasneh, H. M.
2012 Qulban Beni Murra – Unknown Mid-Holocene sepulchral green desert landscapes, pastoral well cultures, and the origins of Arabia's oasis economies, in: F. Klimscha – R. Eichmann – C. Schuler – H. Fahlbusch (Eds.), Wasserwirtschaftliche Innovationen im archäologischen Kontext – von den prähistorischen Anfängen zu den Metropolen der Antike, Forschungscluster 2. Innovationen technisch – sozial, Menschen – Kulturen – Traditionen, Forschungscluster des DAI 5, Berlin, 101–122.

Gernez, G.
2008 L'armement en métal au Proche et Moyen-Orient des origines à 1750 av. J.-C. (PhD thesis, Université de Paris 1 Panthéon-Sorbonne 2008). Online <https://tel.archives-ouvertes.fr/tel-00339404/> (accessed on July, 4th, 2017).

al-Ghabban, A. I.
2010 The Kingdom of Saudi Arabia and its heritage, in: A. al-Ghabban – B. André-Salvini – F. Demange – C. Juvin – M. Cotty (Eds.), Routes d'Arabie. Archéologie et histoire du Royaume Arabie-Saoudite, Paris, 34–43.
2013 Discovering Saudi Arabia, Land of Dialogue and Culture, Rome.

al-Ghabban, A. I. – André-Salvini, B. – Demange, F. – Juvin, C. – Cotty, M. (Eds.)
2010 Routes d'Arabie. Archéologie et histoire du Royaume Arabie-Saoudite, Paris.

Graf, D.
1990 Arabia during Achaemenid times, in: H. Sancisi-Weerdenburg – A. Kuhrt (Eds.), Centre and periphery, Proceedings of the Groningen 1986 Achaemenid History Workshop, Achaemenid history IV, Leiden, 131–148.

Haibt, M.
2013 Chalcolithic bead makers of Tayma (unpublished bachelor thesis, Freie Universität Berlin).
2018 The eastern sabkha of Tayma (unpublished master thesis, Freie Universität Berlin).

al-Hajiri, M.
2011 Syro-Levantine Bronze Weapons from Tayma', in: U. Franke – J. Gierlichs (Eds.), in collaboration with S. Vassilopoulou – L. Wagner, Roads of Arabia – The archaeological treasures of Saudi Arabia, Berlin, 112.

al-Hajri, M.
2002 Tayma Excavations, Rujoum Sasa, first season 1418, Atlal – The journal of Saudi Arabian Archaeology 17, 23–25.
2006 Brief Report on the Excavations at the Industrial Site in Tayma, Atlal – The journal of Saudi Arabian Archaeology 19, 21–26.

al-Hajri, M. – al-Mutlaq, M. – Hashim, A. – al-Shama'n, S. – al-Najam, S. F. – al-Helwa, S. – al-Radhiyan, S.
2005 Archaeological excavations at the site of Rujoum Saʿsaʿ, Tayma, Atlal – The journal of Saudi Arabian Archaeology 18, 23–27.

Hashim, S. A.
2000 A preliminary study of pottery from Al-Bujidi site (1412/1992), Atlal – The journal of Saudi Arabian Archaeology 15, 34–44.
2007 Pre-Islamic ceramics in Saudi Arabia: The chronological and typological study of ceramics technology and craft production discovered in Saudi Arabia from the Neolithic period to the dawn of Islam, Riyadh.

Hausleiter, A.
2010a L'oasis de Taymâ', in: A. al-Ghabban – B. André-Salvini – F. Demange – C. Juvin – M. Cotty (Eds.), Routes d'Arabie. Archéologie et histoire du Royaume Arabie-Saoudite, Paris, 218–239.
2010b La céramique du début de l'âge du fer, in: A. al-Ghabban – B. André-Salvini – F. Demange – C. Juvin – M. Cotty (Eds.), Routes d'Arabie. Archéologie et histoire du Royaume Arabie-Saoudite, Paris, 240.
2011 Ancient Tayma'. An oasis at the interface between cultures. New research at a

key location on the caravan road, in: U. Franke – J. Gierlichs (Eds.), in collaboration with S. Vassilopoulou – L. Wagner, Roads of Arabia – The archaeological treasures of Saudi Arabia, Berlin, 102–120.

2012a Divine representations at Tayma', in: I. Sachet (Ed.) en collaboration avec Ch. Robin, Dieux et déesses d'Arabie – Images et représentations, Actes de la table ronde tenue au Collège de France (Paris) les 1er et 2 octobre 2007, Orient et Méditerranée 7, Paris, 299–338.

2012b North Arabian Kingdoms, in: D. T. Potts (Ed.), A Companion to the Archaeology of the Ancient Near East, Chichester, 816–832.

2014 with a contribution by M. Daszkiewicz, Pottery groups of the late 2nd/Early 1st millennia BC in Northwest Arabia and new evidence from the excavations at Tayma, in: M. Luciani – A. Hausleiter (Eds.), Recent trends in the study of Late Bronze Age ceramics in Syro- Mesopotamia and neighbouring regions, Orient-Archäologie 32, Rahden/Westfalen, 399–434.

2015a Tayma, Saudi-Arabien, Multidisziplinäre Forschungen in der Oase. Die Arbeiten der Jahre 2012 bis 2014, in: Deutsches Archäologisches Institut (Ed.), e-Forschungsberichte 2015, Faszikel 2, 63–70.

2015b Tayma, Saudi-Arabien, Bauwerkserhaltung. Die Arbeiten der Jahre 2012-14, in: Deutsches Archäologisches Institut (Ed.), e-Forschungsberichte 2015, Faszikel 2, 71–73.

2015c Tayma, Saudi-Arabien, Rettungsgrabungen im Gräberfeld von al-Nasim. Die Arbeiten des Jahres 2014, in: Deutsches Archäologisches Institut (Ed.), e-Forschungsberichte 2015, Faszikel 2, 74–76.

2016a with a contribution by M. Münzner, Preserving cultural heritage at Tayma, Northwest Arabia: The architectural remains, Berlin.

2016b Tayma, Saudi-Arabien, Multidisziplinäre Forschungen in der Oase. Die Arbeiten des Jahres 2015, in: Deutsches Archäologisches Institut (Ed.), e-Forschungsberichte 2016, Faszikel 3, 147–154.

2017 Tayma, Saudi-Arabien. Survey in Rujum Saʿsaʿ. Die Arbeiten des Jahres 2016, e-Forschungsberichte des Deutschen Archäologischen Instituts 2017-1, 105–113.

2018 The outer wall of Taymāʾand its dating to the Bronze Age, in: L. Nehmé – A. al-Jallad (Eds.), To the Madbar and Back Again. Studies in the Languages, Archaeology, and Cultures of Arabia to Michael C. A. Macdonald, Studies in Semitic Languages and Linguistics 92, Leiden, 361–391.

in press a Cultural contacts, transfer of images and ideas: On 1st millennium BCE funerary stelae from Tayma.

in press b Statuen der Zeit der Dynastie von Liḥyān (6.-2. Jh. v. Chr.?) aus Dadan und Taymāʾ, Nordwest-Arabien, im archäologischen Kontext.

in press c A carved bird representation from Tayma, Northwest Arabia. Syro-Mesopotamian, Egyptian and local iconographic traditions, in G. J. Selz – K. Wagensonner (Eds.), Kunstgeschichte(n), Festschrift für Erika Bleibtreu, Wiener Offene Orientalistik.

Hausleiter, A. – al-Najem, M. H. (Eds.)

2016 Tayma 2016 – Spring season – 3rd weekly report (unpublished working report).

Hausleiter, A. – Schaudig, H.

2010a Stèle cintrée de Nabonide, roi de Babylone, in: A. al-Ghabban – B. André-Salvini – F. Demange – C. Juvin – M. Cotty (Eds.), Routes d'Arabie. Archéologie et histoire du Royaume Arabie-Saoudite, Paris, 252–253.

2010b Objet en forme de disque portant une inscription du roi Nabonide, in: A. al-Ghabban – B. André-Salvini – F. Demange – C. Juvin – M. Cotty (Eds.), Routes d'Arabie. Archéologie et histoire du Royaume Arabie-Saoudite, Paris, 253.

2016 Rock relief and cuneiform inscription of King Nabonidus at al-Ḥāʾiṭ (Province of Ḥāʾil, Saudi Arabia), ancient Padakku, Zeitschrift für Orient-Archäologie 9, 224–240.

Hausleiter, A. – Zur, A.
2016 Tayma' in the Bronze Age (c. 2,000 BCE): Settlement and funerary landscapes, in: M. Luciani (Ed.), The archaeology of North Arabia – oases and landscapes. Proceedings of the international congress held at the University of Vienna, 5-8 December, 2013, Oriental and European Archaeology 4, Vienna, 135–173.

Hausleiter, A. – Eichmann, R. – al-Najem, M. H. – al-Said, S. F.
2017 Tayma 2008 – 5th Report on the Saudi Arabian-German Archaeological Project, Atlal – Journal of Saudi Arabian Archaeology 24, 31–78.
in press a Tayma 2009 – 6th Report on the Joint Saudi Arabian-German Archaeological Project, Atlal – Journal of Saudi Arabian Archaeology.
in press b Tayma 2010 – 7th report on the Joint Saudi Arabian-German Archaeological Project, Atlal – Journal of Saudi Arabian Archaeology.
in press c Tayma 2011 – 8th report on the Joint Saudi Arabian-German Archaeological Project, Atlal – Journal of Saudi Arabian Archaeology.
in press d Tayma 2012-13 – 9th – 10th report on the Joint Saudi Arabian-German Archaeological Project, Atlal – Journal of Saudi Arabian Archaeology.
in press e Tayma 2014 – Excavations at al-Nasim, 11th report on the Joint Saudi Arabian-German Archaeological Project, Atlal – Journal of Saudi Arabian Archaeology.
in press f Tayma 2014-15 – 12th – 13th report on the Joint Saudi Arabian-German Archaeological Project, Atlal – Journal of Saudi Arabian Archaeology.
in press g Tayma 2016-17 – 14th – 15th report on the Joint Saudi Arabian-German Archaeological Project, Atlal – Journal of Saudi Arabian Archaeology.

Höppner, B. – Lockhoff, N. – Pernicka, E.
2011 Chemische und bleiisotopische Zusammensetzung von zwei Metallobjekten aus Tayma (Unpublished Report).

Hoyland, R.
2001 Arabia and the Arabs – from the Bronze Age to the coming of Islam, London.

Huber, B.
2015 Pyrotechnology in Northwest Arabia: Construction, technology, and interpretation of the oven in Building E-b1 at Tayma (unpublished bachelor thesis, Freie Universität Berlin).

Huber, B. – Hausleiter, A. – Dinies, M. - Christopher, J. – Säumel, I. – Pham, Th. L. H.
2018 An archaeology of odours. Chemical evidence of ancient aromatics at the oasis of Tayma, NW Arabia. Poster presented at the 11th International Congress on the Archaeology of the Ancient Near East, Munich, 3–7 April 2018.

Huber, Ch.
1891 Journal d'un voyage en Arabie, Paris.

Inglis, R. – Sinclair, A. – Shuttleworth, A. – Alsharekh, A. – Deviès, M. – al Ghamdi, S. – Meredith-Williams, M. – Bailey, G.
2014 Investigating the Palaeolithic landscapes and archaeology of the Jizan and Asir regions, south-western Saudi Arabia, Proceedings of the Seminar for Arabian Studies 44, 193–212.

Ingraham, M. L. – Johnson, T. D. – Rihani, B. – Shatla, I.
1981 Comprehensive archaeological survey program: Preliminary report on a reconnaissance survey of the northwestern province (with a note on a brief survey of the northern province), Atlal – The journal of Saudi Arabian Archaeology 5, 59–84.

Intilia, A.
2010 Area C, in: R. Eichmann – A. Hausleiter – M. H. Najem – S. F. al-Said, Tayma 2004 (Autumn) and 2005 (Spring) – 2nd report on the Joint Saudi Arabian-German Archaeological Project, Atlal – The journal of Saudi Arabian Archaeology 20, 109–116.
2016 Qurayyah Painted Ware: a reassessment of 40 years of research on its origins, chronology and distribution, in: M. Luciani (Ed.), The Archaeology of North Arabia – Oases and land scapes. Proceedings of the international congress held at the University of Vienna, 5-8 December, 2013, Oriental and European Archaeology 4, Vienna, 175–255.

Jacobs, B. – Macdonald, M. C. A.
2009 Felszeichnung eines Reiters aus der Umgebung von Taymā', Zeitschrift für Orient-Archäologie 2, 346–376.

Jaussen, A. – Savignac, R.
1909–1922 Mission archéologique en Arabie, vols. 1–3 (Reprint of the 1909–1922 edition), Cairo 1997.

Kainert, C. – Drechsler, P.
2014 An interplay of imports and local traditions? The pottery assemblage from Dosariyah, Saudi Arabia, Proceedings of the Seminar for Arabian Studies 44, 213–226.

Kennedy, D.
2011 The "Works of the Old Men" in Arabia. Remote sensing in interior Arabia, Journal of Archaeological Science 38, 3185–3203.

Kennet, D.
2005 On the eve of Islam: archaeological evidence from Eastern Arabia, Antiquity 79, 107–118.

al-Khowaiter, A.
1977 Foreword, Atlal – The journal of Saudi Arabian Archaeology 1, 5.

Klasen, N. – Engel, M. – Brückner, H. – Hausleiter, A. – Intilia, A. – Eichmann, R. – al-Najem, M. H. – al-Said, S. F.
2011 Optically stimulated luminescence dating of the city wall system of ancient Tayma (NW Saudi Arabia), Journal of Archaeological Science 38, 1818–1826.

Knop, C. – Hausleiter, A.
2016 Tayma, Saudi-Arabien: Bauforschung am Qasr al-Radm. Die Arbeiten der Jahre 2013 bis 2015, in: Deutsches Archäologisches Institut (Ed.), e-Forschungsberichte 2016, Faszikel 3, 155–160.

Liu, S. – Rehren, T. – Pernicka, E. – Hausleiter, A.
2015 Copper processing in the oases of northwest Arabia. Technology, alloys and provenance, Journal of Archaeological Science 53, 492–503.

Livingstone, A. – Spaie, B. – Ibrahim, M. – Kamal, M. – Taimani, S.
1983 Taimā': Recent soundings and inscribed material, Atlal – The journal of Saudi Arabian Archaeology 7, 102–116.

Lora, S.
2017 A Religious Building Complex in the Ancient Settlement of Tayma (North-West Arabia) During the Nabataean Period: Changes and Transformations, in:

C. Durand – L. Tholbecq (Eds.), Archéologie des rituels dans le monde nabatéen: recherches récentes. Actes de la table-ronde tenue à l'Institut français du Proche-Orient, Amman 17 septembre 2015, Syria 94, 17–39.

Lora, S. – Petiti, E. – Hausleiter, A.
2010 Burial contexts at Tayma, NW Arabia. Archaeological and anthropological data, in: L. Weeks (Ed.), Death and burial in Arabia and beyond. Multidisciplinary perspectives, British Archaeological Reports International Series 2107, Oxford, 237–247.

Loreto, R.
2017 Alle origini degli Arabi. Un viaggio nell'archeologia dell'Arabia Saudita, Rome.

Luciani, M.
2016 Mobility, contacts and the definition of culture(s) in new archaeological research in Northwest Arabia, in: M. Luciani (Ed.), The Archaeology of North Arabia – Oases and landscapes. Proceedings of the international congress held at the University of Vienna, 5–8 December, 2013, Oriental and European Archaeology 4, Vienna, 21–56.

Luciani, M. (Ed.)
2016 The Archaeology of North Arabia – Oases and landscapes. Proceedings of the international congress held at the University of Vienna, 5–8 December, 2013, Oriental and European Archaeology 4, Vienna.

Luciani, M. – Alsaud, A. S.
2018 The new archaeological joint project on the site of Qurayyah, northwest Arabia: Results of the first two excavation seasons. Proceedings of the Seminar for Arabian Studies 48, 165–184.

Luciani, M. – Binder, M. – Alsaud, A. S.
2018 Life and living conditions in northwest Arabia during the Bronze Age: First results of the bioarchaeological work at Qurayyah. Proceedings of the Seminar for Arabian Studies 48, 185–200.

Macdonald, M. C. A.
1995 North Arabia in the first millennium BCE, in: J. M. Sasson (Ed.), Civilizations of the Ancient Near East, vol. III, New York, 1351–1369.
1997 Trade routes and trade goods at the northern end of the 'Incense Road' in the first millennium B.C., in: A. Avanzini (Ed.), Profumi d'Arabia. Atti del convegno, Rome, 333–349.
2004 Ancient North Arabian, in: R. D. Woodard (Ed.), The Cambridge Encyclopedia of the World's Ancient Languages, Cambridge, 488–533.
in press Taymāʾ Aramaic, Nabataean, and Taymanitic inscriptions from the Saudi-German excavations at Taymāʾ 2004–2015, in: M. C. A. Macdonald, Taymāʾ II – Catalogue of inscriptions discovered in the Saudi-German excavations, at Taymāʾ, Berlin – Oxford.

Macdonald, M. C. A. – al-Najem, M. H.
in press Taymāʾ III – Catalogue of inscriptions in the Taymāʾ Museum, Berlin – Oxford.

Magee, P.
2014 The archaeology of prehistoric Arabia – Adaptation and social formation from the Neolithic to the Iron Age Arabia, Cambridge.
2015 When was the dromedary domesticated in the Ancient Near East?, Zeitschrift für Orient-Archäologie 8, 252–277.

Maraqten, M.
1996 The Aramaic pantheon of Tayma', Arabian Archaeology and Epigraphy 7, 17–31.

Maritan, L. – Tourtet, F. – Meneghin, G. – Mazzoli, C. – Hausleiter, A.
2017 Technological transfer? Comparative analysis of 2nd–3rd/4th century CE "Late Roman" pottery from Taymāʾ, Saudi Arabia, and Petra, Jordan, Journal of Archaeological Science, Reports 12, 712–725.

Maritan, L. – Mazzoli, C. – Tourtet, F. – Hausleiter, A.
in press Pottery Analysis, in: R. Eichmann – A. Hausleiter – M. H. al-Najem – S. F. al-Said, Tayma 2009 – 6th report on the Joint Saudi Arabian-German Archaeological Project, Atlal – The journal of Saudi Arabian Archaeology.

Masetti Rouault, M. – Rouault, O.
2016 A view from the bridge: Notes about the Assyrian Empire economic system, as seen from Tell Masaikh (Lower Syrian Middle Euphrates Valley), in: I. Finkelstein – T. Römer – C. Robin (Eds.), Alphabets, texts and artefacts in the Ancient Near East, Studies presented to Benjamin Sass, Paris, 395–420.

al-Masry, A.
1977a Preface, Atlal – The journal of Saudi Arabian Archaeology 1, 7.
1977b The historic legacy of Saudi Arabia, Atlal – The journal of Saudi Arabian Archaeology 1, 9–19.

Müller, W. W. – al-Said, S. F.
2002 Der babylonische König Nabonid in taymanischen Inschriften, in: N. Nebes (Ed.), Neue Beiträge zur Semitistik, Jenaer Beiträge zum Vorderen Orient 5, Wiesbaden, 105–122.

Moreh, S.
1972 *s.v.* Samuel ibn ʿĀdiyā, in: Encyclopedia Judaica 14, 819.

al-Najem, M. H. – Macdonald, M. C. A.
2009 A new Nabataean inscription from Taymā', Arabian Archaeology and Epigraphy 20, 208–217.

Nebes, N.
2007 Ita'amar der Sabäer: Zur Datierung der Monumentalinschrift des Yitaʿʾamar aus Sirwah, Arabian Archaeology and Epigraphy 18, 25–33.
2016 Der Tatenbericht des Yiṯaʿʾamar Watar bin Yakrubmalik aus Ṣirwāḥ. Zur Geschichte Südarabiens im frühen 1. Jt. v. Christus. Mit einem archäologischen Beitrag von I. Gerlach – M. Schnelle, Epigraphische Forschungen auf der Arabischen Halbinsel 7, Tübingen – Berlin.

Nehmé, L. – Abu-Azizeh, W. – Bauzou, T. – Durand, C. – Rohmer, J. – as-Sabban, I. – Delhopital, N. – Alhaiti, Kh. – al-Musa, M. – Gerber, Y. – Humbert, J. – Douaud, R. – al-Hajiri, M. – Studer, J. – Tholbecq, L. – Villeneuve, F.
2015 Report on the Fifth Season (2014) of the Madâ'in Sâlih Archaeological Project, https://halshs.archives-ouvertes.fr/ halshs-01122002 (accessed on July, 4th, 2017).

Niehr, H. (Ed.)
2014 The Aramaeans in Ancient Syria, Handbuch der Orientalistik I/106, Leiden – Boston.

Northedge, A.
2008 The Umayyad Desert Castles and Pre-Islamic Arabia, in: K. Bartl – A. Moaz (Eds.), Residences, castles, settlements: transformation processes from late

antiquity to early Islam in Bilad al-Sham, Proceedings of the international conference held at Damascus, 5–9 November 2006, Orient-Archäologie 23, Rahden/Westfalen, 243–259.

Parr, P. J.
1988 Pottery of the late second millennium B.C. in North West Arabia and its historical implications, in: D. T. Potts (Ed.), Araby the blest. Studies in Arabian archaeology, Carsten Niebuhr Institute Publications 7,Copenhagen, 73–90.
1989 Aspects of the archaeology of North Arabia during the 1st millennium BC, in: T. Fahd (Ed.), L'Arabie préislamique et son environnement historique et culturel, Actes du colloque du Strasbourg, 24–27 juin 1987, Leiden, 39–66.

Parr, P. J. – Harding, G. L. – Dayton, J. E.
1970 Preliminary survey in N.W. Arabia, 1968, Institute of Archaeology – Bulletin 8/9, 193–242.
1972 with contributions by A. F. L. Beeston – T. J. Milik, Preliminary survey in N.W. Arabia, 1968 – Part 2, Institute of Archaeology – Bulletin 10, 23–61.

Petiti, E.
2013 People of Tayma. Bioarchaeological analyses of the 4th/3rd century B.C. burial ground from Tayma (Kingdom of Saudi Arabia), Universita degli Studi di Firenze, Florence.

Petiti, E. – Intilia, A. – Hausleiter, A.
2014 Bioarchaeological investigations at a 4th – 3rd century BC cemetery at Tayma, North-West Arabia, in: P. Bieliński – M. Gawlikowski – R. Koliński – D. Ławecka – A. Sołtysiak – Z. Wygnańska (Eds.), Proceedings of the 8th International Congress on the Archaeology of the Ancient Near East 30 April–4 May 2012, University of Warsaw, vol. 3, Wiesbaden, 371–390.

Petraglia, M. D.
2017 Palaeodeserts. Climate change and hominin evolution in the Arabian Desert, www.palaeodeserts.org (accessed on July, 4th, 2017).

Petraglia, M. D. – Groucutt, H. – Parton, A. – Alsharekh, A. (Eds.)
2015 Green Arabia. Human Prehistory at the Crossroads of Continents, Quarternary International 382, 1–302.

Peltenburg, E.
1977 A faience from Hala Sultan Tekke and Second Millennium B.C. Western Asiatic pendants depicting females, in: P. Åström – G. Hult – M. Strandberg Olofsson, Hala Sultan Tekke 3 – Excavations 1972, Göteborg, 177–200.

Pfälzner, P. – al-Maqdissi, M. (Eds.)
2015 Qaṭna and the Networks of Bronze Age Globalism. Proceedings of an international conference in Stuttgart and Tübingen in October 2009, Wiesbaden.

Philby, H. StJ. B.
1957 The land of Midian, London.

Philip, G.
1995 Warrior Burials in the Ancient Near-Eastern Bronze Age. The evidence from Mesopotamia, Western Iran and Syria-Palestine, in: St. Cambell – A. Green (Eds.), The archaeology of death in the Ancient Near East, Oxford, 140–154.

Potts, D. T.
2011 Old Arabia in historic sources, in: U. Franke – J. Gierlichs (Eds.), in collaboration with S. Vassilopoulou – L. Wagner, Roads of Arabia - Archaeological treasures of Saudi Arabia, Berlin, 86–101.
2012 *s.v.* Donkey ii. Domestication in Iran. Encyclopædia Iranica, online edition, 2012, available at http://www.iranicaonline.org/articles/donkey-ii (accessed on July, 4th, 2017).
in press Medes in the desert: Thoughts on the mounted archer near Taym ā', in: R. Loreto (Ed.), Memorial volume for Alessandro De Maigret.

Prust, A. – Hausleiter, A.
in press Camel exploitation in the oasis of Taymā' – Caravan or consumption?, in: D. Agut – B. Redon (Eds.), Proceedings of the colloquium "Les vaisseaux du désert: Presence et usages du chameau (Camelus dromedarius) entre le Tigre et le Nil du milieu du 1er millénnaire av. J.-C. à l'époque romaine".

Purschwitz, C.
2017 The Prehistory of Tayma: The chipped stone evidence. The surface finds and a techno-typological analysis of chert artefacts from the carnelian bead workshop SE2, Zeitschrift für Orient-Archäologie 10, 288–311.
in press Residential Architecture in Areas F and E-South, 2005–2009. Stratigraphy, Chronology and Development from the Late Iron Age to Pre-Islamic Times, in: A. Hausleiter – R. Eichmann – M. H. al-Najem (Eds.), Taymā' IV.

Radner, K. (Ed.)
2014 State Archive of Assyria Online (SAAo), http://oracc.museum.upenn.edu/saao/ (accessed on July, 4th, 2017).

Renzi, M. – Intilia, A. – Hausleiter, A. – Rehren, T.
2016 Early Iron Age metal circulation in the Arabian Peninsula. The oasis of Taymāʾ as part of a dynamic network, Proceedings of the Seminar for Arabian Studies 46, 237–246.

Retsö, J.
2003 The Arabs in antiquity. Their history from the Assyrians to the Umayyads, London – New York.

Rhotert, H.
1938 Transjordanien: vorgeschichtliche Forschungen. Mit Beiträgen von F. M.Th. Böhl und K. Willmann, Stuttgart.

Robin, C.
2008 La lecture et l'interprétation de l'abécédaire Ra's Shamra 88.2215. La preuve par l'Arabie?, in: C. Roche (Ed.), D'Ougarit à Jérusalem: recueil d'études épigraphiques et archéologiques offert à Pierre Bordreuil, Orient et Méditerranée 2, Paris, 233–244.

Rohmer, J.
2016 A revised chronological framework for Northwest Arabia in the late 1st millennium BC. New evidence from excavations in the al-Ula region, Paper presented at the workshop "Archaeology of the Arabian Peninsula: Connecting the Evidence", 10th International Congress on the Archaeology of the Ancient Near East, Vienna, Apil 25th–29th, 2016, Abstract Booklet, Vienna, 187.

Rohmer, J. – Charloux, G.
2015 From Lihyan to the Nabataeans: Dating the end of the Iron Age in Northwest Arabia, Proceedings of the Seminar for Arabian Studies 45, 297–320.

Rollefson, G. O. – Rowan, Y. – Wasse, A. – Hill, A. C. – Kersel, M. – Lorentzen, B. – al-Bashaireh, K. – Ramsay, J.
2016 Investigations of a Late Neolithic Structure at Mesa 7, Wadi al-Qattafi, Black Desert, 2015, Neo-Lithics 1/16, 3–12.

Rossel, S. – Marshall, F. – Peters, J. – Pilgram, T. – Adams, M. D. – O'Connor, D.
2008 Domestication of the donkey: Timing, processes, and indicators, Proceedings of the National Academy of Sciences of the United States of America 105, 3715–3720.

Rowan, Y. – Wasse, A. M. R. – Rollefson, G. O. – Kersel, M. M. – Jones, M. D. – Lorentzen, B.
2015 Late Neolithic Architectural Complexity at Wisad Pools, Black Desert, Neo-Lithics 1/15, 3–10.

al-Said, S. F.
2009 Eine neu entdeckte Erwähnung des Königs Nabonid in den thamudischen Inschriften, Zeitschrift für Orient-Archäologie 2, 358–363.
2010a Dédân (al-Ula), in: A. al-Ghabban – B. André-Salvini – F. Demange – C. Juvin – M. Cotty (Eds.), Routes d'Arabie. Archéologie et histoire du Royaume Arabie-Saoudite, Paris, 262–269.
2010b La sculpture en pierre (with catalogue nos. 111–116), in: A. al-Ghabban – B. André-Salvini – F. Demange – C. Juvin – M. Cotty (Eds.), Routes d'Arabie. Archéologie et histoire du Royaume Arabie-Saoudite, Paris, 276–281.

al-Salook, M.
2000 Kufic inscriptions from Tayma, Atlal – The journal of Saudi Arabian Archaeology 15, 27–33.

Sass, B.
2015 A seal impression with Arabian legend on a Tell Sheikh Hamad tablet, Notes Assyriologiques Brèves et Utilitaires 2015/3, no. 80, 132–134.

Schaudig, H.
2001 Die Inschriften Nabonids und Kyros' des Großen. Textausgabe und Grammatik, Alter Orient und Altes Testament 256, Münster.
in press Cuneiform texts from Tayma, in: M. C. A. Macdonald, Taymāʾ II – Catalogue of the inscriptions discovered in the Saudi-German excavations at Taymāʾ, Berlin – Oxford.

Schiettecatte, J.
2010 The Arabian Iron Age funerary stelae and the issue of cross-cultural contacts, in: L. Weeks (Ed.), Death and burial in Arabia and Beyond. Multidisciplinary perspectives, British Archaeological Reports International Series 2107, Oxford, 191–203.

Schneider, P. I.
2010 Die Mauern von Tayma, in: J. Lorentzen – F. Pirson – P. Schneider – U. Wulf-Rheidt (Eds.), Aktuelle Forschungen zur Konstruktion, Funktion und Semantik antiker Stadtbefestigungen, Kolloquium 9./10. Februar 2007 in Istanbul, BYZAS, Veröffentlichungen des Deutschen Archäologischen Instituts Istanbul 10, Istanbul, 1–25.
2016 Tayma, in: S. Müth – P. Schneider – M. Schnelle – P. De Staebler (Eds.), Ancient fortifications – A compendium of theory and practice, Oxford, 343–352.

Somaglino, C. – Tallet, P.
2013 A road to the Arabian Peninsula in the reign of Ramesses III, in: F. Förster – H. Riemer (Eds.), Desert road archaeology, Africa Praehistorica 27, Cologne, 511–519.

Sperveslage, G.
2013 Ägyptische Einflüsse auf der Arabischen Halbinsel in vorislamischer Zeit am Beispiel der Oase von Tayma, Zeitschrift für Orient-Archäologie 6, 234–252.
2014 Ägypten und Arabien. Ein Beitrag zu den interkulturellen Beziehungen Altägyptens (Unpublished PhD Dissertation, Freie Universität Berlin).
2016 Intercultural contacts between Egypt and the Arabian Peninsula at the turn of the 2nd to 1st millennium BCE, in: J. C. Moreno Garcia (Ed.), Dynamics of production in the Ancient Near East 1300-500 BC, Oxford, 303–330.

Sperveslage, G. – Eichmann, R.
2012 Egyptian cultural impact on North-West Arabia in the second and first millennia BC, Proceedings of the Seminar for Arabian Studies 42, 371–384.

Stein, P.
2014 Ein Aramäischer Kudurru aus Taymâ'?, in: M. Krebernik – H. Neumann (Eds.), Babylonien und seine Nachbarn in neu- und spätbabylonischer Zeit, Wissenschaftliches Kolloquium aus Anlass des 75. Geburtstages von Prof. Dr. Joachim Oelsner. Jena, 2. und 3. März 2007, Alter Orient und Altes Testament 369, Münster, 219–245.
in press Die reichsaramäischen Inschriften der Kampagnen 2005–2009 aus Taymāʾ, in: M. C. A. Macdonald, Taymā' II – Catalogue of the Inscriptions discovered in the Saudi-German excavations at Taymāʾ, Berlin – Oxford.

al-Taimā'i, M. H. S.
1998 Taimā', Haḏi Bilādenā, vol. 30, Riyadh.
2005 Bir Hadaj, Riyadh.
2006 Mintiqat rujum saʿsaʿ bi-taymāʾ – dirasat al-madaniyyah, Riyadh.

Tourtet, F.
in preparation Pottery at the oasis of Tayma (Kingdom of Saudi Arabia): Chronological, Typological and Technological Studies (PhD Dissertation, Freie Universität Berlin).

Tourtet, F. – Weigel, F.
2015 Taymāʾ in the Nabataean kingdom and in Provincia Arabia, Proceedings of the Seminar for Arabian Studies 45, 385–404.

Tourtet, F. – Daszkiewicz, M. – Hausleiter, A.
in press Pottery from Tayma: Chronostratigraphy and cultural interaction, in: M. Luciani (Ed.), Proceedings of the workshop "The Archaeology of the Arabian Peninsula: Connect ing the evidence" held at the 10th International Congress on the Archaeology of the Ancient Near East, Vienna, 2016, Oriental and European Archaeology, Vienna.

Watkins, L.
2018a Understanding the urban space of an Arabian oasis: the residential quarter of Taymāʾ, Proceedings of the Seminar for Arabian Studies 48, 353–368.
2018b Spatial-functional analysis of the central area of the ancient settlement of Tayma, Northwest Arabia, during the Nabataean, Roman and Late Anqtique Periods (PhD Dissertation, Université Paris 1, Pantheon-Sorbonne).

Weigel, F.
in press Excavations in Area H: First Preliminary Report on the Archaeological

Investigations in the Southern Compound A (2008–2009). In: A. Hausleiter – R. Eichmann – M. H. al-Najem (Eds.), Taymāʾ IV.

in preparation Enigmatic Walls: Decoding Residential Architecture at Taymā' in a Preliminary Case Study of Complex E-b9.

Wellbrock, K. – Voß, P. – Grottker, M.

2012 The evolution of water management methods in north-western Arabia and the southern Levant from the Neolithic Age through Antiquity, in: C. Ohlig (Ed.), Zehn Jahre wasserhistorische Forschungen und Berichte, Schriften der Deutschen Wasserhistorischen Gesellschaft 20.1, Siegburg, 29–48.

Wellbrock, K. – Grottker, M. – Gebel, H. G. K.

2017 Archaeohydrological investigation in NW Arabia. Potentials, problems, needs and goals, in: W. Y. al Tikriti – P. Yule (Eds.), Proceedings of water and life in Arabia conference, 14th – 16th December 2014, Abu Dhabi, 27–43.

Wengrow, D.

2010 What makes civilization? The ancient Near East and the future of the West, Oxford.

Wilkinson, T. J.

2003 Archaeological landscapes of the Near East, Tucson.

Wilkinson, T. J. – Philip, G. – Bradbury, J. – Dunford, R. – Donoghue, D. – Galiatsatos, N. – Ricci, A. – Smith, S. L.

2014 Contextualizing early urbanization. Settlement cores, early states and agro-pastoral strategies in the Fertile Crescent during the fourth and third millennia BC, Journal of World Prehistory 27, 43–109.

Winnett, F. V. – Reed, W. L.

1970 Ancient Records of North Arabia, Toronto.

Zur, A. – Hausleiter, A.

2018 Funerary landscapes in 2nd millennium BCE Tayma, Northwest Arabia, in: V. Müller (Ed.), Archaeology of Religion and Ritual, Proceedings of the 10th International Congress on the Archaeology of the Ancient Near East, Vol. I, Wiesbaden, 355–367.

Palaeoenvironment, Vegetation, and Water Management

View from the northern escarpment to the oasis of Taymāʾ via the sabkha (salt flat). Gypsum crusts are evidence of the hyperarid climate (lower left). The occurrence of Balanidae, a typical element of a marine/littoral fauna, confirms the existence of a saline lake c. 8,500 years ago (lower right). Photographs: H. Brückner, Nov. 2006 und Feb. 2007.

منظر مأخوذ من جهة المنحدر الشمالي لواحة تيماء عبر السبخة. تدلّ القشور الجصية على وجود مناخ جاف جداً (أسفل اليسار). يعتبر ظهور البرنقيل Balanidae، الذي ينتمي عادةً إلى الأحياء البحرية\الساحلية تأكيداً على وجود بحيرة مالحة قبل حوالي ٨٥٠٠ سنة مضت (أسفل اليمين). الصورة: هـ. بروكنر، نوفمبر ٢٠٠٦ و فبراير ٢٠٠٧.

Palaeoenvironmental Changes at Taymāʾ as Inferred from *Sabkha* Infill

Max Engel, Nicole Klasen, Andreas Ginau, Martin Patzke, Anna Pint, Peter Frenzel, and Helmut Brückner

***Abstract**: To date, geological evidence of palaeoenvironmental change in northwestern Saudi Arabia is scarce. At Taymāʾ, the stratigraphy of a* sabkha *(salt flat) provides evidence for Holocene climatic and landscape change. Preliminary interpretation of multi-proxy analysis and palaeontological findings indicates that a large perennial lake existed in the* sabkha *basin during the early Holocene. Aridisation during mid-Holocene times resulted in contraction of the lake and the evolution of wetlands before a* sabkha *formed in the last millennium. Even though the first settlers at the oasis of Taymāʾ probably did not witness stable lake conditions, the salt marsh may have served defensive purposes after the end of the 3rd mill. BCE since the ancient city wall enclosing the oasis is interrupted by the* sabkha.

***Keywords**: Saudi Arabia, Holocene, Geoarchaeology, Sedimentary analysis,* Sabkha*, Palaeo-lake*

ملخّص: ما زالت المعطيات الجيولوجية لتغير البيئة القديمة في شمال غربي المملكة العربية السعودية نادرة حتى الآن. يوفر التعاقب الطبقي للسبخة (المسطّح الملحي) في تيماء دليلاً على المناخات القديمة التي سادت خلال عصر الهولوسين و على التغير الكبير الذي طرأ على المحيط الطبيعي. يشير التفسير الأولي للتحليل المتعدد الدلائل و اللقى الأحفورية إلى وجود بحيرة كبيرة دائمة في حوض السبخة و ذلك خلال عصر الهولوسين المبكّر. أدى القحل خلال عصر الهولوسين الأوسط إلى تجفيف مؤقت للبحيرة و إلى تطور شروط مستنقعات ملحية و ذلك قبل أن تتشكل السبخة في الألفية الماضية. و مع أن المستوطنين الأوائل لواحة تيماء لم يشهدوا على الأرجح ظروفاً لبحيرة مستقرة فإن المستنقع الملحي خدم ربما الأغراض الدفاعية بعد نهاية الألف الثالث قبل الميلاد و ذلك لوجود انقطاع بسبب السبخة في سور المدينة المحيط بالواحة.

كلمات البحث: المملكة العربية السعودية، الهولوسين، الجيوأركيولوجيا، تحليل الرسوبيات، السبخة، البحيرة القديمة.

1 Introduction

Geoscientific investigations at Taymāʾ contribute to the recent trend of increasing interdisciplinarity in archaeological research. Even though contacts between the earth sciences and archaeology appear to have a long tradition, institutional collaboration and integrative field work design (e.g. Brückner – Vött 2008) advanced significantly only in the more recent past.

Technically speaking, systematic cooperation between archaeology and the earth sciences dates back to the days of Sir Charles Lyell, whose geological observations at the excavations at Brixham Cave, Devon, fostered the perception of the presence of man during the last glacial cycle within the archaeological community (Prestwich 1859; Lyell 1863). The increasing relevance of stratigraphical analysis – a technique deeply rooted in the geosciences – in archaeological exploration was subsequently demonstrated, for instance, by the efforts of Dörpfeld at Troy (Dörpfeld 1902).

Nevertheless, a well-founded theoretical model and the technical term ‘geoarchaeology’ for a discipline linking archaeology, (pre-)history, geology, physical geography, botany and zoology dates only to the 1960s and 1970s when the first holistic models of palaeoenvironmental change in archaeological landscapes were developed (e.g. Butzer 1960; Butzer 1971; Vita-Finzi 1969; Kraft *et al.* 1977). Rapp and Hill (2006) label this breakthrough period as the ‘Integrative Phase’ in the history of geoarchaeology, succeeding the ‘Foundational Phase’ (before 1900) and the ‘Collaborative Phase’ (1900–1950). Fruitful discussions about the nature of geoarchaeology, the

roles of contributing disciplines and especially the tremendous value for exploring the human past have increased exponentially since then (e.g. Butzer 1971; Rapp 1975; Gladfelter 1977; Gladfelter 1981; Hassan 1978; Hassan 1979; Goldberg 1988; Leach 1992; Canti 2001; Brückner 2006; Fuchs – Zöller 2006; Rapp – Hill 2006; Brückner – Vött 2008). However, understanding and definitions of the term itself vary depending on disciplinary background and provenance. While in North America, for instance, geoarchaeological studies tend to focus on the last 15 ka and are predominantly conducted by geomorphologists, most protagonists in Europe and Asia have a geographical or archaeological background and research questions comprising the entire Quaternary (the last 2.6 Ma) are not uncommon (Butzer 2008).

In the context of Fig. 1, which identifies the major fields of geoarchaeological research, the work at Taymāʾ primarily addresses geochronological topics (Engel *et al.* 2009; 2011) and the reconstruction of landscape change (Engel *et al.* 2012; Ginau *et al.* 2012; this paper). Considering these foci and our professional background as physical geographers, we are favourably disposed to the following definition of geoarchaeology which emphasises the advisory role of the earth-science approach in archaeological investigations: "[Geoarchaeology is] the application of any earth-science concept, technique, or knowledge base to the study of artifacts and the processes involved in the creation of the archaeological record" (Rapp – Hill 2006, 1). Nevertheless, in a reciprocal way scholarly interest not solely concentrates on reconstructing landscapes of certain archaeological periods but also on estimating the magnitude of human impact on the ancient physical environment (Brückner 2006).

But what exactly is the benefit of palaeoenvironmental research in archaeological exploration? Changes in vegetation, hydrography, morphodynamics and pedology strongly influence the behaviour of human societies and played a significant role in fostering technical innovation in the past. Thus, a profound understanding of the social, cultural and economic contexts of an ancient site requires detailed information about associated landscape changes. Climatic fluctuations during the Quaternary period triggered substantial morphodynamic changes and strongly modified the Earth's surface. Sensitive arid ecosystems such as the Taymāʾ region in northwestern Saudi Arabia in particular experienced considerable climatic and morphological changes on a historical time scale.

This paper largely summarizes the early phase of research on the palaeoenvironments of the Taymāʾ oasis in NW Saudi Arabia (2006–2010), even though the later correction of radiometric data (cf. Dinies *et al.* 2015) along with selected key archaeological and palaeoclimatological findings were considered in the discussions. The initial hypotheses about landscape change are based on sedimentary analyses of the local *sabkha* deposits. Discussion and conclusions focus on the prominent archaeological periods of Taymāʾ. Our preliminary results contribute to the main research question of how the inland *sabkha* north of the oasis settlement evolved and to what extent landscape change played a role for early human societies of the oasis. On a broader spatial scale we intend to compare our conclusions on regional palaeoclimatic changes with other records from the Arabian Peninsula.

2 Palaeoclimate of the Arabian Peninsula and the Taymāʾ region – State of the art

Environmental change during the postglacial period comprises changes within the relief sphere, lithosphere, atmosphere, hydrosphere and biosphere. All these physico-geographic realms reveal strong interdependencies. Since the Quaternary is characterised by dramatic climatic fluctuations (glacial-interglacial cycles) due to orbital forcing and a geographic setting of tectonic plates supporting the accumulation of large ice sheets and determining the course of the ocean currents, atmospheric conditions play a key role for reconstructing landscapes of the Holocene (the last 11.7 ka). Thus, understanding local environmental change requires substantiated information about the regional palaeoclimate. Relevant data has been obtained from a wide range of geo-

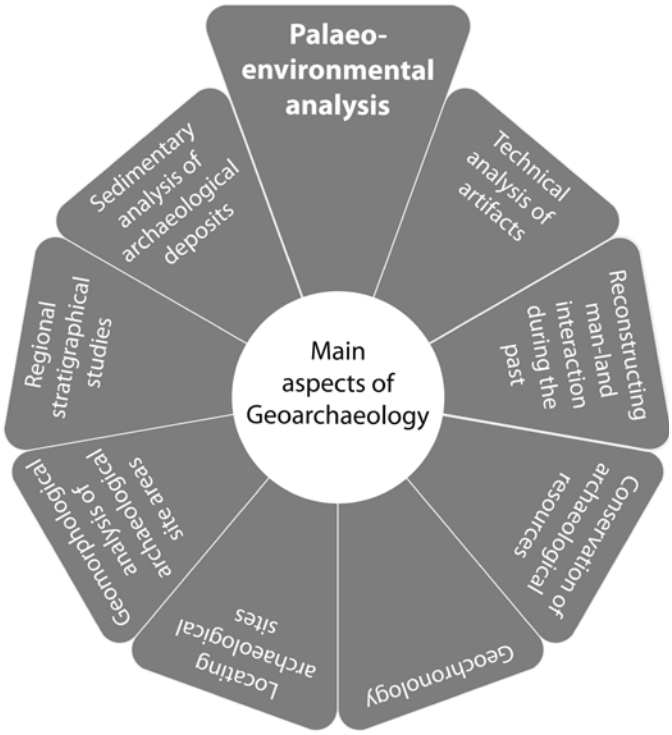


Fig. 1 *Main scope of geoarchaeological research as pointed out by Hassan 1979. The aspect of palaeoenvironmental reconstruction is emphasised in this scheme since it is the main topic of this paper (M. Engel).*

الشكل ١ النطاق الرئيسي للبحث الجيوأركيولوجي كما حدده حسن ١٩٧٩. تم التركيز في هذا المخطط على جانب إعادة تشكيل البيئة القديمة لأنه القضية الرئيسية لهذا البحث *(M. Engel)*.

and bioarchives of the Arabian Peninsula such as speleothems (Neff *et al.* 2001; Fleitmann *et al.* 2003), sand dunes (Bray – Stokes 2003), marine (Arz *et al.* 2003) and lacustrine/terrestrial (McClure 1976; Radies *et al.* 2005; Parker *et al.* 2006; Davies 2006; Lézine *et al.* 2007; Fuchs – Buerkert 2008) deposits as well as coral colonies from the northern Red Sea (Moustafa *et al.* 2000; Felis – Rimbu 2010).

Recent climatic conditions during the winter season are dominated by incursions of polar continental air masses resulting from a powerful anticyclone over Central Asia. High air pressure over the Arabian Peninsula leads to clear skies and stable atmospheric conditions. Maritime air masses from the Mediterranean rarely encroach upon the subcontinent, providing very limited rainfall for the extremely arid region. High summer temperatures produce tropical continental air and activate convective dynamics enriching the atmosphere in dust particles. Convection leads to the absorption of unstable tropical maritime air from the Arabian Sea and the formation of the Intertropical Convergence Zone (ITCZ) (Vincent 2008). The extension of this zone of converging air masses reveals significant interannual variability resulting in an inconsistent year-to-year rainfall pattern especially in mountainous regions (Subyani 2004).

A significant northward shift of the ITCZ and its associated monsoonal dynamics during the summer season have long been considered to be responsible for pluvial periods on the Arabian Peninsula during the Quaternary (Fleitmann *et al.* 2004; Fuchs – Buerkert 2008), whereas more recently it has been agreed upon the substantial role of an eastward penetration of the African Monsoon (Enzel *et al.* 2015; Guagnin *et al.* 2016). Arid conditions during the Last Glacial Maximum (ca. 18 ka ago) persisted until the beginning of the Holocene when a broad range of environmental evidence indicates a shift to a more humid climate. The terrestrial sediment record of Fuchs and Buerkert (2008) from the northern Oman mountains (Figs. 2g and 3g) even reflects the impact of the Younger Dryas cooling event (ca. 12.5–10.5 ka ago), implying a decline in rainfall. The timing of the postglacial shift to humid conditions on the Arabian Peninsula reveals a heterogeneous pattern (Fig. 2). While in the Sedh ad Drah valley in western Yemen (Figs. 2k and 3k) peat growth – triggered by increased precipitation – already started around 10.5 ka ago (Davies 2006), initial signs of climate improvement in the Rub al-Khali (Figs. 2j and 3j) and An-Nafud

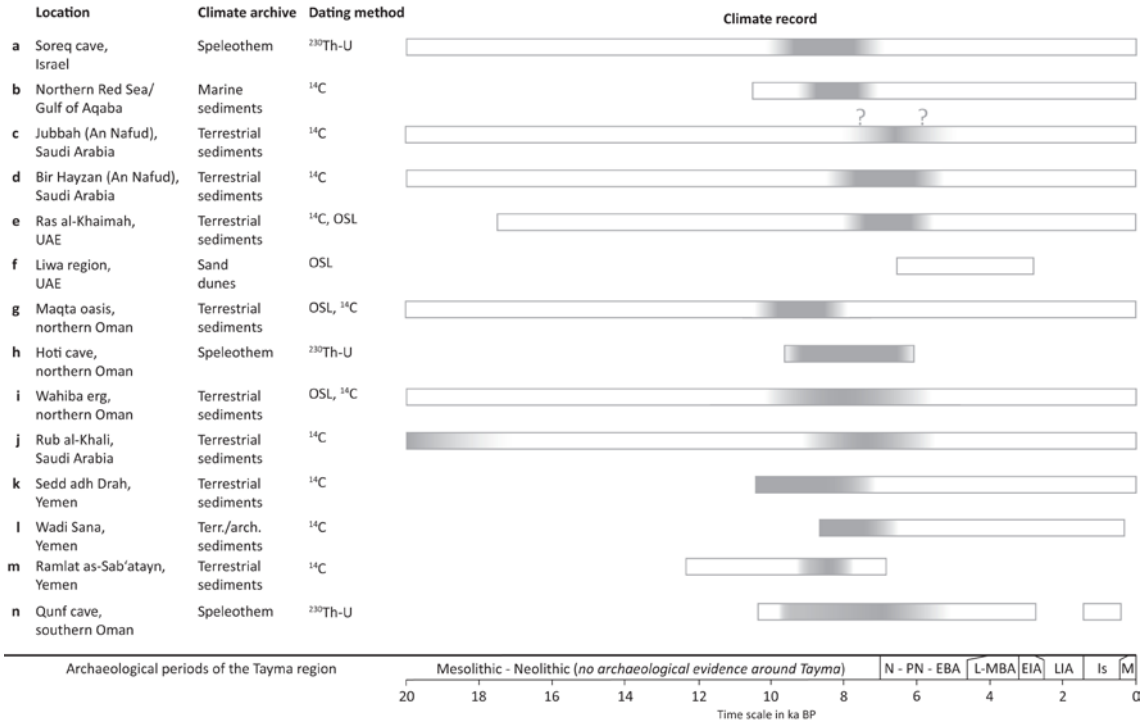


Fig. 2 *Data on Late Quaternary palaeoclimates of the Arabian Peninsula. Grey boxes indicate the length of the record. Grey fillings show periods of increased precipitation. Sources: (a) Bar-Matthews* et al. *1997, (b) Arz* et al. *2003, (c) Garrard* et al. *1981, (d) Schulz – Whitney 1986, (e) Parker* et al. *2006, (f) Bray – Stokes 2003, (g) Fuchs – Buerkert 2008, (h) Neff* et al. *2001, (i) Radies* et al. *2005, (j) McClure 1976, (k) Davies 2006, (l) McCorriston* et al. *2002, (m) Lézine* et al. *2007, (n) Fleitmann* et al. *2003. Fig. 3 shows where the palaeoclimate archives are located. Abbreviations of archaeological periods: N = Neolithic, PN = Post-Neolithic, EBA = early Bronze Age, L-MBA = late-middle Bronze Age, EIA = early Iron Age, LIA = late Iron Age, Is = Islamic, M = Modern (M. Engel).*

الشكل ٢ معطيات المناخات القديمة السائدة خلال العصر الرباعي المتأخر في شبه الجزيرة العربية. تشير الخانات الرمادية إلى طول السجل بينما تُظهر الحشوات الرمادية فترات هطول متزايدة للأمطار. المصادر: *Bar-Matthews (a)* و آخرون ١٩٩٧، *Arz (b)* و آخرون ٢٠٠٣، *Garrard (c)* و آخرون ١٩٨١، *Schulz – Whitney (d)* ١٩٨٦، *Parker (e)* وآخرون ٢٠٠٦، *Bray – Stokes* ٢٠٠٣، *Fuchs – Buerkert (g)* ٢٠٠٨، *Neff (h)* و آخرون ٢٠٠١، *Radies (i)* و آخرون ٢٠٠٥، *McClure (j)* ١٩٧٦، *Davies (k)* ٢٠٠٦، *McCorriston (l)* و آخرون ٢٠٠٢، *Lézine (m)* و آخرون ٢٠٠٧، *Fleitmann (n)* و آخرون ٢٠٠٣. يُظهر الشكل ٣ أماكن وجود المحفوظات المناخية القديمة. اختصارات الفترات الأثرية: *N* = العصر الحجري الحديث، *PN* = ما بعد العصر الحجري الحديث، *EBA* = عصر البرونز المبكّر، *L-MBA* = عصر البرونز الوسيط المتأخر، *EIA* = عصر الحديد المبكّر، *LIA* = عصر الحديد المتأخر، *Is* = العهد الإسلامي، *M* = حديث (*M. Engel*).

(Figs. 2c and 3c) deserts occurred at least 1.5 ka (McClure 1976) or even 2 ka later (Whitney *et al.* 1983; Schulz – Whitney 1986). Based on a high-resolution speleothem record from Oman (Figs. 2n and 3n), Fleitmann and others (2003) provide evidence for an abrupt onset of the early Holocene pluvial period in south Arabia and, by contrast, a rather gradual shift to arid conditions during the mid-Holocene. Pilot studies on early Holocene environments of the western An-Nafud sand sea near Taymāʾ showed that interdunal depressions were filled with shallow lakes and swamps (Schulz – Whitney 1986) and weak pedogenesis took place (Garrard *et al.* 1981). However, the vegetation cover at that time apparently resembled the assemblage of recent semi-desert communities (Schulz – Whitney 1986).

3 Study site

3.1 The environmental setting of Taymāʾ

The oasis of Taymāʾ is located on the Arabian platform in the northwestern part of the Kingdom of Saudi Arabia (Fig. 3). The Arabian platform accumulated in a Palaeozoic to Cenozoic sedimentary basin and overlies the Precambrian craton of the Arabian shield. Its Palaeozoic depositional history is characterised by tectonic stability interrupted by epirogenetic movements of the underlying craton leading to several major unconformities. Today, erosion is the dominant process on the Arabian Peninsula due to Mesozoic and Cenozoic uplift, resulting in the denudation of the Arabian shield in its westernmost part (Vincent 2008). Taymāʾ is located on a gentle homocline of Ordovician sedimentary rocks. The hydrographic pattern of the area south of Taymāʾ comprises *wadi*s directed towards the local *sabkha* (Vaslet *et al.* 1994).

South-southwesterly winds prevail at Taymāʾ. The area receives an average of 45 mm annual rainfall, mostly between November and April. Daytime temperatures hover around 10 °C in winter and may rise above 40 °C in summer. Vegetation is very sparse and includes perennial shrubs and annual grasses (Vaslet *et al.* 1994).

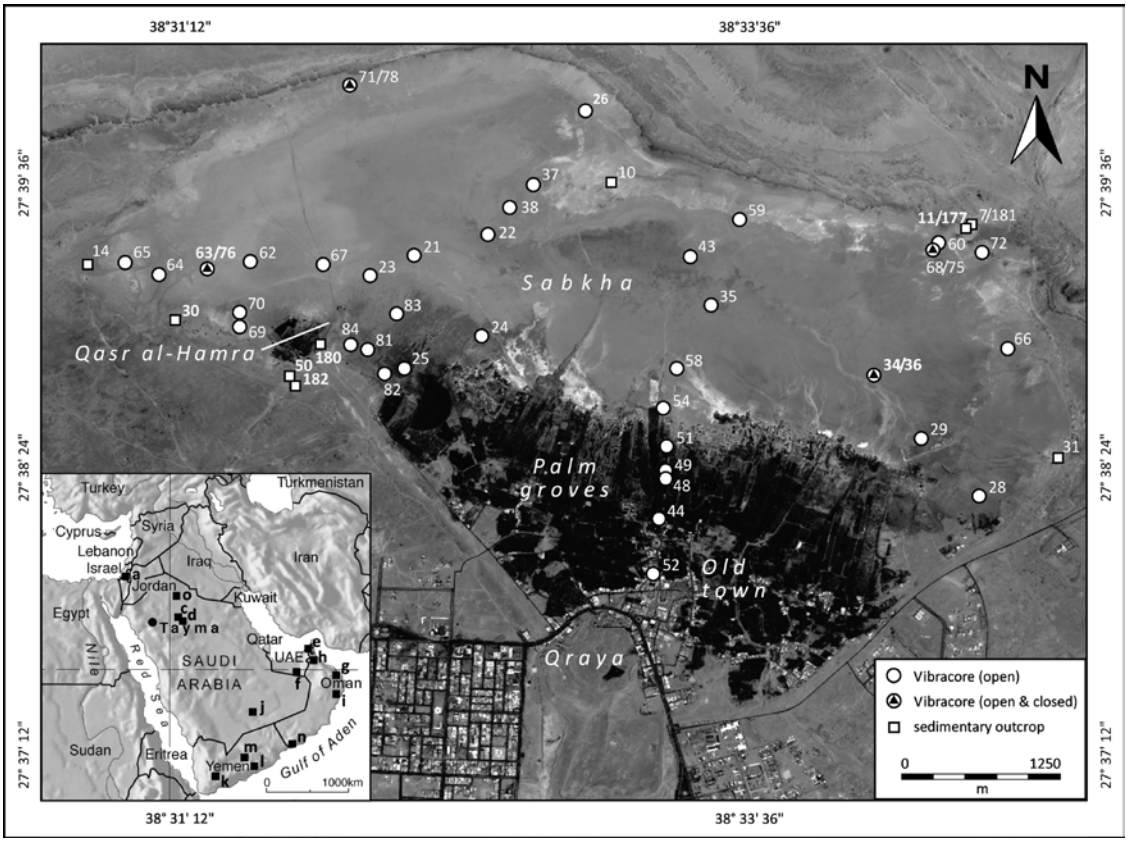


Fig. 3 *The Taymāʾ oasis including all sampling sites as of 2010 in the environs of the sabkha based on Google Earth imagery. The location of Taymāʾ on the Arabian peninsula is shown on the overview map (Mountain High Maps ® Copyright © 1993 Digital Wisdom, Inc.). Insert map: Sites a-o indicate climate archives presented in Fig. 2 and in the text (M. Engel, G. Ziehr).*

الشكل ٣ خريطة تعتمد على صورة برنامج *Google Earth* تُظهر واحة تيماء بما في ذلك جميع مواقع أخذ العينات في محيط السبخة. يظهر موقع تيماء في شبه الجزيرة العربية في الخريطة المصغّرة الصادرة عن ® *(Mountain High Maps Copyright © 1993 Digital Wisdom, Inc.)*. تشير المواقع a - o إلى محفوظات المناخ المعروضة في الشكل ٢ و في النص *(M. Engel, G. Ziehr)*.

3.2 The *sabkha*

In the northern part of the oasis an endorheic depression with an extension of almost 20 km² separates the palm groves of Taymāʾ from a retreating escarpment. It represents the lowest-lying area within the hydrological catchment and is thus supplied with sediment loads during each rainfall event when *wadi* systems are activated. From a geomorphological point of view, such an intra-plateau basin with a flat and shallow sedimentary cover is defined as saliña, salar, salada, playa (in the Spanish-speaking community), pan, saline lake, alkali flat, salt plain, dry lake, salt flat (in the English-speaking community) or *sabkha*/*sebkha* in Arabic (Yechieli – Wood 2002). More specifically, the *sabkha* of Taymāʾ belongs to the relatively unexplored group of inland *sabkhas* which are most prominent in the tectonic depressions of the Rub' al-Khali and in the area of the al-Jawf-Sakakah basin and the An-Nafud further north (Barth 2002). Sedimentary processes – i.e. aeolian erosion as well as aeolian and alluvial accumulation – of inland *sabkha* systems are driven by fluctuations of the groundwater table. Resurging saline groundwaters precipitate capillary evaporates above the water table or in the brine-saturated horizon immediately below (Warren 2006). Coastal *sabkha*s, however, are predominantly distributed along the shoreline between Kuwait and the southern tip of the Arabian Peninsula as well as the Red Sea coast. Their morphodynamic system is substantially controlled by the subsurface intrusion of sea water (Barth 2002).

4 Methods

The methodological approach of this study follows the research design presented by Brückner (2006) and Brückner – Vött (2008). Thus, scenarios of landscape change are mainly based on stratigraphic analysis of the *sabkha* sedimentary infill by means of vibracoring. More than 40 corings were carried out inside the sediment-trapping *sabkha*, including those of the palm groves and the old town of Taymāʾ (Fig. 3). Several sedimentary outcrops and morphological features which point fluctuating environmental conditions were examined. The closed cores of Tay 36 and Tay 76 presented here were sampled in 5 cm intervals within stratigraphic units. Extra samples were taken from sections of warve-like stratification.

Most vibracoring was carried out with open steel auger heads (diameter: 60, 50 and 36 mm). The sediment cores were documented in the field. After stratigraphic documentation in terms of colour (Munsell Soil Color Charts), grain size and degree of rounding, texture, carbonate content (as recommended by *Ad-hoc* Arbeitsgruppe Boden 2005) and macrofaunal and -floral remains, samples for further laboratory analyses were taken. At key stratigraphic sites closed vibracores were taken to transfer the entire sediment column from the field into the lab.

The fine-grained fraction (<2 mm) was used to determine pH values (pre-treatment with Aq. dest. and KCl) and electric conductivity (pre-treatment with Aq. dest.). The $CaCO_3$ content was gasvolumetrically measured applying the Scheibler method. LOI (= loss on ignition) was determined by oven-drying of sediment samples at 105 °C for 12 hours and ignition in a muffle furnace at 550 °C for 4 hours (Beck *et al.* 1995). For the purpose of PO_4^{3-} analyses a Philipps PU 8620 UV/VIS/NIR spectral photometer was used. After gently boiling the samples with concentrated HCl (37%), filtration and dilution, a reaction mixture was prepared consisting of 1 n H_2SO_4, $[NH4]_6Mo_7O_{24}$ x $4H_2O$ (1.25%) and 0.02 N $C_6H_8O_6$ (Beck *et al.* 1995). Ca, Mg, K, Na, Fe and Mn concentrations were determined by means of atomic absorption spectrometry (Perkin Elmer A-Analyst 300). For these analyses digested samples already used for photometric analysis were diluted at 1:50.

Sieving and laser diffraction analysis (Malvern Mastersizer 2000) were applied to elaborate the grain size distribution. Aliquots were pre-treated with H_2O_2 (30%) and $Na_4P_2O_7$ (55.7 g/l) to remove organic carbon and for aggregate dispersion. After sieving, the grain size fraction <1 mm

was used for laser diffraction measurements. Results were processed with Gradistat software (Blott – Pye 2001).

Within the framework of a micropalaeontological pilot study sediment cores Tay 36 and Tay 76 were investigated qualitatively in terms of their microfaunal contents. The samples were pre-treated with H_2O_2 (3%) and fractionated by means of 1000 µm, 200 µm and 63 µm sieves. The fractions of 63–200 µm and 200–1000 µm were studied.

AMS radiocarbon dates of organic remains provide the chronological framework for sedimentary interpretations. For details on the enrichment of pollen for radiocarbon dating see Dinies *et al.* (2015). Calibration was carried out by means of CALIB 6.01 software (Reimer *et al.* 2009), and for ^{14}C data interpretation the 2σ standard deviation was considered (Tab. 1).

5 Results

5.1 Stratigraphy of the eastern *sabkha* (Tay 36)

Sediment cores Tay 34 (open) and Tay 36 (closed) (27°38'44.1"N, 38°34'07.3"E) represent the unconsolidated stratigraphy of the south-eastern *sabkha* (Fig. 4). The bottom section (4.94–3.65 m b.s. (= below surface), Facies C) consists of greenish grey to greenish black sandy silt with evaporitic components, gastropod (*Melanoides tuberculata*) and barnacle remains. Aragonitic layers create a warve-like pattern, especially at 4.73–4.33 and 4.13–4.00 m b.s. Carbonate content is high but fluctuating, LOI ranges between 3 and 5%. In most cases the particle size distribution is left-skewed with a mean grain size (arithmetic) between 16 and 46 µm (medium to coarse silt). The ostracod species of *Cyprideis torosa* (Fig. 5) was identified throughout the sedimentary unit. A sample of enriched pollen (4.53–4.41 m b.s.) was radiocarbon-dated to 9257–9029 cal BP.

A unit of alternating layers of greenish grey sandy silt and silt (3.65–1.13 m b.s., Facies B) is overlying Facies C. It reveals several stratified sections, e.g. 3.65–2.46 m b.s. and 1.82–1.17 m b.s. In general, the mean grain size is lower compared to the underlying unit of Facies C and the grain

Site	Depth b.s. (m)	Material	Lab ID*	$\delta^{13}C$ (‰)	^{14}C age (BP)	Age in sidereal years (2σ cal BP)
Tay 36	2.40–2.51	pollen	UGAMS6102	-24.8	4460 ± 40	5294–4893
Tay 36	4.41–4.53	pollen	UGAMS6101	-24.9	8190 ± 30	9257–9029
Tay 34	3.80–3.85	bulk sediment (humic acid)	KIA34031	-17.61	8435 ± 35	9528–9412
Tay 34	3.80–3.85	bulk sediment (leaching residue)	KIA34031	-19.06	8520 ± 35	9542–9478
Tay 76	1.10–1.16	wood	UGAMS6011	-26.6	670 ± 25	673–562
Tay 76	2.05–2.07	plant fragments	UGAMS6012	-29.6	52040 ± 560	-**
Tay 76	3.05–3.10	plant fragments	UGAMS6013	-16.6	8390 ± 30	9487–9306
Tay 76	3.40–3.45	plant fragments	UGAMS6014	-29.3	43310 ± 370	47211–45496
Tay 11	0.05–0.10	shells (gastropods)	KIA34032	5.78	8125 ± 45	9251–8892
Tay 11	2.05–2.10	shells (gastropods)	KIA34027	-26.85	8980 ± 45	10235–9923

*UGAMS = Center for Applied Isotope Studies, University of Georgia, Athens; KIA = Leibniz Labor für Altersbestimmung und Isotopenforschung, Christian-Albrechts-Universität Kiel.

**IntCal09 calibration dataset (Reimer *et al.* 2009) only supports ^{14}C ages between 0–46.4 ka.

Tab. 1 *Details on radiocarbon data from palaeoenvironmental investigations at Taymāʾ. Samples KIA34032 and KIA34027 were previously published in Engel et al. (2012).*

الجدول ١ تفاصيل عن معطيات الكربون المشع من تحريات البيئة القديمة في تيماء. تمّ نشر العينات *KIA34032* و *KIA34027* سابقاً في (Engel *et al. 2012*).

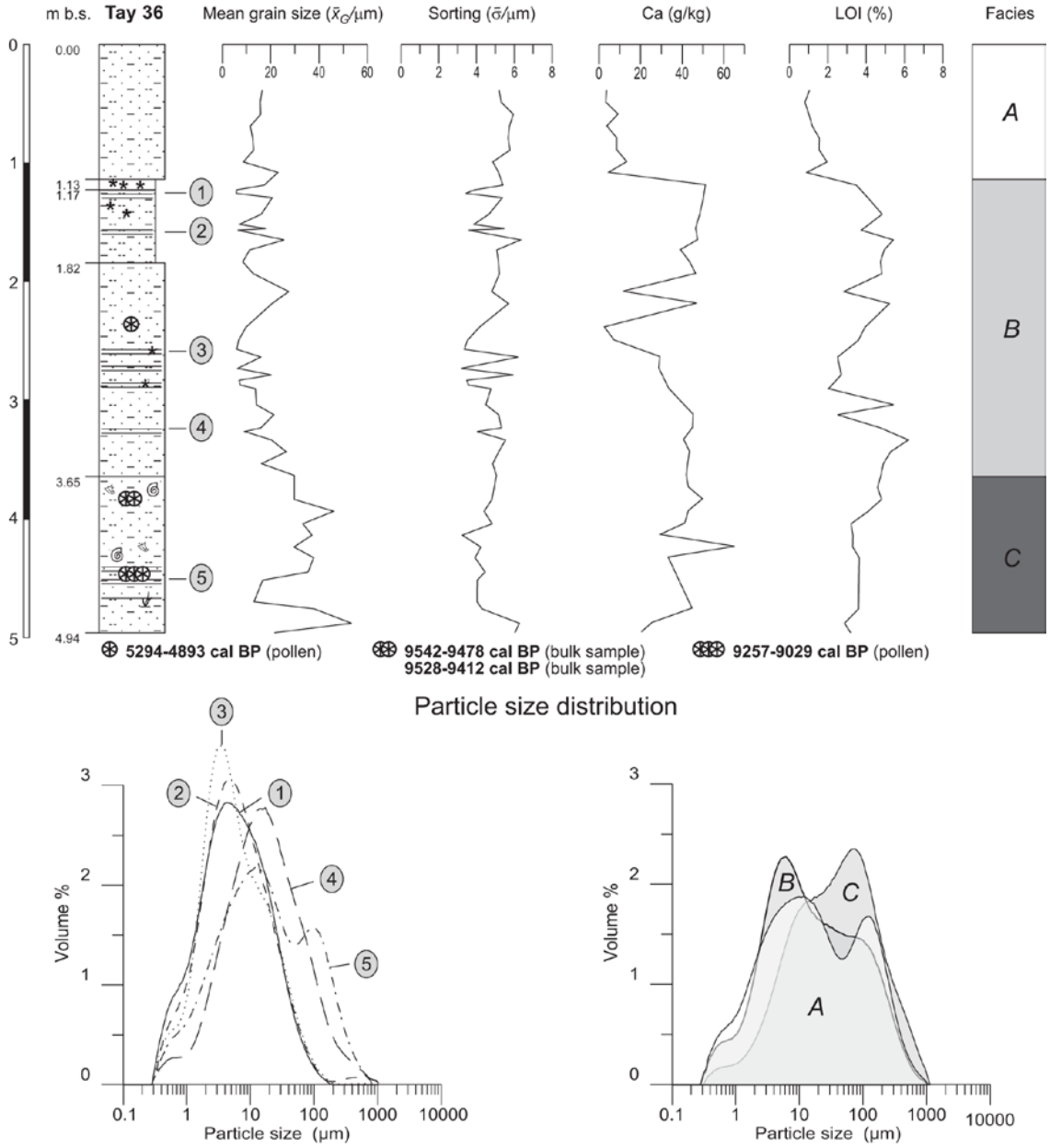


Fig. 4 *Sediment core Tay 36 from the eastern part of the sabkha (Fig. 3) with proxies of mean grain size, sorting, carbonate and LOI. Grain size distribution of five representative samples is shown in the lower left diagram. The lower right diagram displays mean values of grain size distribution of the facies units identified in the profile. Legend in Fig. 5, details on* ^{14}C *data in Tab. 1 (A. Ginau, M. Engel).*

الشكل ٤ المقطع الليبي الرسوبي *Tay 36* المسحوب من الجزء الشرقي للسبخة مع دلائل على متوسط حجم الحبيبات، الفرز، الكربونات و معامل الاوكسجين المحدد. يُظهر توزع حجم الحبيبات لخمس عينات ممثلة في الرسم البياني اليساري السفلي. يعرض الرسم البياني اليميني القيم المتوسطة لتوزّع حجم الحبيبات ضمن السحنات التي تم تمييزها في المقطع. مفتاح المصطلحات في الشكل ٥، تفاصيل عن معطيات نظير الكربون المشع ١٤ في الجدول ١ *(A. Ginau, M. Engel).*

size distribution is right-skewed. The silt layers are brownish and better sorted (particle size distribution, curve 3 in Fig. 4) compared to the sand-containing sections (curve 4). Idiomorphic evaporitic crystals are present at 2.46–2.10 m b.s. $CaCO_3$ is absent, while LOI is fluctuating. Microfaunal remains have not been found. Precipitation of gypsum crystals occurs throughout Facies B and forms a massive crust on top of the unit. A pollen sample from 2.51–2.40 m b.s. revealed an age of 5294–4893 cal BP.

The uppermost part of Tay 36 consists of dark yellowish brown silt and sandy silt. It is free of $CaCO_3$ and reduced in LOI. Its grain size distribution pattern is bimodal and sorting is slightly poorer compared to the underlying units.

5.2 Stratigraphy of the western *sabkha* (Tay 76)

In the western *sabkha* (27°39'11.1"N, 38°31'19.2"E), the lowermost sedimentary unit (4.00–3.44 m b.s.) is characterized by dark olive grey sandy silt (Fig. 6) and low $CaCO_3$ values. Concentrations of Ca cations and LOI increase in the upper part. Smooth ostracod valves of *C. torosa* and foraminifer tests of *Ammonia tepida* were found.

At 3.44–2.45 m b.s., the sediment is grey to very dark greyish brown and reveals a warve-like pattern of silty sand and thin layers of precipitated carbonate (up to 5 mm). Fe, Ca and carbonate concentrations show distinct peaks. The Na/K ratio is relatively low but rises slightly in the upper part. Beside isolated occurrence of barnacle and snail remains, *C. torosa* and *Ammonia tepida* are still abundant. In the upper part several *Miliolidae* tests (Foraminifera) were found. ^{14}C AMS dating of plant fragments from the lowermost part of the unit revealed an age of 47211–45496 cal BP. At 3.10–3.05 m b.s. plant fragments were dated to 9487–9306 cal BP.

The overlying unit comprises a matrix of loamy/silty fine sand (2.45–1.29 m b.s.) with numerous components of evaporitic crystals (up to 3 cm). The upper part is characterised by pedogenetic features such as oxidation and reduction of Fe. While Ca values decrease, Mg concentrations show a reverse trend. $CaCO_3$ is almost absent. Thus far, microfossils were not found in this unit. Radiocarbon dating of plant fragments (2.07–2.05 m b.s.) resulted in an age estimate of 52040 ± 560 years.

The upper part of the profile consists of brownish sand and silt (1.29–0.44 m b.s.) and medium sand (0.44–0.00 m b.s.). The lower section shows stratification features and several evaporitic crystals. LOI as well as Fe and Mg concentrations decrease. $CaCO_3$ values are still low while the Na/K ratio significantly increases. No faunal remains were found. A piece of wood from 1.16–1.10 m b.s. revealed an age of 673–562 cal BP.

5.3 Faunal findings from the *sabkha* margins

Along the margin of the *sabkha* several enigmatic findings of molluscs and crustaceans were documented providing evidence for palaeoecological conditions. In a depression incised into the lowermost escarpment bordering the *sabkha* in the north (Tay 11, 27°39'21.7"N, 38°34'31.0"E), a sediment body was preserved which consists almost entirely of bioclastic material (Figs. 7–9). Dominant components are fragments and entire shells of barnacles and *Melanoides tuberculata* (freshwater snail). Furthermore, the shell assemblage comprises snails of Hydrobiidae and *Cerithium* sp., valves of *C. torosa* as well as foraminifers (Engel *et al.* 2012). The surface of the sediment body is located at an elevation of 811.5 m a.s.l. (= above mean sea level) and has a thickness of 2.40 m (Fig. 7). Barnacle colonies are directly attached to the bedrock (Fig. 9). The shell material is in good condition and does not show any signs of weathering. Shells from the base and the top of the sequence were radiocarbon dated to 10235–9923 and 9251–8892 cal BP. Several disjunct deposits of similarily stratified shell debris were found at the southwestern margin of the *sabkha* around Qasr al-Hamra. Profile Tay 180 (27°38'52.7"N 38°31'47.6"E) represents a massive bioclastic sediment body at the foot of the small hill of the ancient castle (Figs. 10 and 11). Another small outcrop (Tay 30, 27°38'58.3"N, 38°31'11.2"E) was found underlying the collapsed city wall to the west of Qasr al-Hamra. It is located ca. 806 m a.s.l. and consists of numerous shell strata in a fine sand matrix (Fig. 13). At Tay 182 (27°38'42.7"N, 38°31'40.4"E) several barnacle colonies were found in living position attached to the sandstone bedrock (Fig. 12).

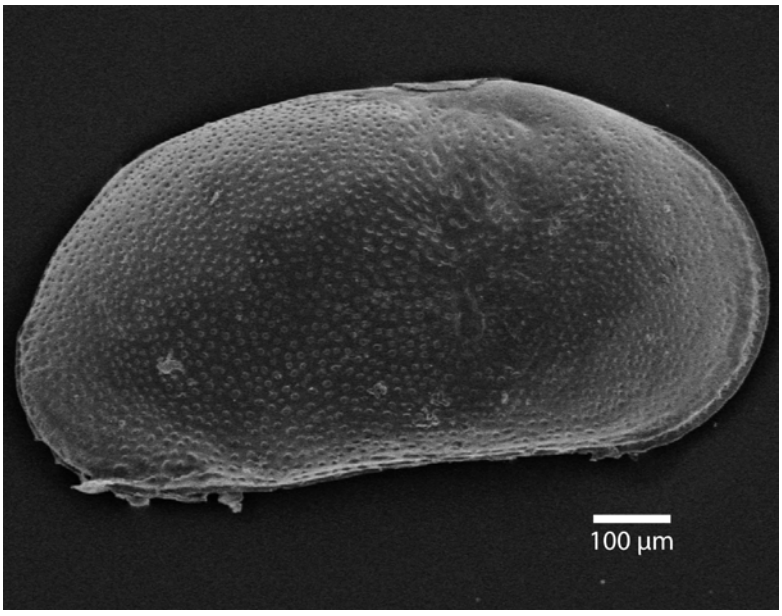


Fig. 5 *SEM (Scanning Electron Microscope) photo of smooth* Cyprideis torosa *from Tay 36 (Facies C, Figs. 3 and 4) (A. Ginau).*

الشكل ٥ صورة مأخوذة باستخدام المجهر الالكتروني الماسح *SEM* لأحفورة ملساء من نوع *Cyprideis torosa* من *Tay 36* (السحنة C، الشكلان ٣ و ٤) *(A. Ginau).*

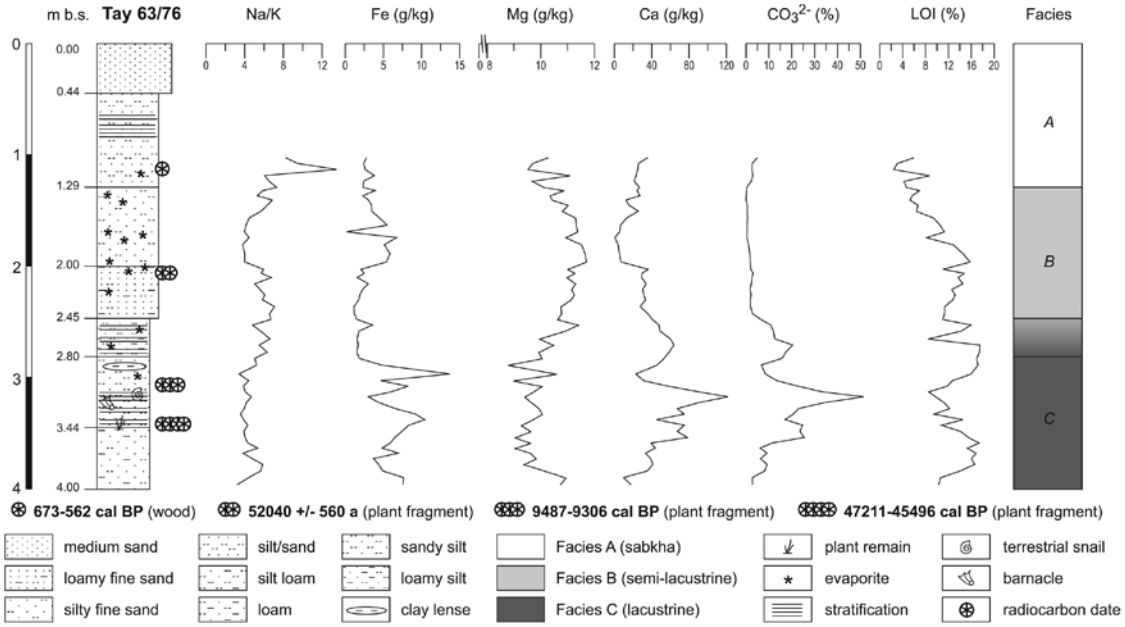


Fig. 6 *Sediment core Tay 76 from the western part of the sabkha (Fig. 3) with proxies of indicative cations (Fe, K, Na, Mg, Ca), carbonate and LOI. Details on ^{14}C data can be found in Tab. 1 (M. Patzke, M. Engel).*

الشكل ٦ المقطع الليبيي الرسوبي *Tay 76* المسحوب من القسم الغربي من السبخة (الشكل ٣) مع شواهد على أيونات موجبة دالّة *(Fe, K, Na, Mg, Ca)*، و على الكربونات و معامل الاوكسجين المحدد. يمكن ملاحظة تفاصيل عن معطيات نظير الكربون المشع ١٤ في الجدول ١ *(M. Patzke, M. Engel).*

6 Discussion

6.1 A permanent lake at Taymāʾ

Scenarios of landscape change focus on the northern oasis since the *sabkha* represents the most important local geoarchive. Here, the lowermost stratigraphic sections of Tay 36 and Tay 76 (Facies C) are characterised by relatively high amounts of $CaCO_3$ which in some sections appears as thin, probably annual precipitation layers. The carbonate-rich strata indicate phases when potential evaporation exceeded precipitation (Davies 2006). However, Parker and others (2006) refer to similar 'laminated marls' as evidence for a permanent water body at Awafi, United Arabian Emirates. At the northwestern Saharan margin (Daiet el Melah), laminated carbonates were associated with the highest water levels of Holocene times (Gasse *et al.* 1987). In this context, the relatively low Na/K ratio points to more humid conditions (Parker *et al.* 2006). The fine sand peak of the grain size distribution graph is due to abundant shells and aeolian sediment input which may indicate open vegetation surrounding the lake (Fig. 4).

An abundance of ostracods (*C. torosa*) and foraminifers (*Ammonia tepida*) and several shell fragments of barnacles and freshwater snails (*M. tuberculata*) are very important features of Facies C. The smooth surface of *C. torosa* and their relatively small size point to NaCl-rich waters (Anadón *et al.* 1986) and palaeo-salinities of at least 8‰ (probably 20–30‰). The dominance of oblong sieve pores as observed in the valves (see also Engel *et al.* 2012) is typical for meso- to polyhaline environments (Rosenfeld – Vesper 1977; Frenzel – Boomer 2005; Pint *et al.* 2012). *C. torosa* is equipped with an outstanding ability to adapt to fluctuating brine concentrations and temperature (Handl *et al.* 1999), even to hypersalinity, although it does not endure dessication (Gasse *et al.* 1987). *M. tuberculata* is abundant in a broad spectrum of freshwater and brackish environments. Where salinity is too high for other freshwater molluscs, it may develop high population densities due to lacking competition. In general, the species is found in littoral habitats of freshwater lakes at a water depth of up to 2 m. It feeds on decaying aquatic and subaquatic plants (Leng *et al.* 1999). Nevertheless, *M. tuberculata* also tolerates salinities of at least up to 23‰ (Plaziat – Younis 2005). Barnacles are typically associated with marine habitats and only rarely colonize non-marine settings (Foster 1987). One of the few intracontinental sites where recent populations are reported is Birket Gessabia (Siwa Oasis, western Egypt), ca. 250 km away from the Mediterranean Sea. At Siwa specimens of *Balanus amphitrite* were probably introduced by birds (Omer-Cooper 1937). *B. amphitrite* occurs in warm waters and is adapted to salinities of 40‰ at Lake Timsah, Suez Canal (Shalla *et al.* 1995), and even more than 45‰ at Siwa (Por 1972; Plaziat 1991).

Early observations of populations of *B. amphitrite* colonizing the entire Suez Canal in "unbelievable numbers" (Keller 1882) are concordant with the extraordinary amount of shells at Tay 11 and Tay 180. The barnacle remains are mixed with myriads of *M. tuberculata* shells which "float easily and consequently accumulate on the shores of lakes" (Plaziat – Younis 2005, 7). The continuous presence of brackish and marine taxa within the shell bed indicates a permanent lake with a water depth of at least 13 m extending from the lowermost escarpment of the northern *sabkha* margin far into the oasis with the old town of Taymāʾ (Engel *et al.* 2012). Their indicator value is supported by (i) the similarity of findings of *in situ*-barnacle colonies at Tay 11, Tay 180 and Tay 182 eliminating the possibility of sediment redistribution, and (ii) early Holocene ^{14}C AMS data from Tay 11 (10235–9923 and 9251–8892 cal BP, cf. Tab. 1). These datings, however, need to be revised, as the local hard water effect was estimated to 1000–1500 years based on newer ^{14}C pollen-based sequences from the *sabkha* stratigraphy (Dinies *et al.* 2015).

Radiocarbon data from the massive shell beds correlate with data from the lacustrine facies in the sediment cores Tay 36 and Tay 76 as well as Tay 54 and Tay 58 (8699–8454 and 8752–8458 cal BP; Engel *et al.* 2012; Engel – Brückner 2011). The early Holocene radiocarbon age

Fig. 7 *Trench Tay 11 at the northeastern margin of the sabkha (Fig. 3). It provides insight into the bioclastic sediment body which is preserved in a morphological depression of the lowermost escarpment of black slaty siltstone. The lateral limit of the sediment body is marked by the darker surface in the middle ground. The view is directed towards the east (photograph: H. Brückner).*

الشكل ٧ السبر *Tay 11* الواقع في الحافة الشمالية الشرقية للسبخة (الشكل ٣). يتيح هذا السبر إلقاء نظرة على الجسم الرسوبي الفتاتي الحيوي المحفوظ ضمن الانخفاض المورفولوجي للجرف الأدنى المكون من حجر الغرين الأسود القاتم. يمثّل السطح القاتم للأرضية الوسطى الحدّ الجانبي للجسم الرسوبي. تتجه الصورة إلى الشرق. (الصورة: معهد الآثار الألماني، قسم المشرق، هـ. بروكنر).

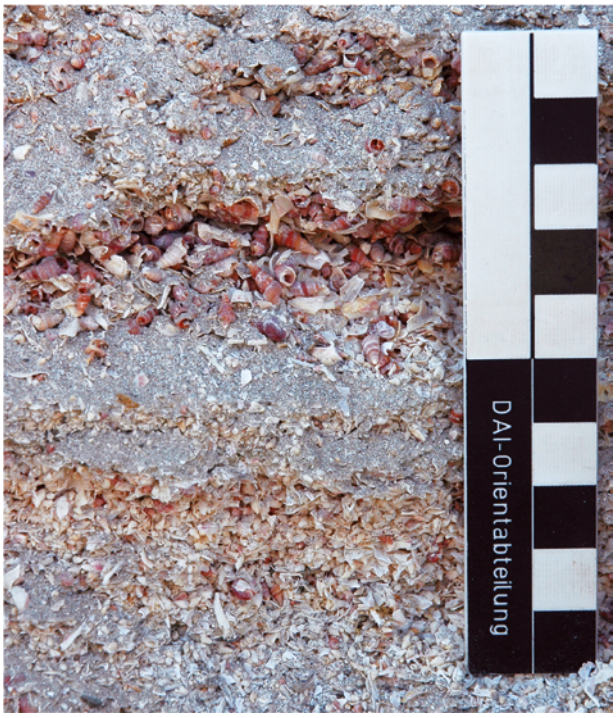


Fig. 8 *Detail photo of shell debris at Tay 11 (Fig. 3). Total length of the scale: 10 cm (photograph: J. Bosch).*

الشكل ٨ صورة تفصيلية لطمي صدفي في *Tay 11* (الشكل ٣)، الطول الإجمالي للمقياس: ١٠ سم (الصورة: معهد الآثار الألماني، قسم المشرق، ي. بوش).

Fig. 9 *Tay 180 at the foot of the elongated ridge of Qasr al-Hamra (Fig. 3). The well-stratified bioclastic outcrop extends for about several decameters and has a thickness of up to 2 m (photograph: N. Klasen).*

الشكل ٩ المقطع *Tay 180* من منطقة سفح الجانب الطولي لقصر الحمراء (الشكل ٣). يمتد البروز الفتاتي العضوي المتطبّق جيداً لمسافة عدة ديكامترات و بسماكة تبلغ المترين (الصورة: معهد الآثار الألماني، قسم المشرق، ن. كلازن).

Fig. 10 *Barnacles found in living position at Tay 11 (Fig. 3). The colonies are attached to the Ordovician bedrock underlying the shell-rich sediment body. Total length of the scale: 10 cm (photograph: H. Brückner).*

الشكل ١٠ قشريات من نوع البرنقيل اكتُشفت في وضعية حياتية في *Tay 11* (الشكل ٣). تلتصق هذه المستعمرات بطبقة صخور الأساس العائدة للعصر الأوردفيشي و تقع تحت الطبقة الرسوبية الغنية بالأصداف. الطول الإجمالي للمقياس: ١٠ سم (الصورة: معهد الآثار الألماني، قسم المشرق، هـ. بروكنر).

Fig. 11 *Detail of Tay 180 (Fig. 3) indicating stratification and the dominance of barnacle shells within the deposit. Note that the layer is nearly void of any non-organic material (photograph: M. Engel).*

الشكل ١١ صورة تفصيلية للمقطع *Tay 180* تُظهر تطبّق و هيمنة أصداف البرنقيل ضمن الترسب. من الملاحظ أن الطبقة خالية تقريباً من أية مواد غير عضوية (الصورة: معهد الآثار الألماني، قسم المشرق، م. إنغل).

Fig. 12 *Barnacle colony in living position attached to an outcrop of Ordovician sandstone southwest of Qasr al-Hamra (Tay 182, Fig. 3) (photograph: M. Engel).*

الشكل ١٢ مستعمرة برنقيل في وضعية حياتية ملتصقة ببروز للصخر الرملي من العصر الأردوفيشي إلى الجنوب الغربي من قصر الحمراء (*Tay 182*، الشكل ٣) (الصورة: معهد الآثار الألماني، قسم المشرق، م. إنغل).

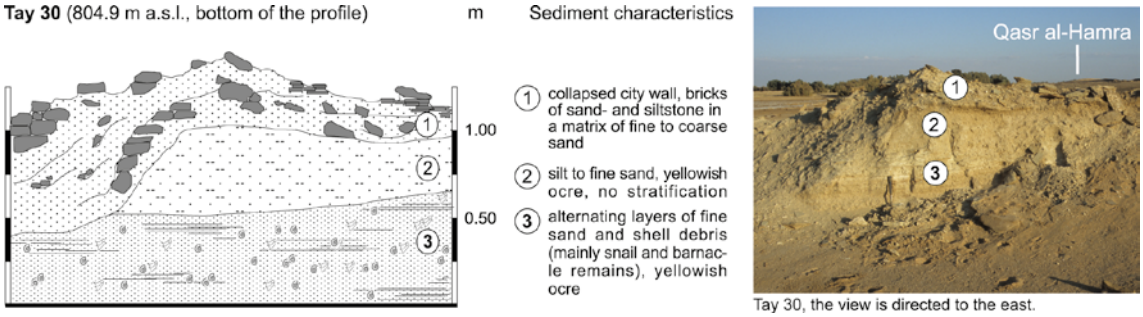


Fig. 13 *Sediment profile Tay 30, ca. 1 km west of Qasr al-Hamra, southwestern sabkha margin (Fig. 3). Well-stratified layers of fine sand and shells of snails and barnacles (3) and a unit of shell-free silty fine sand (2) are unconformably overlain by stones of the collapsed city wall and a matrix of medium sand (1). Key to the symbols in Fig. 5 (M. Engel, J. Bosch).*

الشكل ١٣ مقطع الرسوبيات *Tay 30* من المنطقة الواقعة على بعد ١ كم تقريباً إلى الغرب من قصر الحمراء و جنوب غربي شاطئ السبخة (الشكل ٣). تُغطي أحجار سور المدينة المنهار مع راسب أرضي من الرمل المتوسط *(1)* بشكل غير متجانس طبقات الرمل الناعم وأصداف الحلزونات و البرنقيل *(3)* و وحدة من الرمل الناعم الغريني الخالي من الأصداف *(2)*. توجد مفاتيح الرموز في الشكل ٥ *(M. Engel, J. Bosch)*.

of Facies C in Tay 76 (9487–9306 cal BP) is considered as reliable since it is supported by the lower pollen dating from Tay 36 (9257–9029 cal BP). Thus, the pre-LGM (= Last Glacial Maximum, ca. 18 ka BP) dating (47211–45496 cal BP) was rejected. Reliability of the dating from the upper part of Facies C in Tay 36 (9542–9478 and 9528–9412 cal BP) is reduced since ^{14}C activities in bulk sediment tend to deviate significantly and the hard water effect results in age overestimation (Lézine *et al.* 2007).

The early Holocene pluvial period deduced from Facies C is not associated with a northward shift of the ITCZ triggering monsoon intensification, as inferred for the southern Arabian Peninsula (Fleitmann *et al.* 2003; Fuchs – Buerkert 2008). It is more likely associated with a strengthening of the African Monsoon (Guagnin *et al.* 2016), stronger influence of cool continental air masses during winter controlled by the Arctic Oscillation and/or, during summer, a

monsoon-like circulation pattern due to increased land-sea temperature discrepancies towards the southeastern Mediterranean (Arz *et al.* 2003). Evidence for increased precipitation in the early Holocene presented here is in accordance with similar findings from the An-Nafud desert (Whitney – Gettings 1982; Whitney *et al.* 1983; Schulz – Whitney 1986). In contrast, Fleitmann and others (2004) registered a termination of speleothem growth after 40 ka BP in caves around Kahf al Najmah and Dahl Abu Rijl Maksura, ca. 400 km northeast of Taymāʾ (Fig. 3o), where increased rainfall did not leave an imprint.

6.2 The onset of aridisation

In the upper part of Facies C and in the overlying Facies B at Tay 76, Na/K ratios increase, heralding the onset of the mid-Holocene aridisation process (cf. Parker *et al.* 2006). The low $CaCO_3$ content and the absence of faunal remains point to hostile ecological conditions. *C. torosa* is adapted to salinities of up to 90‰, but cannot reproduce without permanent water cover (Anadón *et al.* 1986; Gasse *et al.* 1987), supporting the assumption that the lake shrinked significantly between 8.5 ka and 5294–4893 cal BP and turned into a wetland environment with fluctuating availability of surface water. In the upper part of Facies B, LOI decreases which significantly indicates reduced biomass production, increasing aridity and a more episodic rainfall and discharge pattern at the beginning of the late Holocene. Gypsum ($CaSO_4$ x nH_2O) and halite (NaCl) crystals occurring throughout the facies unit and forming a massive layer at its upper boundary are controlled by the groundwater table, evaporation and the capillary fringe. The even distribution of evaporites in Facies B reflects significant groundwater fluctuations (al-Harbi *et al.* 2006; Ginau *et al.* 2012).

6.3 From lake to *sabkha*

Further aridisation towards the present-day climate is inferred from a rising Na/K ratio and the uppermost sand unit in Tay 76. The bimodal particle size distribution may indicate episodic shallow standing water (clay/silt) and continuous input of sand which is favoured by a very sparse vegetation cover. The carbonate-rich layers in the uppermost meter of core Tay 76 probably indicate a short period of increased rainfall rather than the re-establishment of lake conditions. According to a radiocarbon dating from Tay 76, the development from a periodically flooded wetland to a dry, episodically flooded *sabkha* occurred before 673–562 cal BP.

6.4 Landscape change and ancient societies at Taymāʾ

The village of Jubbah, ca. 240 km east of Taymāʾ and ca. 40 km inside the an-Nafud sand desert, provides occupation evidence for the middle and upper Palaeolithic and the Neolithic-Chalcolithic (Garrard *et al.* 1981; Petraglia *et al.* 2011; Crassard *et al.* 2013). Almost full-size human and cattle petroglyphs from the Neolithic period (Khan 1988) and several pre-pottery surface sites in the age range of 8.5–8 ka BP relate to a settlement pattern of "partially settled communities based on small-to-medium-sized mammal herding" (Masry 1977, 11). Due to their similarity in scheme and style to the early Jubbah style rock art, human representations in the Taymāʾ area also indicate the presence of cattle-raising nomads at that time (Eichmann *et al.* 2006b).

The oldest archaeological findings from Taymāʾ are flint tools used to produce circular carnelian beads. While Bawden and others (1980) attributed the lithic industry to the Iron Age (3.2–2.9 ka BP) urban environment based on aggregated flints inside certain compounds of the

ancient city walls, Eichmann and others (2006a; 2006b) correlate these artefacts with similar findings from northern Saudi Arabia and sites in southeastern Turkey which are dated to the 5th and 4th mill. BCE (Arsebük 1974; 1986). After having conducted a brief archaeological reconnaissance at Taymāʾ, Winnet and Reed (1970, 175) refered to "flints of a Neolithic type found out of context on the surface". Forthcoming publications, however, provide similar older age estimations for the lithic surface findings and place them as early as the 7th/6th mill. BCE (Purschwitz 2017). Given this scenario, the initial occupation of the oasis had overlaps with the perennial lake phase, which still remains to be explored. The significant lowering of the lake water table was a necessary precondition for the colonization and cultivation of the oasis south of the palaeo-lake (Hamann *et al.* 2008).

Important evidence for both the physical setting of the *sabkha* basin and its functional aspects is provided by the construction of the ancient city wall system. It encloses several compounds at Qrayyah, the central ancient settlement district of Taymāʾ. Two branches of the city wall, several kilometres in extent, surround the entire oasis and end at the eastern and western margins of the *sabkha*. Inside the *sabkha* there is a low earthen wall connecting both branches (Schneider 2010). The oldest parts of the city wall system probably date back at least to the middle of the 3rd mill. BCE (Engel *et al.* 2009; Klasen *et al.* 2011; see now Hausleiter 2018) while the eastern and western sections might be of a younger age. Thus, it can be inferred that during the 3rd and the 2nd mill. BCE the *sabkha* area still represented an obstacle to invaders since a proper city wall construction was (i) not necessary or (ii) unrealisable due to unsuitable subsoil conditions. Whilst there were impenetrable wetlands with significant flooding after heavy rainfall outside the earthen wall, the area inside of it had a drainage system and was suitable for agricultural purposes.

In his work *Mu'jam*, the 11th century Spanish-Arab geographer Abu Ubaid al-Bakri refers to the 'lake' north of Taymāʾ as 'al-'Aqirah' which means "to hinder or to obstruct marching foreward" (al-Najem 2000, 192), thereby still indicating the presence of wetland conditions. Destructive inundation events as reported by Doughty, who visited Taymāʾ in 1877, or Huber, who went to the oasis for the first time in 1879 (Dougherty 1930), refer to the episodic activation of *wadi*s resulting in a temporary flooding of the *sabkha* and clastic sediment supply.

7 Conclusions

The stratigraphy of the *sabkha* of Taymāʾ reflects major climatic and environmental changes from the early Holocene to the present. Preliminary analysis of sediment cores from the *sabkha* and sedimentary outcrops along the *sabkha* margin indicate the existence of a perennial lake at least during the 9th mill. BP. It extended from the lowermost escarpment bordering the *sabkha* in the north far into the area of the present-day settlement of Taymāʾ. Its maximum depth was at least 13 m. The salinity of the lake was generally high but fluctuating, leading to the establishment of large populations of very few adaptable species such as *Melanoides tuberculata, Cyprideis torosa, Balanus* sp. and *Ammonia tepida.* After 8.0 ka BP a shift to wetland conditions started. The exact timing of the shift to non-permanent hydrological conditions due to regional aridisation is not yet resolved. Later, during the 2nd mill. AD, *sabkha* conditions with episodic flooding events established.

It remains under debate, whether the first settlers at the oasis witnessed the perennial lake or were confronted with a wetland of fluctuating presence of surficial water, strongly depending on chronological interpretation of the earliest local lithic artifacts. When the eastern and western branches of the city wall were constructed, the *sabkha* area still represented a significant obstacle to invaders. It was then clearly characterised by wetlands with temporary shallow water bodies, while southward of the earthen wall some parts of the marsh were already being turned into arable land.

Further research should be directed towards a more detailed interpretation of the palaeoenvironmental proxies in order to detect potential climatic events or short-term fluctuations within

the overall aridisation process of the Holocene. Additionally, a more detailed model of the palaeoecological and palaeohydrological succession in space and time has to be developed based on sedimentary and microfaunal evidence.

Acknowledgments

We are indebted to the Orient Department of the German Archaeological Institute, Berlin (DAI) for their financial and scientific support. Logistic support by the Saudi Commission for Tourism and National Heritage (SCTH) and the Taymāʾ Museum of Archaeology and Ethnography is gratefully acknowledged. Jan Bosch (Marburg) assisted during field work. Michèle Dinies and Reinder Neef from the Scientific Department of the German Archaeological Institute (Berlin) conducted the enrichment of pollen for radiocarbon dating. We thank Kirstin Jacobson (Marburg) for English editing and Simon Matthias May (Cologne) for critical comments on the manuscript.

Max Engel
Institute of Geography,
Universität zu Köln
Albertus-Magnus-Platz
50923 Cologne
max.engel@uni-koeln.de

Nicole Klasen
Institute of Geography,
Universität zu Köln
Albertus-Magnus-Platz
50923 Cologne
nicole.klasen@uni-koeln.de

Andreas Ginau
Institute of Geography
Goethe Universität Frankfurt a. M.
Altenhöferallee 1
60438 Frankfurt
ginau@em.uni-frankfurt.de

Martin Patzke
Faculty of Geography,
Philipps-Universität Marburg,
Deutschhausstr. 10
35032 Marburg
martinpatzke@aol.com

Anna Pint
Institute of Geography,
Universität zu Köln
Albertus-Magnus-Platz
50923 Cologne
annapint@web.de

Peter Frenzel
Institute of Earth Sciences,
Friedrich-Schiller-Universität Jena,
Burgweg 11
07749 Jena
peter.frenzel@uni-jena.de

Helmut Brückner
Institute of Geography,
Universität zu Köln,
Albertus-Magnus-Platz
50923 Cologne
h.brueckner@uni-koeln.de

References

Ad-hoc-Arbeitsgruppe Boden der Staatlichen Geologischen Dienste und der Bundesanstalt für Geowissenschaften und Rohstoffe (Eds.)
2005 Bodenkundliche Kartieranleitung, Stuttgart.

Anadón, P. – de Deckker, P. – Juliá, R.
1986 The Pleistocene lake deposits of the NE Baza Basin (Spain): salinity variations and ostracod succession, Hydrobiologia 143, 199–208.

Arsebük, G.
1974 Addendum: Microlithic assemblage from the Tülintepe Chalcolithic, Keban Project Publication Series I/4, 155–159.
1986 An assemblage of microlithic engravers from the Chalcolithic levels of Değirmentepe (Malatya), Anadolu araştırmaları / Jahrbuch für Kleinasiatische Forschung 10, 131–136.

Arz, H. W. – Lamy, F. – Pätzold, J. – Müller, P. J. – Prins, M.
2003 Mediterranean moisture source for an early-Holocene humid period in the northern Red Sea, Science 300, 118–121.

Bar-Matthews, M. – Ayalon, A. – Kaufman, A.
1997 Late Quaternary paleoclimate in the Eastern Mediterranean region from stable isotope analysis of speleothems at Soreq Cave, Israel, Quaternary Research 47, 155–168.

Barth, H.-J.
2002 Sabkhas of Saudi Arabia – an introduction, in: H.-J. Barth – B. Boer (Eds.), Sabkha ecosystems – Volume I: the Arabian Peninsula and adjacent countries, Dordrecht, 37–50.

Bawden, G. – Edens, C. – Miller, R.
1980 Preliminary archaeological investigations at Tayma, Atlal - The journal of Saudi Arabian Archaeology 4, 69–106.

Beck, R. – Burger, D. – Pfeffer, K.-H.
1995 Laborskript. Kleinere Arbeiten aus dem Geographischen Institut der Universität Tübingen 11.

Blott, S. J. – Pye, K.
2001 Gradistat: a grain size distribution and statistics package for the analysis of unconsolidated sediments, Earth Surface Processes and Landforms 26, 1237–1248.

Bray, H. E. – Stokes, S.
2003 Chronologies for Late Quaternary barchan dune reactivation in the southeast Arabian Peninsula, Quaternary Science Reviews 22, 1027–1033.

Brückner, H.
2006 Holozäne Umweltrekonstruktion und Geoarchäologie, Zeitschrift für Geomorphologie, Supplementary Issues 148, 55–59.

Brückner, H. – Vött, A.
2008 Geoarchäologie - eine interdisziplinäre Wissenschaft par excellence, in: E. Kulke – H. Popp (Eds.), Umgang mit Risiken. Katastrophen – Destabilisierung – Sicherheit, Tagungsband Deutscher Geographentag 2007, Bayreuth, 181–202.

Butzer, K.
1960 Archaeology and Geology in Ancient Egypt, Science 132, 1617–1624.
1971 Environment and archaeology: An Ecological Approach to Prehistory, Chicago.
2008 Challenges for a cross-disciplinary geoarchaeology: The intersection between environmental history and geomorphology, Geomorphology 101, 402–411.

Canti, M.
2001 What is geoarchaeology? Re-examining the relationship between archaeology and earth science, in: U. Albarella (Ed.), Environmental Archaeology: Meaning and Purpose, Dordrecht, 103–112.

Crassard, R. – Petraglia, M. D. – Parker, A. G. – Parton, A. – Roberts, R. G. – Jacobs, Z. – Alsharekh, A. – Al-Omari, A. – Breeze, P. – Drake, N. A. – Groucutt, H. S. – Jennings, R. – Régagnon, E. – Shipton, C.
2013 Beyond the Levant: first evidence of a pre-pottery Neolithic incursion into the Nefud Desert, Saudi Arabia, PLOS One 8, e68061.

Davies, C. P.
2006 Holocene paleoclimates of southern Arabia from lacustrine deposits of the Dhamar highlands, Yemen, Quaternary Research 66, 454–464.

Dinies, M. – Plessen, B. – Neef, R. – Kürschner, H.
2015 When the desert was green: grassland expansion during the early Holocene in north-western Arabia, Quaternary International 382, 293–302.

Dörpfeld, W.
1902 Troja und Ilion: Ergebnisse der Ausgrabungen in den vorhistorischen und historischen Schichten von Ilion 1870–1894, Leipzig.

Dougherty, R. P.
1930 A Babylonian city in Arabia, American Journal of Archaeology 34, 296–312.

Eichmann, R. – Hausleiter, A. – al-Najem, M. H. – al-Said, S. F.
2006a Tayma – Spring 2004, Report on the Joint Saudi-Arabian-German archaeological project, Atlal - The journal of Saudi Arabian Archaeology 19, 91–115.

Eichmann, R. – Schaudig, H. – Hausleiter, A.
2006b Archaeology and epigraphy at Tayma, Arabian Archaeology and Epigraphy 17, 163–176.

Engel, M. – Brückner, H.
2011 A stratigraphic transect from the old town of Tayma across the sabkha, in: R. Eichmann – A. Hausleiter – M. H. al-Najem – S. F. al-Said (Eds.), Tayma – Spring and Autumn 2007, 4th Report on the Joint Saudi-Arabian-German Archaeological project, Atlal - The journal of Saudi Arabian Archaeology 21, 66–71.

Engel, M. – Klasen, N. – Brückner, H. – Eichmann, R. – Hausleiter, A. – al-Najem, M. H. – al-Said, S. F. – Schneider, P. I.
2009 New age estimations for the western outer city wall of ancient Tayma (NW Saudi Arabia) based on OSL and radiocarbon data and geomorphologic evidence, Geophysical Research Abstracts 11, EGU2009-4409.

Engel, M. – Brückner, H. – Pint, A. – Wellbrock, K. – Ginau, A. – Voss, P. – Grottker, M. – Klasen, N. – Frenzel, P.
2012 The early Holocene humid period in NW Saudi Arabia – evidence from sediments, micro-fossils and palaeo-hydrological modeling, Quaternary International 266, 131–141.

Enzel, Y. – Kushnir, Y. – Quade, J.
2015 The middle Holocene climatic records from Arabia: reassessing lacustrine environments, shift of ITCZ in Arabian Sea, and impacts of the southwest Indian and African monsoons. Global and Planetary Change 129, 69–91.

Felis, T. – Rimbu, N.
2010 Mediterranean climate variability documented in oxygen isotope records from northern Red Sea corals – A review, Global and Planetary Change 71, 232–241.

Fleitmann, D. – Burns, S. J. – Mudelsee, M. – Neff, U. – Kramers, J. – Mangini, A. – Matter, A.
2003 Holocene monsoon recorded in a stalagmite from southern Oman, Science 300, 1737–1739.

Fleitmann, D. – Matter, A. – Pint, J. J. – al-Shanti, M. A.
2004 The speleothem record of climate change in Saudi Arabia. Saudi Geological Survey, Open-File Report, SGS-OF-2004-8.

Foster, B. A.
1987 Barnacle ecology and adaption, in: A. J. Southward (Ed.), Barnacle Biology, Crustacean Issues 5, 113–134.

Frenzel, P. – Boomer, I.
2005 The use of ostracods from marginal marine, brackish waters as bioindicators of modern and Quaternary environmental change, Palaeogeography, Palaeoclimatology, Palaeoecology 225, 68–92.

Fuchs, M. – Zöller, L.
2006 Geoarchäologie aus geomorphologischer Sicht: Eine konzeptionelle Betrachtung, Erdkunde 60(2), 139–146.

Fuchs, M. – Buerkert, A.
2008 A 20 ka sediment record from the Hajar Mountain range in N-Oman, and its implication for detecting arid–humid periods on the southeastern Arabian Peninsula, Earth and Planetary Science Letters 265, 546–558.

Garrard, A. N. – Harvey, C. P. D. – Switsur, V. R.
1981 Environment and settlement during the Upper Pleistocene and Holocene at Jubba in the Great Nefud, Northern Arabia, Atlal - The journal of Saudi Arabian Archaeology 5, 137–148.

Gasse, F. – Fontes, J.-C. – Plaziat, J.-C. – Carbonel, P. – Kaczmarska, I. – de Deckker, P. – Soulié-Märsche, I. – Callot, Y. – Dupeuble, P. A.
1987 Biological remains, geochemistry and stable isotopes for the reconstruction of environmental and hydrological changes in the Holocene lakes from north Sahara, Palaeogeography, Palaeoclimatology, Palaeoecology 60, 1–46.

Ginau, A. – Engel, M. – Brückner, H.
2012 Holocene chemical precipitates in the continental sabkha of Tayma (NW Saudi Arabia). Journal of Arid Environments 84, 26–37.

Gladfelter, B. G.
1977 The geomorphologist and archaeology, American Antiquity 42(4), 519–538.
1981 Developments and directions in geoarchaeology, Advances in Archaeological Method and Theory 4, 343–364.

Goldberg, P.
1988 The archaeologist as viewed by the geologist, The Biblical Archaeologist 51(4), 197–202.

Guagnin, M. – Jennings, R. – Eager, H.– Parton, A. – Stimpson, C. – Groucutt, H.S. – Drake, N.A. – Pfeiffer, M. – Stepanek, C. – Alsharekh, A. – Petraglia, M.D.
2016 Rock art imagery as a proxy for Holocene environmental change: a view from Shuwaymis, NW Saudi Arabia, The Holocene 26, 1822–1834.

Hamann, M. – Heemeier, B. – Patzelt, A. – Grottker, M.
2008 Wasserwirtschaftliche Anlagen in der historischen Oasenstadt Tayma, Saudi-Arabien, in: C. Ohlig (Ed.), Cura Aquarum in Jordanien, Proceedings of the 13th International Conference on the History of Water Management and Hydraulic Engineering in the Mediterranean Region 2007 in Petra/Amman Schriften der Deutschen Wasserhistorischen Gesellschaft 12, Siegburg, 155–175.

Handl, M. – Mostafawi, N. – Brückner, H.
1999 Ostracodenforschung als Werkzeug der Paläogeographie, Marburger Geographische Schriften 134, 116–153.

al-Harbi, O. A. – Hussain, G. – Khan, M. M.
2006 Sedimentology, mineralogy and geochemistry of al-Awshaziyah inland sabkha, central Saudi Arabia, Arid Land Research and Management 20, 117–132.

Hassan, F. A.
1978 Sediments in archaeology: methods and implications for palaeoenvironmental and cultural analysis, Journal of Field Archaeology 5(2), 197–213.
1979 The geologist and archaeology, American Antiquity 44(2), 267–270.

Hausleiter, A.
2018 The outer wall of Taymāʾand its dating to the Bronze Age, in: in: L. Nehmé – A. al-Jallad (Eds.), To the Madbar and Back Again. Studies in the Languages, Archaeology, and Cultures of Arabia to Michael C. A. Macdonald, Studies in Semitic Languages and Linguistics 92, Leiden, 361–391.

Keller, C.
1882 Die Fauna im Suez-Kanal und die Diffusion der mediterranen und erythräischen Thierwelt, Neue Denkschriften der allgemeinen schweizerischen Gesellschaft für Naturwissenschaften 28, Zürich, 1–39.

Khan, M.
1988 Schematisation and form in the rock art of northern Saudi Arabia, Atlal - The journal of Saudi Arabian Archaeology 11, 95–99.

Klasen, N. – Engel, M. – Brückner, H. – Hausleiter, A. – Intilia, A. – Eichmann, R. – al-Najem, M. H. – al-Said, S. F.
2011 Optically stimulated luminescence dating of the city wall system of ancient Tayma (NW Saudi Arabia), Journal of Archaeological Science 38, 1818–1826.

Kraft, J. C. – Aschenbrenner, S. E. – Rapp Jr., G.
1977 Palaeogeographic reconstructions of coastal Aegean archaeological sites, Science 195, 941–947.

Leach, E. K.
1992 On the definition of geoarchaeology, Geoarchaeology 7(5), 405–417.

Leng, M. J. – Lamb, A. L. – Lamb, H. F. – Telford, R. J.
1999 Palaeoclimatic implications of isotopic data from modern and early Holocene shells of the freshwater snail *Melanoides tuberculata*, from lakes in the Ethiopian Rift Valley, Journal of Palaeolimnology 21, 97–106.

Lézine, A.-M. – Tiercelin, J.-J. – Robert, C. – Saliège, J.-F. – Cleuziou, S. – Inizan, M.-L. – Braemer, F.
2007 Centennial to millennial-scale variability of the Indian monsoon during the early Holocene from a sediment, pollen and isotope record from the desert of Yemen, Palaeogeography, Palaeoclimatology, Palaeoecology 243, 235–249.

Lyell, C.
1863 The geological evidence of the antiquity of man, Philadelphia.

Masry, A. H.
1977 The historic legacy of Saudi Arabia, Atlal - The journal of Saudi Arabian Archaeology 1, 9–19.

McClure, H. A.
1976 Radiocarbon chronology of late Quaternary lakes in the Arabian Desert, Nature 263, 755–756.

McCorriston, J. – Oches, E. A. – Walter, D.E. – Cole, K. L.
2002 Holocene palaeoecology and prehistory in highland southern Arabia, Paléorient 28, 61–88.

Moustafa, Y. A. – Pätzold, J. – Loya, Y. – Wefer, G.
2000 Mid-Holocene stable isotope record of corals from the northern Red Sea, International Journal of Earth Sciences 88, 742–751.

al-Najem, M. H.
2000 Irrigation system and ancient water resources in Tayma area, Atlal - The journal of Saudi Arabian Archaeology 15, 191–197.

Neff, U. – Burns, S.J. – Mangini, A. – Mudelsee, M. – Fleitmann, D. – Matter, A.
2001 Strong coherence between solar variability and the monsoon in Oman between 9 and 6 kyr ago, Nature 411, 290–293.

Omer-Cooper, J.
1937 Zoological expedition to the oasis of Siwa, Egyptian Libya, Nature 140, 919–920.

Parker, A. G. – Goudie, A. S. – Stokes, S. – White, K. – Hodson, M. J. – Manning, M. – Kennet, D.
2006 A record of Holocene climate change from lake geochemical analyses in south-eastern Arabia, Quaternary Research 66, 465–476.

Petraglia, M. D. – Alsharekh, A. M. – Crassard, R. – Drake, N. A. – Groucutt, H. – Parker, A. G. – Roberts, R. G.
2011 Middle Paleolithic occupation on a Marine Isotope Stage 5 lakeshore in the Ne fud Desert, Saudi Arabia. Quaternary Science Reviews 30, 1555–1559.

Pint, A. – Frenzel, P. – Fuhrmann, R. – Scharf, B. – Wennrich, V.
2012 Distribution of *Cyprideis torosa* (Ostracoda) in Quaternary athalassic sediments in Germany and its application for palaeoecological reconstructions, Internation al Review of Hydrobiology 97, 330–355.

Plaziat, J.-C.
1991 Paleogeographic significance of the Cardium, Potamids and Foraminifera living in intracontinental salt lakes of North Africa (Sahara Quaternary, Egypt present lakes), Journal of African Earth Sciences 12, 383–389.

Plaziat, J.-C. – Younis, W. R.
2005 The modern environments of molluscs in southern Mesopotamia, Iraq: a guide to palaeogeographical reconstructions of Quaternary fluvial, palustrine and marine deposits, Carnets de Géologie / Notebooks on Geology: Article 2005/01 (CG2005_A01).

Por, F. D.
1972 Hydrobiological notes on the high-salinity waters of the Sinai Peninsula, Marine Biology 14, 111–119.

Prestwich, J.
1859 On the occurrence of flint-implements, associated with remains of extinct Mammalia, in undisturbed beds of a late geological period, Proceedings of the Royal Society of London 10, 50–59.

Purschwitz, C.
2017 The Prehistory of Tayma: The Chipped Stone Evidence. The surface finds and a techno-typological analysis of chert artefacts from the carnelian bead workshop SE2, Zeitschrift für Orient-Archäologie 10, 288–311.

Radies, D. – Hasiotis, S. T. – Preusser, F. – Neubert, E. – Matter, A.
2005 Paleoclimatic significance of Early Holocene faunal assemblages in wet interdune deposits of the Wahiba Sand Sea, Sultanate of Oman, Journal of Arid Environments 62, 106–125.

Rapp, G.
1975 The archaeological field staff: the geologist, Journal of Field Archaeology 2, 229–237.

Rapp, G. – Hill, C. L.
2006 Geoarchaeology: the earth-science approach to archaeological interpretation, New Haven, London.

Reimer, P. J. – Baillie, M. G. L. – Bard, E. – Bayliss, A. – Beck, J. W. – Blackwell, P. G. – Bronk Ramsey, C. – Buck, C. E. – Burr, G. S. – Edwards, R. L. – Friedrich, M. – Grootes, P. M. – Guilderson, T. P. – Hajdas, I. – Heaton, T. J. – Hogg, A. G. – Hughen, K. A. – Kaiser, K. F. – Kromer, B. – McCormac, F. G. – Manning, S. W. – Reimer, R. W. – Richards, D. A. – Southon, J. R. – Talamo, S. – Turney, C. S. M. – van der Plicht, J. – Weyhenmeyer, C. E.
2009 IntCal09 and Marine09 Radiocarbon Age Calibration Curves, 0–50,000 Years cal BP, Radiocarbon 51(4), 1111–1150.

Rosenfeld, A. – Vesper, B.
1977 The variability of the sieve-pores in recent and fossil species of *Cyprideis torosa* (Jones, 1850) as an indicator for salinity and palaeosalinity, in: H. Löffler – D. Danielopol (Eds.), Aspects of Ecology and Zoogeography of Recent and Fossil Ostracoda, The Hague, 55–67.

Schneider, P. I.
2010 Die Mauern von Tayma, in: J. Lorenzen – F. Pirson – P. I. Schneider – U. Wulf-Rheidt (Hrsg.), Aktuelle Forschungen zur Konstruktion, Funktion und Semantik antiker Stadtbefestigungen, BYZAS: Veröffentlichungen des Deutschen Archäologischen Instituts Istanbul 10, 1–25.

Schulz, E. – Whitney, J. W.
1986 Upper Pleistocene and Holocene lakes in the An-Nafud, Saudi Arabia, Hydrobiologia 143, 175–190.

Shalla, S. H. A. – Ghobashy, A. F. A. – Hartnoll, R. G.
1995 Studies on the barnacle *Balanus amphitrite* Darwin 1854 (Cirripedia) from Lake Timsah in the Suez Canal, Crustaceana 68(4), 503–517.

Subyani, A. M.
2004 Geostatistical study of annual and seasonal mean rainfall patterns in southwest Saudi Arabia, Hydrological Sciences Journal 49(5), 803–817.

Vaslet, D. – Janjou, D. – Robelin, C. – Al Muallem, M. S. – Halawani, M. A. – Brosse, J. M. – Breton, J. P. – Courbouleix, S. – Roobol, M. J. – Dagain, J.
1994 Explanatory notes to the geologic map of the Tayma quadrangle, sheet 27C, Kingdom of Saudi Arabia, scale 1:250,000, Directorate General of Mineral Resource, Jeddah.

Vincent, P.
2008 Saudi Arabia – an environmental overview, London.

Vita-Finzi, C.
1969 The mediterranean valleys: geological changes in historical times, London.

Warren, J. K.
2006 Evaporites – sediments, resources and hydrocarbons, Berlin – Heidelberg.

Whitney, J. W. – Gettings, M. E.
1982 Preliminary geological investigation of the Bi'r Hayzan diatomite deposit, Kingdom of Saudi Arabia. USGS Open-File Report 82-1046, United States Department of the Interior, Geological Survey.

Whitney, J. W. – Faulkender, D. J. – Rubin, M.
1983 The environmental history and present condition of Saudi Arabia's northern sand seas. USGS Open-File Report 83-749, United States Department of the Interior, Geological Survey.

Winnet, F. V. – Reed, W. L.
1970 Ancient records from North Arabia, Toronto.

Yechieli, Y. – Wood, W. W.
2002 Hydrogeologic processes in saline systems: playas, sabkhas, and saline lakes, Earth-Science Reviews 58, 343–365.

Cistanche tubulosa (Desert broomrape) is a root holoparasite on desert shrubs, like tamarisk and saxaul. A holoparasite is a plant which is completely parasitic on other plants. The fleshy stem of this broomrape is sometimes used in traditional medicine

نبات آذان الجن *Cistanche tubulosa* (هالوك الصحراء) هو نبات كامل التطفّل على جذور الشجيرات الصحراوية مثل الأثل والغضا. النبات كامل التطفّل هو النبات الذي يعيش بشكل طفيلي تام على النباتات الأخرى. يستخدم الجذع اللحمي لهذا الهالوك أحياناً في الطبّ التقليدي.

Taymāʾ Oasis (Saudi Arabia) and its Surroundings – a First Synthesis of the Flora, Vegetation, Natural Resources, and Floral History

Harald Kürschner and Reinder Neef

***Abstract**: Based on field studies in February 2009 and 2010, the flora and vegetation of the Taymāʾ oasis and surroundings are described and analysed for the first time. The phytosociological survey reveals more than 175 taxa and six communities whose distribution is determined mainly by geomorphological and edaphical factors. Typical for the rock (*hammada*), gravel deserts (reg) and the Qrayyah area of old Taymāʾ is a Fagonia bruguieri community, which is replaced on the extended sandy desert plains and sand sheets in the surroundings by two communities, typical for North Arabia: the Rhanterium epapposum community ('arfaj' shrubland; on rocky outcrops overblown with aeolian sands) and the Haloxylon salicornicum community ('rimth' shrubland; sandy desert plains). On sand dunes, the Artemisia jordanica community ('adhir' shrubland) dominates. The* sabkha *north of Taymāʾ shows a sparse vegetation of an Aeluropus littoralis community. In all communities (except the latter one), a luxuriant growth of a 'vernal aspect' is favoured after winter rainfalls, consisting of many widespread winter annuals and psammophytic ephemerophytes, derived from a common Saharo-Arabian floral stock. Towards the west (Hijaz Mts.), ca. 30 km west and south-west of Taymāʾ, a strong increase of Retama raetam is obvious, characterising the small sandy* wadi*s and runnels of the desert plain (Retama raetam-Zilla spinosa community). The larger* wadi*s in the Taymāʾ area are vegetated by very open, xeromorphic woodland consisting mainly of Acacia gerrardii and A. tortilis. They remain unstudied at present. Most of these* wadi*s today are destroyed, or heavily devastated by wood cutting, use as fuel reserve and/or sediment digging. A chorotype analysis of the communities documents the strong Saharo-Arabian character of the Taymāʾ vegetation. The final floral historical remarks give a first insight in the apparently younger vegetation history of the area.*
***Keywords**: Arabia, phytosociology, vegetation history, desert,* sabkha

ملخّص: تم للمرة الأولى وصف و تحليل مجموعة النباتات و الكساء الخضري لواحة تيماء و المناطق المحيطة بها و ذلك استناداً على دراسات ميدانية أجريت في شباط/فبراير ٢٠٠٩ و ٢٠١٠. يكشف مسح المجتمعات النباتية عن وجود أكثر من ١٧٥ نوعاً و ستة مجتمعات نباتية تحدد عوامل جيومورفولوجية و تربية أساساً توزعها. يعتبر مجتمع شكاعة بروغييري *Fagonia bruguieri* تقليدياً بالنسبة للصحارى الصخرية (الحماد) و السهول الحصوية و لمنطقة القريا في تيماء القديمة، و يحل محل هذه المجتمع في السهول الصحراوية الرملية الممتدة و الفرشات الرملية في المناطق المحيطة مجتمعان نباتيان تقليديان بالنسبة لمنطقة شمال الجزيرة العربية: مجتمع العرفج *Rhanterium epapposum* الذي تنتشر شجيراته على البروزات الصخرية المغطاة بالرمل الذي تذروه الرياح و مجتمع الرمث *Haloxylon salicornicum* الذي تنتشر شجيراته في السهول الصحراوية الرملية بينما يهيمن مجتمع العاذر *Artemisia jordanica* على منطقة الكثبان الرملية. تُظهر السبخة شمال تيماء انتشاراً متفرقاً لمجتمع العكرش الساحلي *Aeluropus littoralis*. يحصل نمو هائل بشكل ربيعي في كل هذه المجتمعات (ما عدا الأخير) و ذلك بعد هطول الأمطار الشتوية و يشمل هذا النمو العديد من النباتات الحولية الواسعة الانتشار و النباتات الرملية و العابرة القادمة من المخزون النباتي الصحراوي ـ العربي المشترك.
يزداد انتشار الرتم *Retama raetam* بشكل كبير و واضح كلما اتجهنا غرباً باتجاه جبال الحجاز أي حوالي ٣٠ كم إلى الغرب و الجنوب الغربي من تيماء، يميز هذا الانتشار الوديان الصغيرة الرملية و السواقي في السهل الصحراوي (مجتمع الرتم ـ الشبرم). تنتشر غابة صحراوية مفتوحة للغاية في الوديان الأكبر في منطقة تيماء و تتألف بشكل رئيسي من سنط جيراردي *Acacia gerrardii* و السمر *Acacia tortilis* إلا أنها لا تزال غير مدروسة في الوقت الحاضر. معظم هذه الوديان دُمِّر في الوقت الحاضر أو خُرِّب بشدّة بسبب الاحتطاب لاستخدام الخشب كاحتياطي للوقود و/أو بسبب جرف الرسوبيات. يوثّق تحليل التوزع الجغرافي للمجتمعات المدروسة طابعاً دامغاً صحراوياً ـ عربياً للكساء الخضري في منطقة تيماء. تعطي الملاحظات النباتية التاريخية لمحة أولى عن التاريخ الأحدث ظاهرياً للغطاء النباتي في المنطقة.
كلمات البحث: بلاد العرب، علم الاجتماع النباتي، تاريخ الكساء الخضري، الصحراء، السبخة.

1 Introduction

Reconstruction of the environment, e.g. potential natural resources like vegetation, is increasingly used in archaeology to understand the relationship of man to his environment in past and present times. One key factor for a better understanding and reconstruction of the environment is the present-day flora that provides insights into the natural potential of an area. The aim of the first field trips to the Taymāʾ oasis and its surroundings therefore were the evaluation of the flora (diversity, structure, distribution, site ecological requirements), the classification of the vegetation and the inventory of floristic key, chorological and archaeobotanical indicator species (forest and woodland relicts, grazing indicators) to document both real and potential plant resources. These studies provide the basis for archaeobotanical research at Taymāʾ, e.g. the study of botanical macroremains, like seeds, fruits and wood from the excavations at Qrayyah (Taymāʾ) and of botanical microremains, like pollen, from the cores taken from the sediments of the Taymāʾ *sabkha*.

The analysis of the recent vegetation, e.g., of the sand ecosystems (western fringe of the Great Nafud), rocky desert pavement areas and of the larger *wadi*s allows for a more accurate discussion of vegetation reconstruction, resource management and climate development. In the framework of environmental studies, provided by archaeobotany, palynology, archaeozoology and related disciplines the potential natural resources and life conditions in former Taymāʾ can be reconstructed.

In the following the first results of the floristical and phytosociological studies are presented. They give an insight into the rich, highly diverse and complex, sometimes mosaic-like vegetation units of the Taymāʾ area.

2 Study site

2.1 Topographic features

Taymāʾ and its surroundings belong to the Saharo-Arabian (Saharo-Sindian) floral region *sensu* Zohary (1973), characterised by an arid to hyperarid climate with annual rainfall of less than 50 mm per year. Plant life in this phytochorion is normally sparse and mostly confined to depressions, *wadi*s, runnels and rocky pavements that receive water from large catchment areas. In general these areas are treeless and the plant communities are often composed of very few species.

Geomorphologically, the Taymāʾ area and its surroundings belong to the Arabian Shield (Region III, cf. classification in Barth 1976). Principal topographical features in the area include:

- A sandstone plateau in the north (Tabuk area, Region III [1]; Barth 1976), which consists of buttes and canyons of Cambrian sandstones (‘Nubian sandstones’) which extend far to the south. To the east they merge into a plain of low sandstone outcrops.
- Extended lava fields (harrats), typical for the western Najd (Region III [2]; Barth 1976), including dissected table-lands and plains covered with thin sand from which isolated inselbergs rise.
- Crystalline basement rocks (Region III [3]; Barth 1976).

To the west, this region is bordered by the western Escarpment Mountains (Hijaz Mts.) (Region II, Barth 1976), towards the east and south-east by the fringes of the Great Nafud (mostly unconsolidated Quaternary sediments) and the Arabian Platform, the latter covered by a thick sequence of sedimentary rocks. Large parts are overlain by aeolian sands and late Tertiary and Quaternary gravel sheets, bare of vegetation or bearing open, diffuse shrublands or dwarf shrubs, which appear at first sight more or less randomly distributed. Plant cover usually is less than 15%. The inter-shrub space is bare for much of the year and only occupied for a few

weeks by a ground layer of rainy season ephemerals (Mandaville 1990). Most of the vegetation follows the 'mode contracté' (Monod 1954) and is confined to areas such as depressions, small runnels and *wadi*s which receive water from large catchment areas. By contrast, the vast sandy plains (south-western fringes of the Great Nafud) and interdune depressions harbour a diffuse vegetation pattern of small shrubs and dwarf-shrubs ('mode diffuse', Monod 1954).

Within the Taymāʾ area and its surroundings, five main ecosystems can be distinguished which are differentiated according to habitat factors (land form, soil characteristics, water capacity, water runoff) and floristic composition:

(1) *Wadi*s, vegetated by very open, xeromorphic woodland consisting of *Acacia gerrardii* and *A. tortilis*. Today most of these *wadi*s are destroyed, or heavily devastated by wood cutting for fuel and charcoal, (over)grazing, and sediment digging. The smaller *wadi*s and runnels of the desert plain towards the west (Hijaz Mts.) are vegetated by a *Retama raetam* shrubland.
(2) Rock (*hammada*) and gravel deserts (reg, serir), where most of the fine weathering products have been removed by the wind. Often the gravels are overblown by aeolian sands. These deserts belong to the most common and the most impressive landscapes by their bareness and dreariness.
(3) Sandy desert plains and sand sheets with rocky outcrops.
(4) Sand dunes.
(5) *Sabkha*s (saline, flat areas often formed by the drying up of former lakes).

2.2 Climate

The climate of most parts of North Arabia is characterised by very hot, dry, summers and cool to warm winters (accentuated arid desert climate; Fig. 1). Rain, if any, is brought by rain-bearing cyclonic depressions during winter and spring which originate in the Atlantic or Mediterranean. Throughout the area rainfall is erratic and unpredictable in time, quantity and space and often falls as heavy local showers. In some years certain areas may receive almost no rain.

A climate diagram of Taymāʾ is not available. However, the nearest stations, Tabuk in the north and al-'Ula in the south-west, give a good impression of the climate of the study area (Fig. 1).

The diagrams in Fig. 1 follow the notation of Walter (1973), plotting the mean monthly temperature (°C) to a scale which is twice the scale of the mean monthly rainfall (mm). Thus the mean monthly temperature can be taken as indication of the potential evapotranspiration or 'arid period'. Accordingly, all months have to be regarded as arid in the study area, which belongs to the hyperarid interior of Arabia. The mean annual rainfall is 32.1 mm in Tabuk, and 61.0 mm in al-'Ula, with a large variability regarding amounts, but also regarding locations (e.g., Tabuk: 2.8–55.1 mm; al-'Ula: 2.0–188.9 mm; cf. Alex 1985).

The mean annual temperature is 21.4 °C (Tabuk) respectively 24.6 °C (al-'Ula). The summers are dry and hot and during winter time (November to March), the absolute minimum temperature can drop down to -7 °C (Tabuk) respectively -0.5 °C (al-'Ula, Alex 1985). During summer dry northerly winds dominate, coupled with increasing summer temperatures, commonly above 45 °C (Alex 1985). Frosts are rare and if present, only of short duration.

This data indicate that the vegetation in large parts of North Arabia is controlled by rainfall primarily, whereas land form and biotic factors only have secondary effects. Consequently the vegetation in this area in large parts is at the limits of its existence.

3 Material and methods

3.1 Field work

The field work was conducted in February 2009 and 2010 during two field trips to the Taymāʾ area and its surroundings. All sampling localities are indicated in Fig. 1 and listed with their numbers in the heading of the synoptic table (Tab. 1) and in appendix 1.

The present study follows the traditional Braun-Blanquet approach (Braun-Blanquet 1964), using the modified scale of Barkman *et al.* (1964) and Dierschke (1994) for the combined valuation of cover and abundance. The vegetation was sampled in 55 plots. All communities are presented together in a synoptic table (Tab. 1) and remain rankless at present, to avoid unnecessary and/or incorrect names and complications in future studies. Frequency classes (I–V) given in the synoptic table following Dierschke (1994). Detailed vegetation tables of the communities, including the cover-abundance values are given in appendix 2 (Tabs. 3–8).

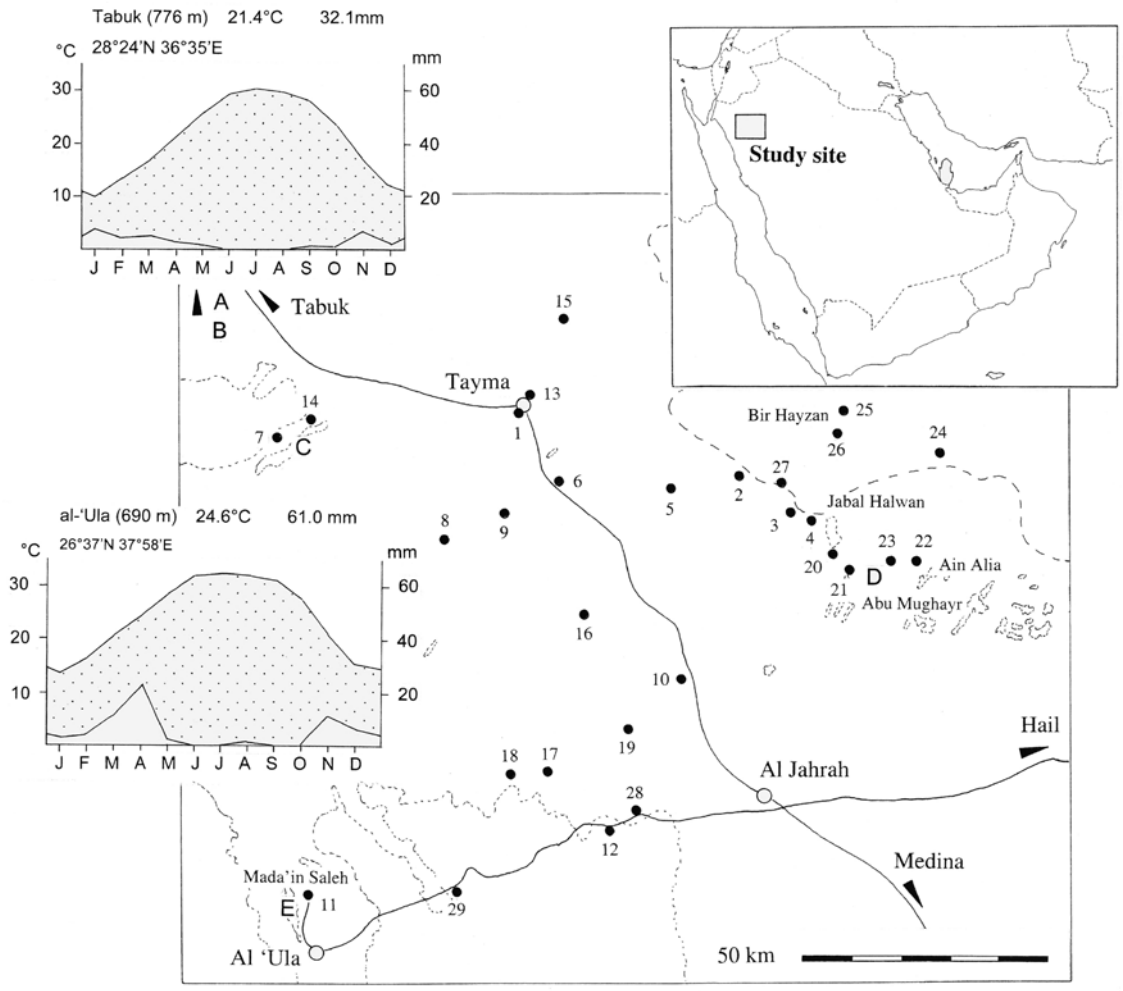


Fig. 1 *Study site and climate. Taymāʾ oasis and surroundings.*

الشكل ١ موقع و طقس الدراسة. واحة تيماء و المناطق المحيطة.

3.2 Taxonomy and nomenclature

Taxonomy and nomenclature of the taxa recorded (Appendix 3) follows the hitherto published first volume of the *Flora of the Arabian Peninsula and Socotra* (Miller – Cope 1996), the *Flora of Eastern Saudi Arabia* (Mandaville 1990) and the *Flora of the Kingdom of Saudi Arabia* (Chaudhary 1999–2001). In addition, the most recent taxonomic revisions have been consulted and in these cases given priority.

An entire set of the specimens collected is deposited in the herbarium of H. Kürschner (Berlin); with duplicates in the herbarium of the Botanischer Garten und Botanisches Museum Berlin-Dahlem (B). When present, pollen and diaspore samples were taken for the reference collection of the Deutsches Archäologisches Institut (DAI, Berlin, Germany).

3.3 Chorotype analysis

The chorotype analysis is based on the cover-abundance values of the phytosociological plots. Cover (dominance, co-dominance) is an important and decisive feature in the physiognomy of a community. The weighted spectra (mean cover-abundance values for each category) therefore much better reflect the chorological and phytogeographical character of a community and region than pure presence/absence data of taxa will do. The classification of chorotypes follows Zohary *et al.* (1980–1982) and Heller – Heyn (1986–1994).

4 Results and discussion

4.1 *Wadi*s

4.1.1 Acacia wadis of xerotropical Sudanian origin (Plate 1)

Seasonal water flows of *wadi*s draining wide catchment areas are one of the most common and important landscape elements of the Arabian Peninsula. Today, most of the larger *wadi*s and depressions of the hot and arid deserts of Arabia are covered by *Acacia*-dominated plant communities. These communities are restricted to alluvial soils that have freshwater available in the root zone. The drainage system, the transport and texture of the sediments, the depth of the groundwater table, the frequency of overflows and the variability of rainfall strongly determine the vegetation, which consists of a mixture of a Sudanian xero-tropical arborescent flora and a Saharo-Arabian flora in the ground layer (Kürschner 1986; Kürschner 1998; Mandaville 1984). As *wadi*s harbour the only arboreal vegetation in large parts of North, East and Central Arabia, they have been attractive for man and his livestock, both in the ancient and recent history of tribes and settlements. This vegetation is highly endangered nowadays by destruction, e.g., cutting of young shoots and beating of leaves for fodder, cutting of trunks for firewood and charcoal, destruction of the herb layer by litter pollution, trampling and grazing, and quarrying of sediments.

Nearly all *wadi*s in the surroundings of Taymāʾ (e.g., Wadi Qalibah and tributaries, locality A, B, Fig. 1; Wadi Madyses, locality C, Fig. 1) are characterised by destruction and digging of sediments, leaving back naked ground and many stumps and bare-cutt trunks of *Acacia's* (Plate 1.3, 5, 6). Today, most of these *wadi*s provide floristical impoverished stands, the vegetation seriously in danger of extincton. The occurence of the recent stands of *Acacia-wadi*s therefore must be seen as remnants of former larger and denser woodlands that originate from a xero-tropical arborescent vegetation of palaeotropical origin. These woodlands migrate via the large *wadi* systems from refuge areas in the mountains of western Arabia during more humid periods in Early Pleistocene

times (Kürschner 1998). They played an important role in water balance, water and wind erosion and animal life.

Main arboreal components are *Acacia gerrardii* (dominant) and *A. tortilis* (only sporadically), both today heavily devastated and/or affected by wood cutting. Co-dominant in the understorey are *Artemisia judaica, Astragalus sieberi* (Plate 1.4), *Farsetia aegyptia, F. burtonae, Panicum turgidum, Periploca tomentosa, Polycarpaea repens,* and *Schouwia purpurea*. After winter rainfall, a common floristic stock of psammophytic ephemerophytes can be observed, consisting of *Aizoon canariense, Arnebia hispidissima, A. linearifolia, Asphodelus tenuifolius, Astragalus hauarensis, A. schimperi, A. tribuloides, Bassia eriophora, Cleome amblyocarpa, Eremobium aegyptiacum, Ifloga spicata, Koelpinia linearis, Launaea mucronata* subsp. *cassiniana, Paronychia arabica* subsp. *breviseta, Picris babylonica, Plantago ciliata, P. cylindrica, Savignya parviflora, Schismus arabicus, S. barbatus, Seetzenia lanata,* and *Zygophyllum simplex*. This 'vernal aspect' is common to many communities in the surrounding of Taymāʾ.

An impression of a more natural and undisturbed *Acacia wadi* is provided by the fenced part of the Wadi al-'Ula in Mada'in Saleh (locality E, Fig. 1; Plate 1.1, 2). The vegetation here is formed by a distinct, 3-stratified arboreal layer, consisting of

(1) large emergent (monumental) trees of mainly *Acacia gerrardii* and *A. tortilis* (height: 10–15 m, trunk diameter: > 1 m; crone diameter: up to 16 m),
(2) a second tree layer of *Acacia raddiana* and *A. tortilis* (height: 7–10 m),
(3) a very dense shrub layer (cover up to 100%; height: 4–6 m), consisting mainly of div. Chenopodiaceae (e.g., *Atriplex halimus, A. leucoclada, Salsola cyclophylla, S. imbricata, S. tetrandra, Suaeda monoica*), *Lycium shawii*, and *Ochradenus baccatus* (Plate 1.2).

In addition, a well established and very dense herb layer exists (height: 0.4–0.7 m; cover: 100%) dominated, by *Astragalus corrugatus, Bassia eriophora, Lepidium aucheri, Phalaris paradoxa,* and *Suaeda aegyptiaca*. Today such *wadi*s are a rarity in North Arabia and – if fenced – impressively demonstrate the effect of the exclusion of man and his livestock and the high natural potential of undisturbed *wadi* communities for former wildlife.

4.1.2 *Retama raetam* wadis of Saharo-Arabian origin (Plate 2)

Small and medium-sized sandy *wadi*s and runnels are a common geomorphological feature in north-western Aabia and cut the vast *harrat*s, *hammada*s, reg and gravel plains. They are vegetated by a shrub formation of Saharo-Arabian origin, dominated by *Retama raetam*. *'Retam'* shrubland is widely distributed in the deserts of the Sinai and Negev, the Judean Desert, southern Jordan (Wadi Araba, Wadi Ram area) and North-West Arabia (Tabuk area). It is typical also for the inselbergs, sandstone outcrops and weathered sandstones west and south-west of Taymāʾ (Arada area), becoming more frequent towards the mountainous sandstone area of al-'Ula.

Tab. 1 *Main ecosystems and plant communities (synoptic table of character species) in Taymāʾ and surroundings (NW Arabia).* [*1 Retama raetam-Zilla spinosa community, 2 Fagonia bruguieri community (rocky development); 3 Fagonia bruguieri community (sandy development); 4 Rhanterium epapposum community; 5 Haloxylon salicornicum community; 6 Artemisia jordanica community; 7 Aeluropus littoralis community*].

الجدول ١ النظم البيئية و المجتمعات النباتية الرئيسية (جدول إجمالي للأنواع المميزة) في تيماء و محيطها (شمال غرب الجزيرة العربية).
[1 مجتمع الرتم - الشبرم *Retama raetam-Zilla spinosa*؛ 2 مجتمع شكاعة بروغييري *Fagonia bruguieri* (تطور متعايش مع بيئة صخرية)؛ 3 مجتمع شكاعة بروغييري *Fagonia bruguieri* (تطور متعايش مع بيئة رملية)؛ 4 مجتمع العرفج *Rhanterium epapposum*؛ 5 مجتمع الرمث *Haloxylon salicornicum*؛ 6 مجتمع العاذر *Artemisia jordanica*؛ 7 مجتمع العكرش الساحلي *Aeluropus littoralis*].

Ecosystem	**Small wadis and runnels**	**Rock and gravel desert (hammada, reg)**		**Sandy desert plain and sand sheets**		**Sand dunes**	**Sabkha**
	Sandy	Reg	Sandy reg	with rock outcrops			
Community type	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Sampling localities *(cf.* Fig. 1)	12, 17, 19, 28, 29	7, 14,15	1, 5	6, 9, 20-23	2, 3, 10-12, 16, 18	4, 8, 10, 24-27	13
No. of plots	8	4	8	9	13	11	2
Mean no. of species	26.9	21.0	19.1	20.6	15.7	15.1	10.5
Mean cover (%)	45.0	33.8	32.5	30.0	34.2	28.6	30.0
Character species							
Retama raetam	V_{2a-3}	.	.	.	.	.	.
Zilla spinosa	III_{+-1m}	.	.	.	.	.	.
Ferula communis	IV_{+-2a}	.	.	.	.	.	.
Blepharis ciliaris	III_{+}	.	.	.	.	.	.
Fagonia bruguieri	V_{+-1}	V_{2a}	V_{+-2b}	I_1	.	.	.
Morettia parviflora	.	V_{+-1}	IV_{+}	.	.	.	.
Diplotaxis acris	.	V_{2a-2b}	.	.	.	.	.
Fagonia schweinfurthii	.	V_1	.	.	.	.	.
Helianthemum lippii	.	V_{2a}	.	.	.	.	.
Heliotropium crispum	.	V_{+-2a}	.	.	.	.	.
Rhanterium epapposum	.	.	.	V_{2a-3}	.	.	.
Gymnocarpos decandrus	.	III_1	.	V_{1-2a}	.	.	.
Haloxylon salicornicum	V_{2a-3}	.	.	.	V_{1-3}	.	.
Ephedra alata	IV_{1-2b}	.	.	.	IV_{1-3}	IV_{2a-3}	.
Artemisia jordanica	.	.	.	.	.	V_{1-2a}	.
Calligonum comosum	.	.	.	.	.	IV_{+-3}	.
Moltkiopsis ciliata	.	.	.	.	.	IV_{+-1}	.
Stipagrostis drarii	.	.	.	.	.	IV_{1-1m}	.
Scrophularia hypericifolia	.	.	.	.	.	II_{+-1}	.
Aeluropus littoralis	.	.	.	.	.	.	V_{1-1m}
Frankenia pulverulenta	.	.	.	.	.	.	V_1
Common stock of widespread Saharo-Arabian ephemerophytes							
Schismus barbatus (incl. *S. arabicus*)	IV_{1m-2a}	V_{1-1m}	IV_{+-1m}	V_{+-1m}	IV_{+-1m}	III_{+-1m}	.
Asphodelus tenuifolius	IV_{+-1}	V_{1m-2a}	I_{+}	III_{+}	II_{+}	.	.
Plantago ciliata	IV_{1-1m}	V_{+-1}	IV_{1-1m}	III_{+-1}	II_{1-1m}	.	.
Eremobium aegyptiacum	V_{1-2a}	.	IV_{+-1m}	V_{+-1m}	V_{1-1m}	V_{1m}	.
Ifloga spicata	IV_{1m-2a}	.	IV_{1-1m}	V_{+-1m}	V_{+-1m}	I_1	.
Anthemis scrobicularis	V_{1-1m}	.	III_{1-2a}	.	V_{+-2b}	V_{1m-2a}	.
Astragalus schimperi	III_{1-1m}	.	II_{+-1}	IV_{+-1}	IV_{+-1}	.	.
Neurada procumbens	I_1	.	IV_{+-1}	I_{+}	III_{+-1}	.	.
Savignya parviflora	.	III_{+-1}	IV_{+-2a}	IV_{+-1m}	II_{+}	.	.
Astragalus hauarensis	III_{+-1}	.	II_{+}	IV_{+-1}	III_{+-1}	.	.
Aizoon canariense	II_{1-1m}	V_{+-1}	V_{1-2a}	.	II_{r-+}	.	.
Anisosciadium lanatum	.	.	II_{1m-2a}	III_{+}	II_{+}	.	.
Arnebia linearifolia	II_{+}	.	II_{+}	IV_{+-1}	.	.	.
Common stock of widespread Saharo-Arabian chamaephytes and hemicryptophytes							
Stipagrostis plumosa	V_{1-1m}	V_{+-1m}	V_{+-1}	V_{+-1}	V_{+-2b}	I_{1m}	.
Farsetia burtonae	.	.	II_{+}	I_{+}	II_{+}	.	.
Polycarpaea repens	II_{+-1}	.	II_{+}	.	.	I_{+}	.

Retama raetam-Zilla spinosa community
(*'retam'* shrubland, Tab. 1 [1], Tab. 3, Plate 2)

Floristic inventory

Character species of the *'retam'* shrubland is *Retama raetam*, one of the most common desert shrub with extension into the Mediterranean and Irano-Turanian territories. It is a 1–2 m tall, evergreen, broom-like profusely branched shrub with a very striking spartioid habit and white flowers (Plate 2.1, 2). Its optimal range includes sandy *wadi*s, where it survives dry years when sufficient run-in water is available even after light showers. Co-associates are *Blepharis ciliaris* and *Zilla spinosa* (Plate 2.3), the latter dwarf-shrub varying from 20 cm to 1.5 m in height. As in *Retama*, the leaves of *Zilla* are shed soon and the leafless green stems carry on photosynthesis. Fruit and seed dispersal in the *wadi*s takes place by flood water or when the entire dead plants or broken parts are dislodged by floods or wind (e.g., *Zilla spinosa*). The number of accompanying species, especially Saharo-Arabian ephemerophytes can be high and varies from year to year depending on rainfall and run-in moisture. To be mentioned are *Anthemis scrobicularis, Eremobium aegyptiacum, Erodium oxyrhynchium, Leysera leyseroides, Medicago laciniata, Plantago ciliata*, or *Trigonella stellata*. Within the chamaephytes, the spiny *Astragalus spinosus* is fairly common, easily recognized by the strong inflated calyx enclosing the fruit (Plate 2.4, 5). As in *Retama* and *Zilla*, dispersal of the fruits is by *wadi* floods or strong wind.

Vegetation analysis

The *Retama raetam-Zilla spinosa* community (Tab. 1 [1]) is indicated by eight plots, all confined to the south-western part of the study area. Here, the weathering products of the surrounding sandstones are accumulated in most of the small *wadi*s, offering optimal site conditions for the community. In spring time, the white-flowering spartioid twigs of *Retama raetam* are widely visible in the desert. Often interspersed are single trees and shrubby remnants of isolated *Acacia gerrardii* and/or *A. tortilis*, indicating a former denser arborescent flora which today is mostly destroyed due to severe grazing and wood cutting. Most of these small *Retama wadi*s are embedded in the vast sandy desert plains or cut the gravel plains. Introgressives of the adjacent communities such as *Haloxylon salicornicum* and *Ephedra alata* (*Haloxylon salicornicum* community) or *Fagonia bruguieri* and *Stipagrostis plumosa* (*Fagonia brugieri* community) therefore are frequent in the understorey of the community, and partly reach a high cover-abundance (Tab. 1 [1]). A strict delimitation of the community then often is difficult due to the overlapping floristical and ecological site conditions.

The more overgrazed, ruderal and polluted aspect of the today's *wadi*s is indicated by *Citrullus colocynthis, Euphorbia retusa, Ferula communis*, and *Lycium shawii*, which contribute much to the present community's physiognomy. After rainfall, the sands provide an excellent substrate for many psammophytic ephemerophytes, increasing the number of species in the community to 40 per plot (mean species number 26.9). The cover vary from 25–60% (mean cover 45%) and the mean plot size is 51.5 m^2.

The *'retam' wadi* vegetation, as well as communities dominated by *Retama raetam* are poorly studied at present and difficult to classify, as *Retama* may occur in many different vegetation units. Zohary (1973) reported a *Retama raetam-Zilla spinosa* fagonietosum subassociation from southern Palestine which might be conspecific with the stands in the Taymāʾ area. These northern stands are characterised additionally by different *Fagonia* spp. In deed, this holds true for the sites studied in the Taymāʾ area, also characterised by a high constancy of *Fagonia brugieri*. At present, however, it remain unclear if this taxon invades the *wadi*s from the nearby reg and gravel plains (*Fagonia bruguieri* community) or can be seen as an ecological indicator of special site conditions within the *Retama-Zilla* community *sensu* Zohary (1973). To solve this problem and for a better classification, more phytosociological samples are required.

Both character species, *Retama raetam* and *Zilla spinosa* provide an excellent source of

fodder for goats and camels which browse the leaves, flowers and fruits in spring time. The stems of *Retama* are cut for fuel and charcoal production.

4.2 Rock (hammada) and gravel deserts (reg/serir) (Plate 3)

Rock and gravel deserts consist of large plains resembling a pavement which is covered with packed small to medium-sized gravel or rubble of various lithological origins (Zohary 1973). They are made up of a silex or debris of often calcareous crusts. The soil surface is covered to at least 75% by stones. The alluvial pavement, often mixed with sand, has been transported from the adjacent plateaus or mountains and is characterised by strong deflation. These 'sand *hammada*s' form a boulder pavement with secondary sand drifts in the study area, very poor in water-soluble salts. Water run-off in these areas often is limited by the sand layer, supporting a relatively rich flora and a dense flush of ephemerophytes and winter annuals which germinate after the winter and spring rains.

Floristic inventory

Reg and sandy reg formations are widely distributed in the Taymāʾ area, including the archaeological sites of the old oasis. The whole Qrayyah area, including the central hill and the sites around the north city wall are occupied by sandy reg and sandy slopes, vegetated by a sparse cover of dwarf shrubs consisting of *Fagonia bruguieri* (Plate 3.4), *F. glutinosa, F. indica, Farsetia burtonae*, and *Morettia parviflora*. Further perennials in the flora, which contribute much to the physiognomy are *Cornulaca aucheri, C. monacantha, Haloxylon salicornicum, Helianthemum lippii, Polycarpaea repens, Stipagrostis obtusa, S. plumosa*, and *Suaeda monoica*. The most visible perennial grass in these sandy reg formations is *Stipagrostis plumosa*. It is a major grazing resource and valuable browse before the panicle appearance.

After winter rainfalls, a luxuriant growth of a 'vernal aspect' appears consisting of winter annuals and psammophytic ephemerophytes. They increase – for a short time – the number of species in the Qrayyah area to more than 70 species, and change the former 'desert' into a green spotted area of patches of annuals. They concentrate mostly on soft deposits, usually shallow sheets of sand, which provide a briefly sustained water supply during the rainy season. Most of these patches of ephemerals look like micro-oases amidst the dry desert plain (Zahran – Willis 1992). The majority of them exhibits typical desert ephemeral life cycles with rapid germination, quick development and flowering, and considerable size plasticity (Mandaville 1998).

Typical examples are *Aizoon canariense* (Plate 3.3), *Mesembryanthemum forsskalii* and *Zygophyllum simplex* (succulent type of ephemeral vegetation), ephemeral grasses such as *Cutandia memphitica, Schismus arabicus, S. barbatus*, and herbaceous ephemerals such as *Aniscosciadium lanatum, Anthemis scrobicularis, Arnebia hispidissima* (Plate 3.2), *A. linearifolia, A. tinctoria, Asphodelus tenuifolius, Astragalus hauarensis, A. schimperi, A. tribuloides, Bassia eriophora, Cakile arabica, Cleome ambylocarpa, Diplotaxis acris, Eremobium aegyptiacum, Erodium oxyrhynchium, Gymnarrhena micrantha, Ifloga spicata, Lappula sinaica, Lasiopogon muscoides, Launaea capitata, L. mucronata* subsp. *cassiniana, Leysera leyseroides, Medicago laciniata, Monsonia nivea, Neurada procumbens* (Plate 3.6), *Oligomeris linifolia, Picris babylonica* (Plate 3.7), *Plantago ciliata, P. cylindrica* (Plate 3.5), *Pteranthus dichotomus, Rumex vesicarius, Savignya parviflora, Seetzenia lanata, Senecio breviflorus, S. glaucus, Silene arabica, Tribulus terrestris* var. *terrestris, Trichodesma africana*. They all belong to a common stock of psammophytic Saharo-Arabian ephemerophytes, widely distributed in the eastern desert of Egypt (Zahran – Willis 1992), South-West Jordan (Baierle 1993), central and eastern Saudi Arabia (Baierle *et al.* 1985; Mandaville 1990; 1998). They are important contributors to biomass production in sandy ecosystems and therefore of great economic importance as valuable grazing resources.

The small silty-clayey depressions in the Qrayyah area are vegetated by a relatively dense flora, with additional ruderals and somewhat 'weedy', nitrophytic species. Examples are *Anastatica*

hierochuntica, Atriplex halimus, Brassica tournefortii, Hyoscyamus aureus, H. muticus, H. pusillus, Lepidium aucheri, Malva parviflora var. *parviflora, Salsola imbricata,* and *Suaeda vermiculata*. These sites are partly polluted and obviously often used as a place to rest for herds of sheep and goats.

Vegetation analysis

Fagonia brugieri community (Tab. 1, Tab. 4)

The vegetation analysis (phytosociological sampling) of the Taymāʾ area and its surroundings shows that the stands (plots) analysed can be classified as *Fagonia brugieri* community (cf. summarizing Tab. 1). Most prominent in the community are the two Zygophyllaceae, *Fagonia brugieri* and *F. glutinosa* which might be the character species of an, at present, undescribed association (Baierle *et al.* 1985).

Within the Taymāʾ area and surroundings, two developments of the community can be observed:

- A more rocky, gravelly pavement where most of the weathering products were carried away by the wind (Tab. 1 [2]),
- and a sandy-gravelly pavement, which favours the establishment of a 'vernal aspect' of winter annuals and psammophytic ephemerophytes (Tab. 1 [3]) after rainfall.

The rocky and gravelly plateaus north and north-west of Taymāʾ (surroundings of Wadi Madyses, Wadi Abu Sillah, Fig. 1) are characterised by a typical gravel desert (reg formation with 'Wüstenlackbildung'), dominated by various dwarf shrubs. In addition to the character species *Fagonia bruguieri* and *F. mollis*, further woody species, such as *Fagonia schweinfurthii, Gymnocarpos decandrus, Helianthemum lippii,* and *Heliotropium crispum* occur with high constancy on the rocky pavement. Together with the winter-spring annuals *Diplotaxis acris*, which is typical for gravelly ground (reg), *Trigonella stellata*, and the luxuriant growth of *Asphodelus tenuifolius* they additionally characterise this development of the community. Most conspicuous in the community is *Gymnocarpos decandrus*, an intricately branched shrublet with white to greyish-white bark, widely distributed in the rock and gravel deserts of the Saharo-Arabian region. Communities of this type, often were classified as Gymnocarpetum fruticosi Eig 1938 (syn. Gymnocarpetum decandri Zohary 1973), and reported also from the neighbouring south-western Jordan by Baierle (1993) ('*Gymnocarpos decandrum* Bestände'). The specific hierarchical rank of these communities, however, still is unsolved and needs further phytosociological studies.

Much more widely distributed in the surroundings of Taymāʾ and the south-eastern al-Kotayeb area are gravelly pavements, frequently overblown with sand. Together with smaller sand sheets and sandy slopes they form a complex mosaic, vegetated by the typical *Fagonia bruguieri* community (Tab. 1 [3]). During summer, the community can easily be overlooked. This unfavourable season is withstanded in an arido-inactive (passive) state, where most of these ephemeral species have disappeared and most of the dwarf shrubs have shed their leaves. Wide areas then give the impression to be bare of vegetation.

This vegetation is largely affected by the use as grazing and firewood reserve by the Bedouins and local villagers. Modern transport by 'pick-up' cars has led to a greater dispersion of the grazing pressure on these communities. Access to grazing in large parts of the study area was formerly limited by the absence of water supplies. Today this is overcome by the Bedouins' use of tank tracks to transport water from drilled wells to the sporadically existing grazing grounds.

4.3 Sandy desert plains and sand sheets (often with rock outcrops)

A further characteristic of North and Central Arabia are sandy desert plains and sand sheets, often overlying rock outcrops, rock and stone deserts (*harrat*s, *hammada*s). In North Arabia, these areas are mainly vegetated by two communities, dominated by *Rhanterium epapposum* and *Haloxylon salicornicum* (Frey – Kürschner 1989; Miller – Cope 1996).

4.3.1 *Rhanterium epapposum* community (*'arfaj'* shrubland) (Tab. 1 [4], Tab. 5, Plate 4)

Communities formed by *Rhanterium epapposum* are common in North and Central Arabia. They concentrate between 25° and 30° N and from 40° E to the Arabian Gulf, Kuwait and Iraq (Vesey-Fitzgerald 1957). The typical habitats are slightly rolling areas where windblown shallow sand overlies sandstone, limestone or gravel plains, but they are lacking on high dynamic dunes.

Whereas the community is very widespread on the eastern Arabian Platform, dominating vast areas, it does not extend very far into the Arabian Shield. The Taymāʾ area and surroundings therefore harbour one of the westernmost outposts of this vegetation type. Wide areas of this habitat type are found south and south-west of Taymāʾ, where the community is well developed. On deeper sand layers and towards the west, it is often replaced by the *Haloxylon salicornicum* community *('rimth'* shrubland).

Floristic inventory

Characteristic of the *'arfaj'* shrubland is *Rhanterium epapposum*, a composite dwarf shrub profusely branched and woody at the base, shedding the leaves during the dry part of the year (Plate 4.2, 3). Co-associate is *Gymnocarpos decandrus*, typical for places where rock outcrops and gravel are overlain with ribs of windblown sand (Plate 4.4). Frequently associated in the understorey is *Astragalus spinosus*, a thorny dwarf shrub easily recognizable by its balloon-like, inflated calyces which enclose the fruits (Plate 2.4, 5). Further dwarf shrubs and perennials at these stands are *Fagonia bruguieri, F. glutinosa, Farsetia burtonae, Stipagrostis ciliata, S. obtusa,* and *S. plumosa*.

The windblown sands arrest and absorb sheet flow, leading – as in the former community – to a thin carpet of annual herbs and grasses (mainly Saharo-Arabian ephemerophytes) in great variety between the dwarf shrubs after the winter rains. Most common are *Aniscosciadium lanatum, Arnebia linearifolia, Asphodelus tenuifolius, Astragalus hauarensis, A. schimperi, A. tribuloides, Cenchrus ciliaris, Cleome amblyocarpa, Eremobium aegyptiacum, Erodium oxyrhynchium, Gymnarhena micrantha, Hippocrepis areolata, Ifloga spicata, Launaea capitata, L. mucronata* subsp. *cassiniana, Matthiola longipetala, Medicago laciniata, Moltkiopsis ciliata, Neurada procumbens, Plantago boissieri, P. ciliata, P. cylindrica, Savignya parviflora, Schismus arabicus, Silene arabica,* and *S. villosa*.

Vegetation analysis

The *Rhanterium epapposum* community was sampled in nine plots in the surroundings of Taymāʾ and the Abu Mughayr area (Tab. 1 [4]). The cover ranges from sparse (10%) to relatively dense 40% (mean cover 30%), leading to a diffuse distribution of the community over the rocky outcrops. It presents one of the best grazing types in North Arabia. However, as most species are highly palatable and nutritious, it is underlying a high danger of overgrazing (Thalen 1979). In spring, the grazing value even for sheep and goats is high, due to the presence of grasses and forbs. In addition, the woody dwarf shrubs of *Rhanterium epapposum* are cut for firewood.

The *Rhanterium epapposum* community has a wide distribution in northern and eastern Arabia. It is reported by Baierle *et al.* (1985) from central Saudi Arabia (area between ar-Riyadh, Thadiq, Shaqra, Afif, and Dawadmi), where it is typical for flat, gravelly plains with low sand layers. Mandaville (1990) presents an example from eastern Arabia (17 km north-east of Qaryat al-Ulya), and Halwagy *et al.* (1982) from the Kuwait desert. It is very frequent also in the Thumama area north of Riyadh (Baierle – Kürschner 1985) within the western gravel plain where rocky outcrops are overblown with aeolian sands. This raises the question, if the *Rhanterium* community represents the climax vegetation of northern, central, and eastern Arabia. However, as this dwarf shrubland is of great importance as a grazing resource and often heavily overgrazed over wide areas, it cannot be ascertained whether or not this community is a remnant of the natural climax.

4.3.2 *Haloxylon salicornicum* community ('*rimth*' shrubland) (Tab. 1 [5], Tab. 6, Plate 5)

The *Haloxylon salicornicum* community is widely distributed in the Taymāʾ area and its surroundings. It covers more land in North Arabia than any other vegetation type (Mandaville 1990), being one of the dominant communities of the landscapes of the Arabian Platform. It ranges from Iraq to north-eastern Arabia, down into the northern edge of the Rub' al-Khali and towards north-western Arabia (Arabian Shield), the Sinai Peninsula and the deserts of Egypt. In general it is growing on sandy gravel plains (regs) and areas, where the sand is derived from the weathering of sandstone.

Floristic inventory

Character species is *Haloxylon salicornicum* (syn.: *Hammada salicornica, Hammada elegans*) which forms a complex of various plant communities depending on land form and soil type (Plate 5.1, 2). Luxuriant growth, however, occurs where deep sand is accumulated. Here it forms a diffuse but typical vegetation pattern on the sands, together with co-associates, such as *Ephedra alata* (Plate 5.3), *Fagonia glutinosa, Farsetia burtonae, Polycarpaea repens,* and *Stipagrostis plumosa* (Tab. 1 [5]).

After the winter rainfalls, as in the previously described communities, the common stock of widely distributed Saharo-Arabian psammophytic ephemerophytes is obvious. To name are *Aizoon canariense, Anisosciadium lanatum, Anthemis scrobicularis, Arnebia hispidissima, A. tinctoria, Asphodelus tenuifolius, Astragalus hauarensis, A. schimperi, A. tribuloides, Bassia eriophora, Cakile arabica, Citrullus colocynthus, Cleome amblyocarpa, Cutandia memphitica, Eremobium aegyptiacum, Erodium oxyrhynchium, Gastrocotyle hispida, Gymnarhena micrantha, Horwoodia dicksoniae, Ifloga spicata, Koelpinia linearis, Launaea capitata, L. mucronata* subsp. *cassiniana, Neurada procumbens, Oligomeris linifolia, Picris babylonica, Plantago ciliata, P. cylindrica, Savignya parviflora, Schismus barbatus, Sclerocephalus arabicus, Silene villosa*, and *Zygophyllum simplex*, which all contribute to the 'vernal aspect' of the community. They concentrate mainly on micro-nebkhas and miniuature dunes formed around the base of *Haloxylon salicornicum* (Brown – Porembski 1998). Sporadically *Retama raetam* occur, as well as *Centropodia fragilis* and *Scrophularia hypericifolia*.

Vegetation analysis

The *Haloxylon* community has a wide distribution in the Taymāʾ area, represented by 13 plots (Tab. 1 [5]). Frequently associated and highly constant is *Ephedra alata*, which is also typical for this type of vegetation across the Red Sea in the eastern desert of Egypt, between Suez and Hurghada and southwards to the Sudanian border (Zahran – Willis 1992) and East Arabia (Mandaville 1990). Stands of this type often are classified as *Ephedra alata* community, however, hardly deserve the rank of a community of its own.

Clearly dominant is *Haloxylon salicornicum*, a scaly leaved, succulent shrub or dwarf shrub, with green articulate branches and very deep roots that forms hummocks that may reach considerable sizes. New stems elongate in spring and the whole plant is physiologically most active during summer (arido-active). On older twigs, the succulent, green, assimilating cortex dries out, becomes whitish, slits and is shed from the shoots. Its winged, one-seeded diaspores are dispersed during winter by wind and germinate rapidly after rainfall. Often drops of a sweet fluid excreted by insects can be seen, which is collected by the bedouins and called 'mann el-rimth' (Danin 1983).

Haloxylon salicornicum itself, as the whole community, is a major range resource and major summer pasture for livestock. Especially camels like stands of this type particularly, grazing the *Haloxylon* and *Ephedra* with preference. As this plant community is under intensive pressure from overgrazing and is also used as a fuel source – the bedouins pull out 'pick-up'-loads for their winter camps – the whole community is seriously endangered. In spring time, the grazing value

of this community is high also for sheep and goats, due to the luxuriant presence of ephemeral grasses and forbs.

The relation of the *Haloxylon salicornicum* community to distinct edaphic or climatic factors appears much less clear, compared to the *Rhanterium epapposum* community. Although one of the most abundant communities and widely distributed in the deserts south and east of Cairo/Egypt (Kassas 1953), the southern part of the Sinai Peninsula, Jordan, Iraq, and Kuwait (Halwagy *et al.* 1982; Thalen 1979; Zohary 1950). Vesey-Fitzgerald (1957) does not recognize a distinct *Haloxylon* community in northern and central Arabia and considers it as a subtype of his *Stipa* steppe. He maintains that the dominance of *Haloxylon salicornicum* over vast areas indicates saline conditions. However, *H. salicornicum* is not a true halophyte and – as shown by the studies of Baierle – Kürschner (1985), Baierle *et al.* (1985), Mandaville (1990) and Popov – Zeller (1963) – has a wide ecological range, ranging from gravelly soils, sand blown sheets to fixed sandy plains. This indicates, without doubt, the existence and wider distribution of a *Haloxylon salicornicum* community in Arabia. Examples are given by Baierle *et al.* (1985) from central Saudi Arabia (between ar-Riyadh, Thadiq, Shaqra, Afif, Dawadmi), Mandaville (1990) (eastern Arabia, 18 km south-west of as-Saffaniyah), Halwagy *et al.* (1982), Brown – Porembski (1998) from the Kuwait desert, and Zahran – Willis (1992) from the eastern desert of Egypt. It is very common also in the Thumama area north of Riyadh, dominating the physiognomy of the plains together with *Ephedra alata* (Baierle –Kürschner 1985). At present, however, it remains unclear if the *Haloxylon salicornicum* community is of natural origin (climax community) or represents only a remnant of another community type (substitute community) supported by heavy grazing.

4.4 Sand dunes

4.4.1 *Artemisia jordanica* community (*'adhir'* shrubland) (Tab. 1 [6], Tab. 7, Plate 6)

The *Artemisia jordanica* community is typical for inland sands and dunes, including larger parts of the Great Nafud and most of the Dhahna (Chaudhary 1983; Mandaville 1990; 1998). It is confined to extreme desert areas with less than 50 mm rainfall per year, where it occurs on the mid-upper part of the dunes, interdune depressions, the sides of deep hollows and on the large sheets of undulating deep sands. Sand, compared to other substrates has a relatively high porosity, permeability and wettability. All rainfall is absorbed and runoff is negligible. Rainwater infiltrating in the rainy years may be stored in deeper layers for a longer period, and a relatively persistent moist horizon exists within the root zone. This layer is exploited by the extensive horizontal root system of many psammophytes, enabling them for an optimal use of moisture (Mandaville 1998). Large sand areas therefore can sustain a sparse but diffuse vegetation of deep rooting shrubs and dwarf shrubs.

This psammophytic flora and some floristically impoverished remnants exist at the south-western fringes of the Great Nafud south-east (al-Kotayeb area), south (al-Jahrah area) and south-west (al-Buayb al-Astnay) of Taymāʾ. Typical stands (dunes, interdune depressions) were studied in the area of Biʻr Hayzan (Great Nafud).

Floristic inventory

The physiognomy of the smaller dunes in the surrounding of Taymāʾ is determined by the silvery leaved shrubs of *Artemisia jordanica* (Plate 6.1), which for a long time was misidentified as *A. monosperma* (Danin 1999; Chaudhary 1999–2001). The latter species, however, is not present on the Arabian Peninsula. *A. jordanica* is known from southern Jordan, northern, eastern and central Saudi Arabia and South-West Iraq (Danin 1999), where it typically characterises dunes.

Depending on the quantity of each season's winter rainfall, annual herbs may be abundant. Chaudhary (1983) lists 149 annuals and non-woody perennials from the Great Nafud. Although, this number is much lower in the Taymāʾ area, psammophytic ephemerophytes contribute well to the community's aspect. Examples are *Anthemis scrobicularis, Astragalus tribuloides, Bassia eriophora, Cakile arabica, Eremobium aegyptiacum, Ifloga spicata, Moltkiopsis ciliata, Monsonia nivea, Plantago cylindrica, Schismus barbatus, Silene villosa* (Plate 6.2), and *Cutandia memphitica*, the latter a valuable grazing for livestock in the rangelands here.

Vegetation analysis
Diagnostic species of the community are *Artemisia jordanica, Calligonum comosum* and *Scrophularia hypericifolia*. Frequently associated in the typical community are *Moltkiopsis ciliata, Monsonia nivea*, and tussocks of perennial grasses such as *Stipagrostis drarii* and the sedge *Cyperus conglomeratus* (Tab. 1 [6], Plate 6.3). All in general are common on the dunes and wide sand sheets of the Great Nafud and elsewhere, wherever deep deposits of sand are found. In the Taymāʾ area they occur, however, with much lower frequency (Tab. 1 [6]).

Despite the relatively low frequence of *Calligonum comosum* (Plate 6.5) and *Scrophularia hypericifolia* (Plate 6.4) in the Taymāʾ area, the bulk of character species clearly indicate a classification within the *Calligonum comosum-Artemisia monosperma-Scrophularia hypericifolia* community (floristically impoverished development), as described from the dunes of the Great Nafud (Chaudhary 1983; Mandaville 1998). This is obvious in the Bi'r Hayzan area, where both, *Calligonum comosum* and *Scrophularia hypericifolia* are quite common and contribute much to the community's physiognomy. This community corresponds directly with the 'Central Arabian red sand vegetation' of Vesey-Fitzgerald (1957). It is reported also from the sand dunes west of the Thumama area (central Arabia), which are in close contact to the sands of the Dhahna corridor, connecting the Great Nafud and the Rub' al-Khali (Baierle – Kürschner 1985).

4.5 *SABKHA* COMMUNITIES (PLATE 7)

Inland *sabkha*s are highly saline, flat areas of the desert plain (Plate 7.1) often formed by the drying up of former lakes and continued evaporation from the soil. Dominant abiotic stress factors for plant life are the high salinity, high evaporation and water availability of the substrate. Usually they are devoid of vegetation, although some halophytic species occur on the fringes, which often form monospecific stands. The vegetation of such flat, silty-salty inland depressions is poorly studied in Arabia (Deil 1998).

4.5.1 *TAMARIX PASSERINOIDES* VAR. *MACROCARPA* SHRUBLAND (PLATE 7.3)

Taymāʾ oasis is bordered towards the north by a large *sabkha*, which in former times (ca. 9,500–4,5000 calBP) was occupied by a lake. In general, this *sabkha* is bare of vegetation and characterised by clayey-silt soils with high excretion of salts ('Salzausblühungen'). At the south-eastern fringe of this *sabkha*, a shrubland of *Tamarix passerinoides* var. *macrocarpa* exist, forming monotypic stands over large areas. It forms a transition zone to the old date palm oasis. Sporadically, a second *Tamarix* species, *T. aphylla* exist. Despite an extended *Phragmites australis* reed (especially at the southern fringe of the *sabkha* and here related to subterranean groundwater-flow), the underground, however, mostly is bare of any vegetation due to the high salt content of the substrate.

4.5.2 *Aeluropus littoralis* community (Tab. 1 [7], Tab. 8)

At the eastern corner of the Taymāʾ *sabkha*, in spring 2009 a sparse but distinct patchy vegetation was present, consisting of several halophytes and ruderal species, the latter may be invasive from the nearby agricultural and/or ruderal village sites (Plate 7.2).

Floristic inventory
This halophytic vegetation is dominated by *Aeluropus littoralis* and *Frankenia pulverulenta. Aeluropus littoralis* is a perennial, rhizomatous grass with prostrate and creeping stolons, which grows frequently on saline grounds and around cultivated areas with irrigation runoff. It has a typical, more northern distribution and is replaced on the Arabian Peninsula towards the south by the close relative *A. lagopoides* (Frey *et al.* 1985). Further halophytes at this site are *Suaeda aegyptiaca*, and *Tamarix passerinoides* var. *macrocarpa*, who occur in quite a good number of seedlings. A certain bulk of ruderals and somewhat 'weedy' species in the community indicate an introgression from nearby cultivated or polluted stands. To name are *Atriplex dimorphostegia, A. suberecta, Bassia eriophora, Hyoscyamus muticus, Oligomeris linifolia, Trigonella hamosa*, and *Zygophyllum simplex*. Best example for such an 'invasive species' in the Taymāʾ area is *Atriplex suberecta*, which is introduced from Australia (synanthropic element) with fodder plants by the farmers.

Vegetation analysis
The *Aeluropus littoralis* community of the Taymāʾ *sabkha* was studied by two plots only (Tab. 1 [7]). A character species is *Aeluropus littoralis* which often forms a typical belt within a mosaic of halophytes (*Aeluropus littoralis* belt *sensu* Frey – Kürschner 1983). Its distribution is strongly dependent on soil salinity and water availability. Co-associate is *Frankenia pulverulenta*, a low sub-prostrate annual halophyte with glands for salt excretion (Tab. 1 [7]). Both taxa are widely distributed all around the Mediterranean, North Africa, South-West and Central Asia, and also typical for disturbed areas. It can not excluded therefore that both species invade the *sabkha* from the nearby cultivated grounds (intensive rounded irrigation systems) north of the *sabkha* (ar-Rib'a hills).

Communities, characterised by a high constancy and cover of *Aeluropus littoralis* are reported for South-West Asia from Turkey (Tuz Gölü, Kürschner 1983), Israel and Jordan (Dead Sea area, Azraq, cf. Frey – Kürschner 1983; Frey *et al.* 1985; Zohary 1973). At these localities, which present natural stands, many halophytic Chenopodiaceae are associated, lacking in the Taymāʾ *sabkha*.

4.6 Chorotype analysis (phytogeographical indicators, Tab. 2)

The main part of the Arabian Peninsula belongs to the Saharo-Arabian floral region *sensu* Zohary (1966; 1973) that correspond to the Saharo-Sindian regional zone (Arabian regional subzone, cf. White 1983; Léonard 1989) and the Saharo-Sindian region *sensu* Eig (1938). This phytochorion is a more or less well defined entity which is influenced by a bi-seasonal, Mediterranean type of climate with a rain maximum during winter and spring. The flora is relatively poor in species, however, consists of an autonomous stock of Saharo-Arabian taxa derived from a common ancient Mesogean floral stock (Old-Mediterranean), formerly widely distributed during Tertiary along the northern and southern coasts of the Tethys Sea (Zohary 1973; Kürschner 1986; 1998). These taxa share a common geographical area of origin, often reinforced by present-day patterns of endemism. Typical derivates from this ancient stock are *Anastatica hierochuntica, Astragalus spinosus, Cornulaca* spp., *Diplotaxis acris, Fagonia* spp., *Gymnocarpos decandrus* (Fig. 2), *Gymnarrhena micrantha, Haloxylon salicornicum, Helianthemum lippii, Moltkiopsis ciliata, Morettia parviflora, Neurada procumbens, Oligomeris linifolia, Polycarpaea repens,*

Ecosystem	Small wadis and runnels	Rock and gravel desert (hammada, reg)		Sandy desert plain and sand sheets		Sand dunes	Sabkha
	Sandy	Reg	Sandy reg	with rock outcrops			
Community type	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Chorotype							
SA (incl. E-SA)	25.7	37.0	30.8	25.1	32.6	79.2	74.7
SA/Su	26.5	25.9	39.8	63.9	52.8	12.9	9.3
Su	-	3.5	8.3	-	-	-	4.5
SA/IT	42.6	30.1	17.6	8.1	11.7	7.0	2.3
others (bi-, triregional)	5.2	3.5	3.5	2.8	2.9	0.9	9.2
No. of species	53	27	47	30	42	20	10
	zonal						azonal

Tab. 2 *Chorotype analysis of the plant communities in Taymāʾ and its surroundings (NW Arabia).* [*mean cover-abundance values in %; 1 Retama raetam-Zilla spinosa community, 2, 3 Fagonia bruguieri community, (2 rocky development; 3 sandy development); 4 Rhanterium epapposum community; 5 Haloxylon salicornicum community; 6 Artemisia jordanica community; 7 Aeluropus littoralis community; E-SA East Saharo-Arabian; IT Irano-Turanian; SA Saharo-Arabian; Su Sudanian*].

الجدول ٢ تحليل التوزع الجغرافي للمجتمعات النباتية في تيماء و محيطها (شمال غرب الجزيرة العربية). [متوسط قيم النسب المئوية لمعامل الوفرة ـ التغطية؛ 1 مجتمع الرتم ـ الشبرم *Retama raetam-Zilla spinosa*؛ 2 ـ 3 مجتمع شكاعة بروغييري *Fagonia bruguieri* (2 تطور متعايش مع بيئة صخرية، 3 تطور متعايش مع بيئة رملية)؛ 4 مجتمع العرفج *Rhanterium epapposum*؛ 5 مجتمع الرمث *Haloxylon salicornicum*؛ 6 مجتمع العاذر *Artemisia jordanica*؛ 7 مجتمع العكرش الساحلي *Aeluropus littoralis*؛ *E-SA*: صحراوي ـ عربي شرقي؛ *IT*: إيراني ـ طوراني؛ *SA*: صحراوي ـ عربي؛ *Su*: سوداني].

Pteranthus dichotomus, Retama raetam, Rhanterium epapposum, Savignya parviflora (Fig. 2), *Sclerocephalus arabicus, Stipagrostis* spp. or *Zilla spinosa*. Today most of these taxa are common in the Taymāʾ area and its surroundings and contribute to the flora and vegetation.

Whereas most of the semi-arid and arid part of northern and central Arabia belongs to this Saharo-Arabian floral region, the south-western and southern part of Arabia is strongly influenced by a tropical climate and monsoonal rainfalls. Zohary (1966; summarized in Zohary 1973) proposed a Sudanian floral region (Sudano-Deccanian *sensu* Eig 1938, Nubo-Sindian province Zohary 1966) for this area, which already belongs to the Palaeotropic floristic kingdom. In addition to these Saharo-Arabian and Sudanian taxa, further chorological elements penetrate far into the Arabian Peninsula (biregional, pluriregional chorotype). They originate from the Euro-Siberian, Mediterranean and Irano-Turanian floral region (Zohary 1966; 1973) and indicate floral history and former phytogeographical migration routes.

The chorotype analyses of the communities of the Taymāʾ area (Tab. 2) clearly show the strong Saharo-Arabian character of the flora and vegetation. Due to often overlapping ecological factors, most effective dispersal mechanisms, floral historical reasons, or introduction by man and his livestock, many species have a wider distribution area.

Most typical, however, are Saharo-Arabian and Sudanian taxa, which together – except in the sandy expression of the *Fagonia bruguieri* community – reach more than 80% in the chorotype spectra (Tab. 2). They all belong to the already mentioned commonly evolved and adapted floral stock of psammophytic ephemerophytes. Of special interest are the East Saharo-Arabian taxa, which are mostly confined to the Arabian Peninsula and surroundings (endemics). Examples of this chorotype are *Anthemis scrobicularis, Arnebia tinctoria, Artemisia jordanica, A. judaica, Cornulaca aucheri, Cyperus conglomeratus, Ephedra alata, Lappula sinaica, Picris babylonica,* and *Plantago boissieri.* They concentrate mainly in the sand dunes and shallow sand fields (*Artemisia jordanica* community; *Haloxylon salicornicum* community).

Typical Sudanian taxa, merely confined to the southern part of Arabia are rare in the north (e.g., *Zygophyllum simplex*), reaching only low proportions in the spectra or are lacking.

Many character species of the small, sandy *wadi*s and runnels, rocky hamadas, sandy reg and gravel plains show a biregional Saharo-Arabian – Irano-Turanian distribution pattern, and extend far to the east into the gravel deserts of Iran and central Asia. Examples are *Aeluropus littoralis, Arnebia linearifolia, Astragalus sieberi, A. spinosus, Atriplex dimorphostegia, Cutandia memphitica, Erodium oxyrhynchium, Fagonia bruguieri, Gastrocotyle hispida, Heliotropium crispum, Lasiopogon muscoides, Reichardia tingitana, Retama raetam, Rhus tripartita* (relict of former woodlands), *Rumex vesicaria, Schismus arabicus. S. barbatus, Senecio glaucus, Silene arabica, Stipagrostis plumosa,* and *Trigonella stellata*. Within the *Retama raetam-Zilla spinosa* community and the *Fagonia bruguieri* community (sandy expression), the proportion of these biregionals increases to 42.6% *resp*. 30.1% (Tab. 2).

The *sabkha* community shows a relatively high proportion (9.2%) of bi- and pluriregional taxa, when compared with the other ecosystems. This figure results from the wider distribution of the character species *Aeluropus littoralis* (Mediterranean – Irano-Turanian – Saharo-Arabian) and *Frankenia pulverulenta* (Euro-Siberian – Mediterranean – Irano-Turanian – Saharo-Arabian). But it is a typical phenomenon of azonal communities mainly determined by edaphic factors (e.g., in this case salt evaporation) which do not underlie the natural climax. Its wider distribution often is favoured by migration of water birds, transporting the diaspores.

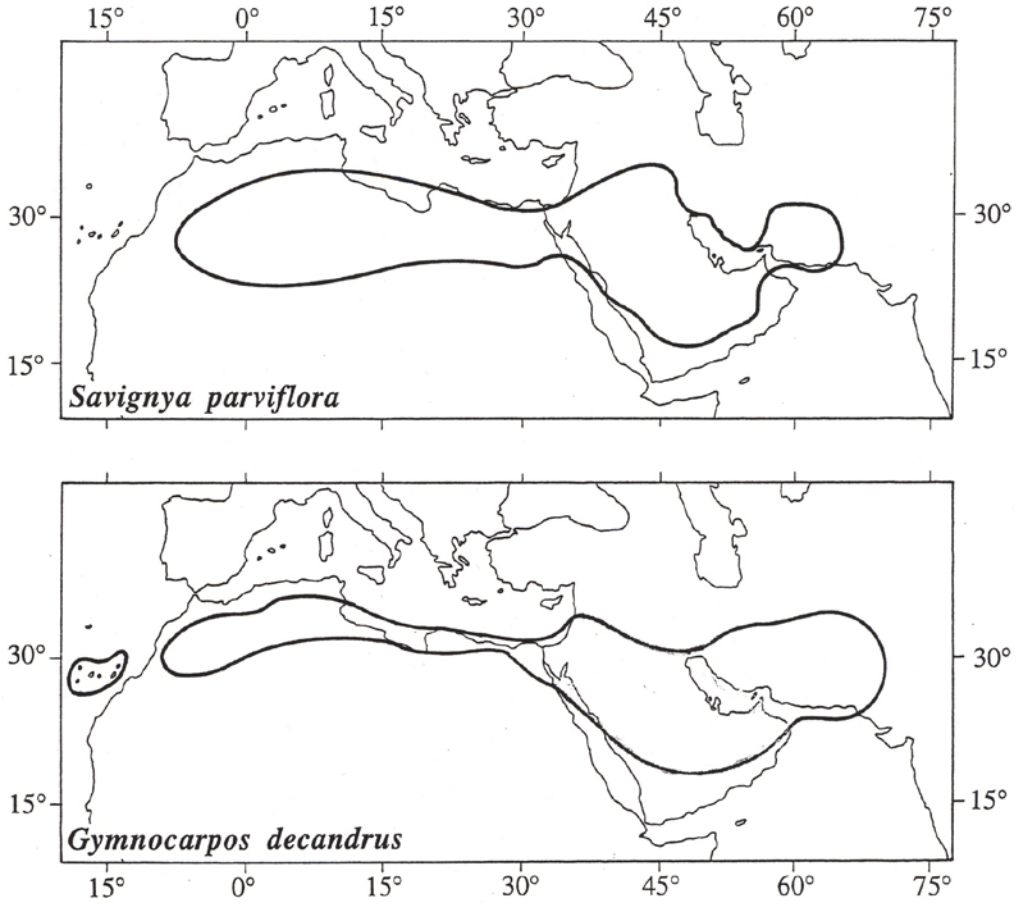


Fig. 2 *Distributional range (area) of Gymnocarpos decandrus and Savignya parviflora. Examples for a Saharo-Arabian floral element (modified after Kürschner 1998).*

الشكل ٢ المجال الجغرافي لانتشار الخضر *Gymnocarpos decandrus* و القليقلان *Savignya parviflora*.
أمثلة على عنصر نباتي صحراوي ـ عربي (تم التعديل وفقاً لـ Kürschner ١٩٩٨).

4.7 Floral historical remarks

Most parts of North Arabia today are characterised by an arid to hyperarid climate with annual rainfall of less than 50 mm per year. Plant life therefore is normally sparse and large areas are covered with mainly treeless sand, rock and gravel deserts. When plant life exists, it is often poor in species, but adapted by its life cycles to the harsh environmental conditions. There is some evidence, however, for a moister climate on the Arabian Peninsula during Pleistocene times, when wetter periods led to important changes in local environments. McClure (1976) reports a series of late Quaternary freshwater lakes in the western Rub' al-Khali between 30,000 and 20,000 BP with a second period from 9,000 to 6,000 BP, the latter correlating with a probable northerly shift of the monsoon rains. According to Hoelzmann *et al.* (2004), more humid conditions in relation to the today's arid climate may have occured in the eastern Sahara and the Arabian Peninsula in the period between ca. 4,700–3,500 cal. BCE. This correlates well with the formation of a lake in the Taymāʾ *sabkha*, dated to ca. 5,000 BP. At this time, much denser vegetation with a high frequency of a xero-tropical, arborescent Sudanian *Acacia*-flora and an eastwards extension of the Saharo-Arabian *Retama* vegetation in the *wadi*s around Taymāʾ is very likely, as well as in the dwarf shrub communities of the surrounding gravel deserts (reg) and sandy plains. This scenario is supported by the numerous rock drawings in the Taymāʾ area, which show lions, ostriches, giraffes and leopards (Al-Kabawi *et al.* 1989) indicating a savannah-like climate and vegetation of Sudanian character (cf. also Mandaville 1984) and a drastically different climate. After this pluvial episode, central and northern Arabia again became more arid, as hotter and dryer conditions favoured the establishment of the present pre-adapted Saharo-Arabian desert flora.

Of special interest in this respect is the area of Abu Mugayr (locality D, Fig. 1), a rocky sandstone area ('Nubian sandstones'; 'inselberg') famous for its episodical spring (Ain 'Awainah Alia) and prehistoric rock art (mainly Thamudic inscriptions and figures). Here, a relatively diverse woody flora exists, including small trees of *Rhus tripartita*. This West Irano-Turanian – Saharo-Arabian floral element is typical for desert areas, characterised by cliffs and canyons, where it grows in deep-fissured metamorphic rocks and sandstones. It is restricted to wet micro-habitats fed by springs. According to Danin (1983) it is likely that *R. tripartita* was more widely distributed in Arabia, the Negev and the Sinai Peninsula when this area had a moister climate (indicator species for woodland and shrubland). However, a dispersal by migrating birds (ornithochory) to the Abu Mugayr area cannot be excluded, as the species disperses by red berries. Together with the numerous rock drawings (ostriches, leopards) in the surroundings of the spring, this may indicate such a moister climate along the south-western fringes of the Great Nafud.

Pollen diagrams based on cores of peat or *sabkha* deposits which would give insight into past vegetation history and/or climate fluctuations are at present unavailable for North Arabia. The core from the Taymāʾ *sabkha* is still under study, however, first results are given by Dinies *et al.* (see the following article in this volume). The Early Holocene palaeo-vegetation map of the Near and Middle East (ca. 8,000 BP), published by Bottema – Zeist (1990) is not helpful in this respect. It only roughly indicates the Taymāʾ area as "treeless vegetation: xeromorphic dwarf shrublands, grasslands rich in forbs, saline vegetations and deserts". Nevertheless, the Taymāʾ *sabkha* core is promising and its analysis may help to better understand vegetation history and climate change in the area.

Acknowledgments

We gratefully acknowledge the financial and logistical support of the Saudi Commission for Tourism and Antiquities (Prof. Dr. A. Ghabban), the King Saud University Riyadh (Prof. S. F. Al-Said), the Taymāʾ Museum for Archaeology and Ethnography (M. H. Al-Najem) and the Deutsches Archäologisches Institut, Orient-Abteilung (Prof. Dr. R. Eichmann, Dr. A. Hausleiter). Special thanks belong to the members of the 2009 and 2010 spring campaigns for their hospitality, to Dr. A. Hausleiter for his great support of our studies, and to M. H. Al-Najem who perfectly guided most of our tours.

Harald Kürschner
Freie Universität Berlin
Institut für Biologie, Systematische
Botanik und Pflanzengeographie
Altensteinstr. 6
14195 Berlin
kuersch@zedat.fu-berlin.de

Reinder Neef
German Archaeological Institute
Scientific Department at the Head Office
Im Dol 2-6
14195 Berlin
reinder.neef@dainst.de

References

Alex, M.
1985 Klimadaten ausgewählter Stationen des Vorderen Orients, Beihefte Tübinger Atlas des Vorderen Orients, Reihe A (Naturwissenschaft) Nr. 14, Wiesbaden, 1–419.

al-Kabawi, A. – Khan, M. – al-Mubarak, A. – al-Tamai, M. – al-Ubaid, S. – al-Subhan, J.
1989 Preliminary report on the fourth season of comprehensive rock art and epigraphic survey of northern Saudi Arabia 1408 AH/1987 AD., Atlal - The journal of Saudi Arabian Archaeology 12, 41–51.

Baierle, H. U.
1993 Vegetation und Flora im südwestlichen Jordanien, Dissertationes Botanicae 200, 1–254.

Baierle, H. U. – el-Sheikh, A. M. – Frey, W.
1985 Vegetation und Flora im mittleren Saudi Arabien (at-Tai'f – ar-Riyad), Beihefte Tübinger Atlas des Vorderen Orients, Reihe A (Naturwissenschaft) Nr. 22, Wiesbaden, 1–142.

Baierle, H. U. – Kürschner, H.
1985 Development of the Thumama Nature Park. Report of the vegetation. Report for the Riyadh Development Authority.

Barkman, J. J. – Doing, H. – Segal, S.
1964 Kritische Bemerkungen und Vorschläge zur quantitativen Vegetationsanalyse, Acta Botanica Nederlandica 13, 374–419.

Barth, K. H.
1976 Naturräumliche Gliederung und Einzellandschaften, in: H. H. Blume (Ed.), Saudi Arabien. Natur, Geschichte, Mensch und Wirtschaft, 51–90, Stuttgart.

Bottema, S. – van Zeist, W.
1990 Vorderer Orient. Vegetation im Frühholozän (ca. 8000 B. P.), Karte A VI 2 Tübinger Atlas des Vorderen Orients, Wiesbaden.

Braun-Blanquet, J.
1964[3] Pflanzensoziologische Grundzüge der Vegetationskunde, Wien.

Brown, G. – Porembski, S.
1998 Flora and vegetational aspects of miniature dunes in a sand-depleted *Haloxylon salicornicum* community in the Kuwait desert, Flora 193, 133–140.

Chaudhary, S. A.
1983 Vegetation of the Great Nafud, Journal of the Saudi Arabian Natural History Society 2, 32–33.

Chaudhary, S. A. (Ed.)
1999–2001 Flora of the Kingdom of Saudi Arabia, Vol. 1–3, Riyadh.

Danin, A.
1983 Desert vegetation of Israel and Sinai, Jerusalem.
1999 Contributions to the flora of Jordan. 3. A new species of *Artemisia* (*Compositae, Anthemideae*) from S Jordan, Willdenowia 29, 147–153.

Deil, U.
1998 Coastal and sabkha vegetation, in: S. A. Ghazanfar – M. Fisher (Eds.), Vegetation of the Arabian Peninsula, Dordrecht – Boston, 209–228.

Dierschke, H.
1994 Pflanzensoziologie. Grundlagen und Methoden, Stuttgart.

Eig, A.
1938 On the phytogeographical subdivision of Palestine, Palestine Journal of Botany, Jerusalem Series 1, 4–12.

Frey, W. – Kürschner, H.
1983 Photosyntheseweg und Zonierung von Halophyten an Salzseen in der Türkei, in Jordanien und im Iran, Flora 173, 293–310.
1989 Die Vegetation im Vorderen Orient. Erläuterungen zur Karte A VI 1 Vorderer Orient. Vegetation des 'Tübinger Atlas des Vorderen Orients', Beihefte Tübinger Atlas des Vorderen Orients, Reihe A (Naturwissenschaft) Nr. 30, Wiesbaden, 1–92.

Frey, W. – Kürschner, H. – Stichler, W.
1985 Photosynthetic pathways and ecological distribution of halophytes from four littoral salt marshes (Egypt/Sinai, Saudi Arabia, Oman and Iran), Flora 177, 107–130.

Halwagy, R. – Moustafa, A. F. – Kamel, S. M.
1982 On the ecology of the desert vegetation in Kuwait, Journal of Arid Environments 5, 95–107.

Heller, D. – Heyn, C. C.
1986–94 Conspectus Florae Orientalis. An annotated catalogue of the flora of the Middle East, Fasc. 3–9, Jerusalem.

Hoelzmann, P. – Gasse, F. – Dupont, L. M. – Salzmann, U. – Staubwasser, M. – Leuschner, D. C. – Sirocko, F.
2004 Palaeoenvironmental changes in the arid and subarid belt (Sahara-Sahel – Arabian

Peninsula) from 150 kyr to present, in: R. W. Battarbee – F. Gasse – C. E. Stickley (Eds.), Past climate variability through Europe and Africa, Development and Palaeoenvironmental Research 6, Dordrecht, 219–256.

Kassas, M.
1953 Habitat and plant communities in the Egyptian desert. II. The features of a desert community, Journal of Ecology 41, 248–256.

Kürschner, H.
1983 Vegetationsanalytische Untersuchungen an Halophytenfluren Zentralanatoliens (Türkei), Beihefte Tübinger Atlas des Vorderen Orients, Reihe A (Naturwissenschaft) Nr. 11, Wiesbaden, 1–89.
1986 Omanisch-makranische Disjunktionen. Ein Beitrag zur pflanzengeographischen Stellung und zu den florengenetischen Beziehungen Omans, Botanische Jahrbücher für Systematik, Pflanzengeschichte und Pflanzengeographie 106, 541–652.
1998 Biogeography and introduction to vegetation, in: S. A. Ghazanfar – M. Fisher (Eds.), Vegetation of the Arabian Peninsula, Dordrecht – Boston, 63–98.

Léonard, J.
1989 Contribution à l'étude de la flore et de la végétation des deserts d'Iran, fasc. 9. Les chorotypes. Considérations phytogéographiques sur les phytochories irano-touranienne, saharo-sindienne et de la Somalie-pays Masai, Jardin Botanique Nationale Belgique 1989, 1–122.

Mandaville, J. P.
1984 Studies in the flora of Arabia XI: Some historical and geographical aspects of a principal floristic frontier, Notes of the Royal Botanic Garden Edinburgh 42, 1–15.
1990 Flora of Eastern Saudi Arabia, Cornell University.
1998 Vegetation of the sands, in: S. A. Ghazanfar – M. Fisher (Eds.), Vegetation of the Arabian Peninsula, Dordrecht – Boston, 191–208.

McClure, H. A.
1976 Radiocarbon chronology of late Quaternary lakes in the Arabian desert, Nature 263, 755–756.
1978 Ar Rub' Al Khali, in: S. S. Al-Sayari – J. G. Zötl (Eds.), Quaternary period in Saudi Arabia, Wien – New York, 252–263.

Miller, A. G. – Cope, T. C.
1996 Flora of the Arabian Peninsula and Socotra, Vol. 1, Edinburgh.

Monod, T.
1954 Mode 'contracté' et 'diffus' de la végétation saharienne, in: J. L. Cloudsley-Thompson (Ed.), Biology of deserts, the proceedings of a symposium on the biology of hot and cold deserts organized by the Institute of Biology, London, 35–44.

Popov, G. B. – Zeller, W.
1963 Ecological survey report on the 1962 survey in the Arabian Peninsula, FAO Progress Report UNSF/DL/ES/6, 12–31.

Thalen, D. C. P.
1979 Ecology and utilization of desert shrub rangelands in the Iraq, The Hague.

Vesey-Fitzgerald, D. F.
1957 The vegetation of central and eastern Arabia, Journal of Ecology 45, 779–798.

Walter, H.
1973[3] Die Vegetation der Erde. I. Die tropischen und subtropischen Zonen, Jena.

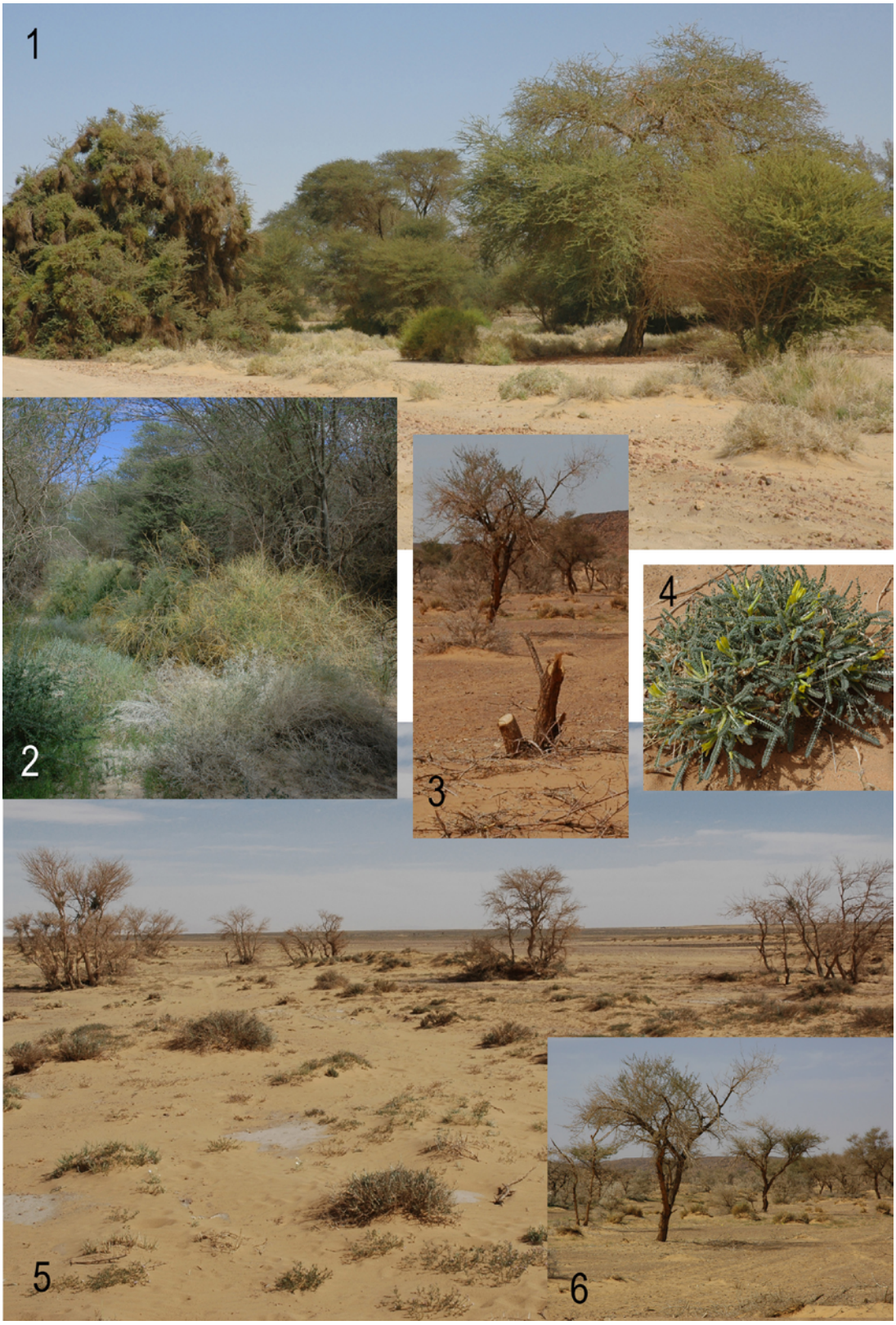
White, F.
1983 The vegetation of Africa, a descriptive memoir to accompany the UNESCO AETFAT UNSO vegetation map of Africa, Paris.

Zahran, M. A. – Willis, A. J.
1992 The vegetation of Egypt, Dordrecht.

Zohary, M.
1950 The flora of Iraq and its phytogeographical subdivision, Agricultural Bulletin 31, 1–201.
1966 Flora Palaestina, Part I, Jerusalem.
1973 The geobotanical foundations of the Middle East, 2 vols., Stuttgart.

Zohary, M. – Heyn, C. C. – Heller, D.
1980–82 Conspectus Florae Orientalis. An annotated catalogue of the flora of the Middle East, Fasc. 1,2, Jerusalem.

Plate 1



Acacia wadis*. 1 Dense* wadi *vegetation at Mada'in Saleh, dominated by Acacia gerrardii and A. tortilis; 2 Understorey vegetation at Mada'in Saleh; 3 Wadi Madyses/Taymāʾ area, tree cutting; 4 Astragalus sieberi; 5, 6 Highly devastated and disturbed Wadi Madyses/Taymāʾ area.*

اللوحة ١ وديان السنط. 1 كساء خضري كثيف للوادي في مدائن صالح مع هيمنة للسنط الجيراردي *Acacia gerrardii* و *السمر Acacia tortilis*؛ 2 كساء خضري أرضي في مدائن صالح؛ 3 وادي مديسيس/منطقة تيماء، قطع الأشجار؛ 4 قتاد البحر الميت *Astragalus sieberi*؛ 5، 6 وادي مديسيس/منطقة تيماء، كساء خضري مخرّب و مشتت بشكل كبير.

Plate 2

Retama wadi *SW of Taymāʾ, Arada area. 1 Retama raetam* wadi*; 2 Retama raetam, flowers; 3 Zilla spinosa; 4, 5 Astragalus spinosus.*

اللوحة ٢ نبات الرتم في وادي إلى الجنوب الغربي من تيماء، منطقة عردة. 1 وادي مغطى بنبات الرتم *Retama raetam*؛ 2 أزهار الرتم *Retama raetam*؛ 3 نبات الشبرم *Zilla spinosa*؛ 4، 5 نبات القتاد الشوكي *Astragalus spinosus*.

Plate 3

Gravel desert. 1 Fagonia brugieri community NW of Taymāʾ (Abu Sillah area); 2 Arnebia hispidissima; 3 Aizoon canariense; 4 Fagonia bruguieri; 5 Plantago cylindrica; 6 Neurada procumbens; 7 Picris babylonica.

اللوحة ٣ صحراء حصوية. 1 مجتمع شكاعة بروغييري *Fagonia brugieri* إلى الشمال الغربي من تيماء (منطقة وادي أبو سلة)؛ 2 نبات العطان *Arnebia hispidissima*؛ 3 نبات الدعاع *Aizoon canariense*؛ 4 نبات شكاعة بروغييري *Fagonia brugieri*؛ 5 نبات الربل *Plantago cylindrica*؛ 6 نبات السعدان *Neurada procumbens*؛ 7 نبات الحوذان *Picris babylonica*.

Plate 4

Sandy desert plain with rock outcrops. 1,3 Rhanterium epapposum community SE of Taymā'; 2 R. epapposum, capitulae; 4 Gymnocarpos decandrus.

اللوحة ٤ سهل صحراوي رملي مع بروزات صخرية. 3,1 مجتمع العرفج *Rhanterium epapposum* جنوب شرقي تيماء؛ 2 سنبلة نبات العرفج *Rhanterium epapposum*؛ 4 نبات الخضر *Gymnocarpos decandrus*.

Plate 5

Sandy desert plain. 1 Haloxylon salicornicum community E of al-Kotayeb; 2 Haloxylon salicornicum; 3 Ephedra alata.

اللوحة ٥ سهل صحراوي رملي. 1 مجتمع الرمث *Haloxylon salicornicum* إلى الشرق من الكتيب؛ 2 نبات الرمث *Haloxylon salicornicum*؛ 3 نبات العلندى *Ephedra alata*.

Plate 6

Inland sands and dunes. SW fringes of the Nafud. 1 Artemisia jordanica community W of Jabal Halwan; 2 Silene villosa; 3 Cyperus conglomeratus; 4 Scrophularia hypericifolia; 5 Calligonum comosum.

اللوحة ٦ الرمال و الكثبان الداخلية. الأطراف الجنوبية الغربية لصحراء النفود. 1 مجتمع العاذر *Artemisia jordanica* إلى الغرب من جبل حلوان؛ 2 نبات الغبيشة *Silene villosa*؛ 3 نبات الثندي *Cyperus conglomeratus*؛ 4 نبات العلقا *Scrophularia hypericifolia*؛ 5 نبات الأرطاة *Calligonum comosum*.

Plate 7

Sabkha *vegetation. 1 Taymāʾ* sabkha *(in background: Tuwayil Saʿid); 2 Aeluropus littoralis community; 3 Tamarix passerinoides var. macrocarpa shrubland at the SE* sabkha *fringe with date palms (Phoenix dactylifera) of the old oasis.*

اللوحة ٧ الكساء الخضري في السبخة. 1 سبخة تيماء (في الخلفية طويّل سعيده)؛ مجتمع العكرش الساحلي *Aeluropus littoralis*؛ تجمع للأثل كبير الثمار *Tamarix passerinoides* var. *macrocarpa* على الطرف الجنوبي الشرقي للسبخة مع نخيل البلح (*Phoenix dactylifera*) من الواحة القديمة.

Appendix 1. Study sites

Phytosociological sampling

Area	Locality (*cf.* Fig. 1)
1	Tabuk province: Taymāʾ, archaeological site of Taymāʾ (Qrayyah area), old city wall near the museum, 27°37’44’’N, 38°32’40’’E, sandy reg formations, small dune slopes and sandy-clayey depressions, 830 m, 18 February 2009
1	Tabuk province: Taymāʾ, archaeological site of Taymāʾ (Qrayyah area), 27°37’21’’N, 38°32’59’’E, sandy reg formations, small dune slopes and sandy-clayey depressions, 820–830 m, 19 February 2009
2	Tabuk province: Taymāʾ – al-Kotayeb, 5 km E of al-Kotayeb, SE of Taymāʾ, SW border of the an-Nafud, 27°26’15.5’’N, 38°59’17.3’’E, mosaic of sands, dunes and sandy reg formations, 902 m, 21 February 2009
3	Tabuk province: Taymāʾ – al-Kotayeb, 10–15 km E of al-Kotayeb, SE of Taymāʾ, SW border of the an-Nafud, 27°21’39.5’’N, 39°04’25.1’’E, mosaic of sands, dunes and sandy reg formations, 950 m, 21 February 2009
4	Tabuk province: Taymāʾ – al-Kotayeb, 15-20 km E of al-Kotayeb, SE of Taymāʾ, SW border of the an-Nafud, 27°20’17.5’’N, 39°06’53.6’’E, mosaic of sands, dunes and sandy reg formations, 990 m, 21 February 2009
5	Tabuk province: Taymāʾ – al-Kotayeb, 5 km W of al-Kotayeb, SE of Taymāʾ, 27°25’49.6’’N, 38°50’34.1’’E, reg formations (‘Wüstenlackbildung’), 940 m, 21 February 2009
6	Tabuk province: 20 km S of Taymāʾ, 27°28’29’’N, 38°36’08’’E, mosaic of sands and white sandstones, 960 m, 21 February 2009
7	Tabuk province: Taymāʾ, Plateau between upper Wadi Madyses and Wadi Abu Sillah, NW of Taymāʾ, 27°38’06.2’’N, 38°01’55.8’’E, reg formation (‘Wüstenlackbildung’), 980 m, 22 February 2009
8	Tabuk province: Taymāʾ – al-Bweyb al-Astnay, 20-25 km SW of Taymāʾ, 27°23’47.6’’N, 38°21’14.5’’E, sands and rock formations (‘Nubian sandstones), 980 m, 22 February 2009
9	Tabuk province: 10 km SW of Taymāʾ, 27°25’45.6’’N, 38°29’01.6’’E, mosaic of sands and white sandstones, 970 m, 22 February 2009
10	Tabuk province: Taymāʾ – al-Jahra junction, ca. 60 km S of Taymāʾ, 27°04’53.6’’N, 38°47’30.4’’E, sand and sandy reg formations, 990-1000 , 23 February 2009
11	Medina province: al-‘Ula, Mada’in Saleh, ca. 10 km NE of al-‘Ula, 26°46’34.3’’N, 37°56’50.2’’E, sand and sandy reg formations, 770 m, 23 February 2009
12	Tabuk province: Taymāʾ – al-Jahra junction, ca. 15 km E of al-Jahra, 26°49’18.0’’N, 38°35’41.2’’E, sand and sandy reg formations, 1140 m, 23 February 2009
13	Tabuk province, Taymāʾ, *sabkha* N of Taymāʾ, 27°38’38.3’’N, 38°34’33’’E, halophytic-nitrophytic formation on salty and swampy soil, 800–802 m, 24 February 2009
14	Tabuk province: Taymāʾ, upper Wadi Madyses, NW of Taymāʾ, 27°39’26.9’’N, 38°06’28.3’’E, small rocky side valley, 980 m, 22 February 2009
15	Tabuk province: Taymāʾ, 8 km NE Taymāʾ towards Geraish, 27°46’41.9’’N, 38°40’09.7’’E, sandy reg formations, 860 m, 26 February 2010
16	Tabuk province: SW of Taymāʾ towards Arada, 27°13’28.3’’N, 38°36’40.5’’E, mosaic of sands and sandstones, 990 m, 27 February 2010
17	Tabuk province: W of Arada towards al-‘Ula, 26°56’26.3’’N, 38°29’0.2’’E, small sandy *wadi*s and runnels, 1080 m, 27 February 2010
18	Tabuk province: NW of Arada, near Gelala, 26°56’50.2’’N, 38°24’21.9’’E, mosaic of sands and white sandstones, 1070 m, 27 February 2010
19	Tabuk province: SE of Arada, towards al-Jahrah junction, 27°00’12.1’’N, 38°39’56.7’’E,

small sandy *wadi*s and runnels, 1030 m, 27 February 2010

20 Tabuk province: ca. 30 km SE of al-Kotayeb, Abu Mughayr area, 27°16’20.4’’N, 39°08’34.1’’E, mosaic of sands and rock outcrops, 1090 m, 28 February 2010

21 Tabuk province: ca. 35 km SE of al-Kotayeb, Abu Mughayr area, 27°14’46.6’’N, 39°10’09’’E, mosaic of sands and rock outcrops, 1050 m, 28 February 2010

22 Tabuk province: ca. 35 km SE of al-Kotayeb, Abu Mughayr area, 27°13’47.9’’N, 39°19’19.3’’E, mosaic of sands and rock outcrops, 970 m, 28 February 2010

23 Tabuk province: ca. 35 km SE of al-Kotayeb, Abu Mughayr area, al-Hasana well, 27°14’41.9’’N, 39°16’57’’E, mosaic of sands and rock outcrops, 930 m, 28 February 2010

24 Tabuk province: E of al-Kotayeb, Jabal Halwan, SW fringes of the an-Nafud, 27°25’26.8’’N, 39°24’28.7’’E, sand dunes, 980 m, 1 March 2010

25 Tabuk province: an-Nafud, N of Bi’r Hayzan, 27°31’57.6’’N, 39°13’12.8’’E, sand dunes, 1040 m, 1 March 2010

26 Tabuk province: an-Nafud, Bi’r Hayzan, 27°30’05.8’’N, 39°12’11.5’’E, sand dunes and interdune depressions, 980 m, 1 March 2010

27 Tabuk province: W of Jabal Halwan, SW fringes of the an-Nafud, 27°24’57.2’’N, 39°03’42.3’’E, sand dunes, 1030 m, 1 March 2010

28 Tabuk province: 25 km W of al-Jahrah junction towards al-‘Ula, 26°50’20.1’’N, 38°39’15.8’’E, small sandy *wadi*s and runnels, 1170 m, 3 March 2010

29 Medina province: 40 km E of al-‘Ula, 26°44’50.5’’N, 38°15’09.7’’E, small sandy *wadi*s and runnels, 1080 m, 3 March 2010

Floristic sampling

Area	Locality (*cf.* Fig. 1)

A Tabuk province: Taymāʾ – Tabuk, al-Qalibah, 125 km N of Taymāʾ, Wadi Qalibah, 28°23’49’’N, 37°41’24’’E, devastated sandy *wadi* dominated by *Acacia gerrardii*, 900 m, 18 February 2009

B Tabuk province: Taymāʾ – Tabuk, ca. 150 km N of Taymāʾ, small *Acacia gerrardii wadi*s close to the main road, mostly completely devastated, 900 m, 18 February 2009

C Tabuk province: Taymāʾ, Wadi Madyses, ca. 20 km NW of Taymāʾ, 27°39’26.9’’N, 38°06’28.3’’E, devastated (burning, wood cutting), sandy *Acacia gerrardii*, 930 m, 2 February 2009

D Tabuk province: Taymāʾ – al-Kotayeb, ca. 30 km SE of al-Kotayeb, Abu Mughayr area, Ain Awainah Alia, SW border of the an-Nafud, 27°11’55.6’’N, 39°20’10.7’’E, episodic spring with a mosaic of sands, sandy reg and rock formations (‘Nubian sandstones’), dominated by various dwarf shrubs and ephemerophytes, as well as a relic of *Rhus tripartita* in rocky clefts, 1030 m, 20 February 2009

E Medina province: al-‘Ula, Mada’in Saleh, ca. 10 km NE of al-‘Ula, 26°46’34.4’’N, 37°56’50.1’’E, semi-natural main (central) *wadi* of Mada’in Saleh, with large and dense stands of *Acacia gerrardii* and *A. tortilis* and dense thickets of shrubs and dwarf shrubs in the understory, 760 m, 23 February 2009

Appendix 2. Phytosociological tables (vegetation analysis)

Plot no.	36	37	40	41	53	54	55	29
Locality (Fig. 1)	17	17	19	19	28	29	28	12
Plot size (m^2)	36	36	36	49	60	60	36	100
Altitude (m)	1080	1080	1030	1030	1170	1080	1170	1140
Inclination (°)	< 5	< 5	< 5	< 5	< 5	0	< 5	-
Exposure	S	SE	SW	S	S	-	NW	-
Cover (%)	40	45	60	60	25	50	40	40
Total number of species	40	37	32	28	28	20	14	16
Character species								
Retama raetam	3	2b	2b	3	3	3	3	2a
Ferula communis (ruderal indicator)	2a	2a	1	1	[1]	.	1	+
Zilla spinosa	1	+	1	1m	.	1	.	.
Blepharis ciliaris	+	+	.	+	.	.	.	+
Remnants of former arborescent wadi vegetation								
Acacia gerrardii (a single small tree)	.	.	.	.	.	1	.	.
Acacia tortilis (a single small tree)	.	.	+	.	2a	.	.	.
Ochradenus baccatus	.	.	.	.	.	2a	.	.
Introgressives of the adjacent *Haloxylon salicornicum* community								
Haloxylon salicornicum	2a	2a	2a	2a	2a	2a	2a	3
Ephedra alata	2a	1	1	.	1	.	1	2b
Ephemerophytes of probable higher syntaxonomic rank								
Eremobium aegyptiacum	2a	1	1m	2a	2a	1	1m	.
Erodium oxyrhynchium	1m	1m	1m	1m	1	.	1	1m
Medicago laciniata	1m	1m	2a	2a	1	1	.	.
Anthemis scrobicularis	1m	1m	1m	1m	1m	.	1	.
Plantago cylindrica	1m	1m	+	1	1m	.	1m	.
Launaea mucronata subsp. *cassiniana*	1	+	1m	1m	+	.	.	+
Ifloga spicata	1m	1m	2a	1m	1m	.	.	.
Schismus barbatus (incl. *S. arabicus*)	1m	1m	2a	1m	1m	.	.	.
Trigonella stellata	1	1m	2a	2a	.	1	.	.
Leysera leyserioides	1m	1m	1m	1m	.	+	.	.
Picris babylonica	1	1	+	1	.	.	.	+
Silene villosa	1	1	.	.	+	.	+	1
Plantago ciliata	1m	1	1m	1	.	.	.	1m
Schimpera arabica	+	+	+	+	.	+	.	.
Astragalus schimperi	1	1m	1	1	.	.	.	.
Launaea capitata	.	.	1	1	1	1m	.	.
Astragalus hauarensis	+	+	.	.	+	.	.	1
Asphodelus tenuifolius	+	1	.	.	+	.	.	+
Arnebia linearifolia	+	.	.	.	+	+	.	.
Arnebia hispidissima	1	1m	.	.	.	.	.	+
Anastatica hierochuntica	1m	1m	.	.	.	1	.	.
Arnebia tinctoria	+	.	+	+	.	.	.	.
Aizoon canariense	1	1m	.	.	.	.	.	.
Hippocrepis constricta	+	1	.	.	.	.	.	.
Neurada procumbens	.	.	.	.	1	.	.	.
Plantago psammophila	.	.	.	.	1m	.	.	.
Lappula sinaica	.	.	.	.	+	.	.	.
Chamaephytes and hemicryptophytes of probable higher syntaxonomic rank								
Fagonia bruguieri	+	1	1	+	+	+	+	+
Astragalus spinosus	+	1	1	1	+	+	1	1
Stipagrostis plumosa	1m	1	1	1m	1	1	1m	
Farsetia aegyptia	.	.	+	.	+	+	.	.
Stipagrostis obtusa	1	1m	.	.	.	.	.	.
Polycarpaea repens	.	.	.	.	+	1	.	+
Morettia parviflora	.	.	+	1	.	.	.	.
Heliotropium crispum	.	.	+	1	.	.	.	.
Scorzonera tortuosissima	+	.	.	.	.	.	.	.
Others								
Lycium shawii	2b	2a	.	.	.	1	+	.
Euphorbia retusa	+	1m	+	1	.	.	.	.
Kickxia aegyptiaca	+	1	+	1	.	.	.	.
Cakile arabica	1	+	.	.	1	.	+	.
Citrullus colocynthus	.	+	.	.	1	+	.	.
Linaria simplex	1m	1	.	.	.	.	.	.
Stipagrostis ciliata	.	.	.	.	+	.	.	.
Dipcadi erythraeum	+	.	.	.	.	.	.	.
Cistanche tubulosa	.	.	+	.	.	.	.	.
Koelpinia linearis	.	.	+	.	.	.	.	.

Tab. 3 *The Retama raetam-Zilla spinosa community of the small sandy wadis and runnels.*

الجدول ٣ مجتمع الرتم ـ الشبرم *Retama raetam-Zilla spinosa* للوديان الصغيرة الرملية والسواقي.

Plot no.	18	19	33	32	14	15	1	2	3	4	5	6
Locality (Fig. 1)	7	7	15	14	5	5	1	1	1	1	1	1
Plot size (m^2)	16	16	25	16	36	25	25	25	9	16	16	16
Altitude (m)	990	990	860	980	940	940	820	820	825	820	820	830
Inclination (°)	0	0	< 5	0	< 5	0	30	30	< 5	-	< 5	-
Exposure	-	-	N	-	S	-	NW	W	W	-	S	-
Geology/Geomorphology	reg formation				sandy reg formation							
Cover (%)	30-40	30	30	40	40-50	40-50	25	30	25	25	20	40-50
Total number of species	18	17	25	24	20	19	16	17	21	16	20	24
	A				**B**							
Character species												
Fagonia bruguieri	2a	2a	2a	2a	1	+	2a	2b	1	+	1	1
Fagonia glutinosa	1	2a	+	+	2a	2a	1	1	1	+	+	1
Diplotaxis acris	2b	2b	.	2a	.	.	.	.	.	.	.	.
Gymnocarpos decandrus	2a	1	+	1	.	.	.	.	.	.	.	.
Plantago afra	1m	1m	.	1	.	.	.	.	.	.	.	.
Heliotropium crispum	+	1	1	2a	.	.	.	.	.	.	.	.
Trigonella stellata	1	1	+	+	.	.	.	.	.	.	.	.
Helianthemum lippii	.	2a	+	2a	.	.	.	.	.	.	.	.
Fagonia schweinfurthii	1	1	.	.	.	.	.	.	.	.	.	.
Ephemerophytes of probable higher syntaxonomic rank												
Aizoon canariense	1	+	1	1	2a	1	1	2a	1	2a	1	1
Schismus arabicus (incl. *S. barbatus*)	1m	1	1m	1m	1m	1m	.	.	1m	+	1	1m
Zygophyllum simplex	+	.	+	+	1	1	2a	1	1	1	1m	1
Mesembryanthemum forsskalii	.	.	.	.	1	+	1	1	1	+	+	+
Bassia eriophora	[+]	.	.	+	.	.	1	1	1	1	.	1
Eremobium aegyptiacum	.	.	2a	.	1	1m	1	.	+	.	+	.
Savignya parviflora	.	+	1	1	.	.	+	1	.	+	1	2a
Ifloga spicata	.	.	1m	.	1m	1	.	.	1	.	1m	1m
Neurada procumbens	.	.	.	.	.	.	.	1	+	+	+	1
Cleome amblyocarpa	.	.	1	.	1	1	1	.	+	.	.	+
Plantago ciliata	1	+	+	1	1m	1	.	.	.	.	.	1m
Launaea mucronata subsp. *cassiniana*	.	.	1	.	.	.	+	+	.	+	.	+
Astragalus tribuloides	.	.	+	.	+	+	.	.	1	+	.	.
Anthemis scrobicularis	.	.	.	.	.	.	.	[+]	2a		1	1
Arnebia linearifolia	.	.	1	.	.	+	.	.	+	.	+	.
Arnebia hispidissima	.	.	+	.	.	.	+	1	.	.	.	1
Asphodelus tenuifolius	2a	1m	.	1	.	.	.	+	.	.	.	.
Picris babylonica	1	1m	+	.	.	.	.	.	.	.	+	.
Astragalus schimperi	.	.	.	.	+	.	.	.	1	1	.	.
Plantago cylindrica	.	.	.	.	+	1	.	.	.	.	1	.
Astragalus hauarensis	.	.	.	.	.	.	.	.	.	+	+	+
Medicago laciniata	.	.	+	.	+	+	.	.	.	.	.	.
Silene arabica	.	.	.	.	+	+	.	.	.	.	.	.
Oligomeris linifolia	.	.	.	.	.	.	.	+	.	.	.	.
Anisosciadium lanatum	.	.	.	.	1m	2a	.	.	.	.	.	.
Chamaephytes and hemicryptophytes of probable higher syntaxonomic rank												
Stipagrostis plumosa	1	+	1	1m	1	1	1	+	+	.	.	+
Fagonia indica	.	.	.	.	.	.	1	+	1	1	1	2a
Morettia parviflora	+	+	1	1	.	.	.	.	+	.	+	+
Farsetia burtonae	.	.	.	.	+	.	.	.	+	.	.	+
Polycarpaea repens	.	.	.	.	.	+	.	.	.	.	+	.
Farsetia aegyptiaca	+	.	.	1	.	.	.	.	.	.	.	.
Pulicaria crispa	.	.	2b	.	.	.	.	.	.	.	.	.
Anvillea gracinii	.	.	1	.	.	.	.	.	.	.	.	.
Stipagrostis obtusa	1	.	.	.	.	.	.	.	.	.	.	.
Others												
Trichodesma africana	.	.	.	.	.	.	.	.	+	1m	.	+
Tribulus terrestris var. *terrestris*	.	.	+	.	.	.	.	+	.	[+]	+	.
Lappula sinaica	.	.	.	1	1m	1m	.	.	.	.	.	.
Anastatica hierochuntica	.	.	.	+	.	.	.	.	.	1	+	.
Cornulaca aucheri	.	.	.	.	.	.	+	1	+	.	.	.
Suaeda monoica	.	.	.	.	.	.	+	+	.	.	.	.
Senecio breviflorus	.	.	.	+	.	.	+	[+]	.	.	.	.
Rumex vesicarius	.	.	.	+	.	.	[+]	.	.	.	.	.
Arnebia tinctoria	.	.	.	.	.	.	.	.	.	.	.	1m
Seetzenia lanata	.	.	.	.	.	.	.	.	.	.	.	+
Cakile arabica	.	.	.	.	.	.	.	.	.	.	.	2a
Stipa capensis	.	.	.	1	+	.	.	.	.	.	.	.
Gymnarrhena micrantha	.	.	.	+	.	[+]	.	.	.	.	.	.
Periploca tomentosa	[+]	.	.	.	.	.	.	.	.	.	.	.
	A				**B**							

Tab. 4 *The Fagonia bruguieri community of the gravel and debris desert.*

الجدول ٤ مجتمع شكاعة بروغييري *Fagonia bruguieri* للصحراء الحصوية و الردمية.

Plot no.	16	17	22	23	42	43	44	45	46
Locality (Fig. 1)	6	6	9	9	20	20	21	22	23
Plot size (m^2)	100	64	64	25	25	30	30	25	36
Altitude (m)	960	960	970	970	1090	1090	1050	970	930
Cover (%)	40	30	10	25	30	30	35	40	30
Total number of species	27	23	15	11	22	19	21	23	24
Character species									
Rhanterium epapposum	2b	3	2a	3	3	2b	3	3	3
Gymnocarpos decandrus	2a	1	1	1	2b	2b	2a	+	2a
Ephemerophytes of probable higher syntaxonomic rank									
Schismus arabicus (incl. *S. barbatus*)	1m	+	1	1	1m	2a	1m	1m	1m
Ifloga spicata	1	+	1m	1m	1m	1	1m	1	1m
Eremobium aegyptiacum	+	1	1	1m	1	1m	1m	1	1m
Erodium oxyrhynchium	+	+	+	.	1	1	1m	1	1
Plantago ciliata	+	1	.	.	1	1m	1	1m	1
Arnebia linearifolia	1	+	.	+	+	.	+	+	.
Launaea capitata	+	1	.	.	+	+	+	+	+
Launaea mucronata subsp. *cassiniana*	.	1	.	.	+	+	1	1	1
Silene villosa	+	+	+	1	.	.	+	.	+
Plantago cylindrica	1m	+	2a	2a	.	.	+	.	+
Savignya parviflora	1m	1m	+	.	.	.	1	1	1
Astragalus hauarensis	1	+	.	+	.	+	.	.	1
Cleome amblyocarpa	1m	1m	.	.	+	.	.	+	+
Plantago boissieri	1m	1m	.	.	.	+	.	.	1m
Anisosciadium lanatum	+	+	.	.	+	.	.	+	.
Anthemis scrobicularis	.	.	.	.	1	.	+	1	1m
Astragalus tribuloides	1	+	+	.	.	.	.	.	.
Astragalus schimperi	+	1	+	.	.	.	.	.	.
Asphodelus tenuifolius	+	+	.	.	.	.	.	.	.
Neurada procumbens	.	+	.	.	.	.	.	.	.
Medicago laciniata	+	.	.	.	.	.	+	.	.
Chamaephytes and hemicryptophytes of probable higher syntaxonomic rank									
Stipagrostis plumosa	+	1	+	1	1m	1	1m	1m	1m
Fagonia glutinosa	2a	1	1	2a	.	1	+	+	+
Astragalus spinosus	+	.	+	[+]	.	.	.	+	1
Fagonia bruguieri	1	.	.	.	+	1	.	+	+
Farsetia aegyptia	.	.	.	.	+	+	.	1	2a
Ephedra alata	.	.	.	.	2a	+	.	.	2a
Polycarpaea repens	.	.	.	.	1	+	.	+	.
Helianthemum lippii	.	.	.	.	1	.	+	.	.
Leysera leyserioides	.	.	.	.	.	+	1	.	.
Farsetia burtonae	+	.	.	.	.	.	.	.	.
Others									
Stipagrostis obtusa	1	.	1	.	1	.	1	+	.
Horwoodia dicksoniae	.	.	.	.	.	+	+	1	1
Dipcadi erythraeum	.	.	.	.	+	.	.	+	+
Stipagrostis ciliata	1	.	.	.	+	.	.	.	.
Gymnarrhena micrantha	.	[+]	.	.	.	.	.	.	.

Tab. 5 *The Rhanterium epapposum community ('arfaj' shrubland) of the sandy plains with sandstone rock outcrops.*

الجدول ٥ مجتمع العرفج *Rhanterium epapposum* للسهول الرملية ذات بروزات صخور الحجر الرملي.

Plot no.	27	28	24	25	7	10	8	9	11	34	35	38	39
Locality (Fig. 1)	11	11	10	10	2	3	2	2	3	16	16	18	18
Plot size (m^2)	80	64	36	24	40	50	40	50	10	25	30	30	30
Altitude (m)	770	770	1000	1000	900	950	900	900	950	990	990	1070	1070
Cover (%)	40	30	50	40	40	20	40	40	15	25	30	40	35
Total number of species	20	19	10	10	13	20	13	17	18	22	24	17	17
Character species													
Haloxylon salicornicum	3	2b	2a	2b	2b	2a	3	2a	1	2b	3	3	3
Ephedra alata	2a	2b	3	2b	.	[1]	.	.	1	3	2b	2b	3
Ephemerophytes of probable higher syntaxonomic rank													
Ifloga spicata	1	1	+	+	1m	1m	1m	1m	1m	1m	1m	1m	1m
Eremobium aegyptiacum	1m	1	1	1	1m	1m	1m	1m	1m	1m	1m	2a	1
Anthemis scrobicularis	1m	1m	1m	1	.	+	+	+	+	2a	1m	1	1m
Schismus barbatus (incl. *S. arabicus*)	+	1m	+	1	.	1	1	+	.	1	1m	1m	1m
Plantago cylindrica	.	.	.	.	2a	2a	2a	2b	1m	1m	1	1	+
Launaea capitata	+		.	.	+	+	+	1	+	+	+	.	+
Astragalus schimperi	+	1	.	.	+	+	+	+	1	.	+	.	.
Silene villosa	.	.	.	.	1	1	.	+	1	1m	1m	1	+
Cleome amblyocarpa	.	.	.	.	+	+	+	1	+	.	+	.	+
Neurada procumbens	+	1	.	.	.	1	.	+	1	+	.	+	.
Plantago ciliata	1m	1	.	.	.	.	.	.	.	+	1m	1m	1m
Erodium oxyrhynchium	+	1	.	.	.	.	.	.	.	.	1m	.	+
Astragalus hauarensis	+	1	.	.	.	1	.	.	1	.	.	.	.
Medicago laciniata	.	.	.	.	.	.	.	.	.	+	1m	+	1m
Arnebia hispidissima	1	+	.	.	.	.	.	.	.	+	1	.	.
Anisosciadium lanatum	.	.	.	.	+	+	.	+	.	.	.	+	.
Astragalus tribuloides	+	+	.	.	.	.	.	.	.	+	1	.	.
Picris babylonica	.	.	.	.	.	.	.	.	.	+	+	+	1m
Bassia eriophora	.	+	.	.	.	.	.	.	r	.	+	.	.
Trigonella stellata	.	.	.	.	.	.	.	.	.	1	1m	.	.
Erodium laciniatum var. *pulverulentum*	.	.	.	.	.	.	.	.	.	+	.	1	.
Launaea mucronata subsp. *cassiniana*	+	+	.	.	.	.	.	.	.	.	.	.	.
Asphodelus tenuifolius	.	.	.	.	.	+	+	.	.	.	.	.	.
Savignya parviflora	.	.	.	.	.	+	.	.	+	.	.	.	.
Cutandia memphitica	.	.	+	+	.	.	.	.	.	.	.	.	.
Aizoon canariense	r	+	.	.	.	.	.	.	.	.	.	.	.
Zygophyllum simplex	r	.	.	.	.	.	.	.	.	.	.	.	.
Oligomeris linifolia	.	.	.	.	.	.	.	+	.	.	.	.	.
Chamaephytes and hemicryptophytes of probable higher syntaxonomic rank													
Stipagrostis plumosa	2b	2a	+	1m	.	1m	+	+	1m	+	1	1m	1
Fagonia glutinosa	.	.	.	.	1	+	1	+	1	.	.	.	.
Polycarpaea repens	+	+	.	.	.	.	+	+	.	.	+	.	.
Farsetia arabica	.	.	.	.	.	.	.	.	.	+	1	.	.
Farsetia burtonae	.	.	[+]	.	+	.	.	.	.	.	.	.	.
Others													
Cakile arabica	.	.	1	+	.	.	.	.	.	+	+	1	1
Cutandia memphitica	.	.	.	.	.	.	.	.	.	1	+	+	1
Sclerocephalus arabicus	.	.	.	.	+	.	.	+	+	.	.	.	.
Stipagrostis ciliata	.	.	1	+	.	.	.	.	.	.	.	.	.
Arnebia tinctoria	1	1	.	.	.	.	.	.	.	.	.	.	.
Citrullus colocynthus	.	.	.	.	+	.	.	.	.	.	.	.	.
Koelpinia linearis	.	.	.	.	.	+	.	.	.	.	.	.	.
Gastrocotyle hispida	.	.	.	.	.	+	.	.	.	.	.	.	.
Horwoodia dicksoniae	.	.	.	.	.	+	.	.	.	.	.	.	.
Gymnarrhena micrantha	.	.	.	.	.	.	.	.	r	.	.	.	.
Astragalus spinosus	.	.	[+]	.	.	.	.	.	.	.	.	.	.
Cynomorium coccineum	.	.	.	.	.	.	.	.	.	r	.	.	.

Tab. 6 *The Haloxylon salicornicum community ('rimth' shrubland) of the sandy desert plain.*

الجدول ٦ مجتمع الرمث *Haloxylon salicornicum* لسهل الصحراء الرملي.

Plot no.	12	13	20	21	26	47	48	49	50	51	52
Locality (Fig. 1)	4	4	8	8	10	24	24	25	26	26	27
Plot size (m^2)	80	64	64	64	25	80	80	60	60	60	50
Altitude (m)	990	990	980	980	990	980	980	1050	980	980	1020
Inclination (°)	10	15	20	20	15	< 5	< 5	-	15	15	< 5
Exposure	NW	NW	N	E	E	E	NE	-	W	NW	E
Geology/Geomorphology	Aeolian sands and small dunes					Dunes and interdune depressions of the an-Nafud					
Cover (%)	25	20	30	25-30	20	30	35	20	50	40	20
Total number of species	12	14	11	13	14	19	17	12	20	22	13
	A					**B**					
Character species											
Artemisia jordanica	2a	2a	1	2a	2a	2a	2b	2a	3	2a	3
Moltkiopsis ciliata	+	1	.	+	1	1	1	.	+	1	1m
Stipagrostis drarii	1m	1	1	.	.	1m	1m	1	1	1	1
Calligonum comosum	.	+	.	+	.	2b	2a	2a	2b	3	+
Cyperus conglomeratus	+	1	.	.	.	1	+	+	.	+	+
Scrophularia hypericifolia	.	.	.	+	.	.	.	.	1	1	.
Ephemerophytes of probable higher syntaxonomic rank											
Anthemis scrobicularis	1m	2a	1m	1m	1m	1	+	+	1m	1	+
Eremobium aegyptiacum	1m	1m	1m	1m	1m	2a	2a	1m	1m	+	1
Plantago cylindrica	1	1	1m	2a	1	1m	1m	1	1m	2a	.
Monsonia nivea	1	.	1	1m	+	.	+	.	1	1	2a
Silene villosa	.	+	1m	1	+	1	1	.	+	+	+
Schismus barbatus	.	.	+	1m	1	.	.	1	.	+	.
Ifloga spicata	.	.	.	.	1	1m	1	.	.	.	.
Cutandia memphitica	1	1	.	.	.	.	.	.	.	.	.
Erodium oxyrhynchium	.	.	.	.	.	.	.	.	1	1	.
Neurada procumbens	.	.	.	.	.	1m	1	.	.	.	.
Astragalus tribuloides	.	.	1	+	.	.	.	.	.	.	.
Senecio glaucus	.	.	.	.	.	.	.	.	+	1	.
Bassia eriophora	+	r	.	.	.	.	.	.	.	.	.
Chamaephytes and hemicryptophytes of probable higher syntaxonomic rank											
Ephedra alata	2a	2b	3	2b	.	1	1	.	2a	1	1
Stipagrostis plumosa	.	.	.	.	1m	1	+	.	1	+	.
Heliotropium digynum	.	+	.	+	.	+	+	.	+	.	+
Polycarpaea repens	.	.	.	.	+	+	.	.	+	+	.
Others											
Cakile arabica	1	+	.	.	1	2a	1m	1m	1m	1	.
Cistanche tubulosa	.	.	+	.	.	+	.	+	.	.	.
Centropodia fragilis	.	.	.	.	.	.	.	.	1	+	1
Matthiola longipetala	.	.	.	.	.	.	.	+	.	+	+
Crucianella membranacea	.	.	.	.	.	.	.	.	+	1	.
Hypecoum geslinii	.	.	.	.	.	.	.	.	1	1	.
Bellevalia flexuosa	.	.	.	.	.	+	+	.	.	.	.
Astragalus spinosus	.	.	.	.	1	.	.	.	.	.	.
Retama raetam	.	.	.	.	1	.	.	.	.	.	.
Matthiola arabica	.	.	.	.	.	.	.	+	.	.	.
Atractylis carduus	.	.	.	.	.	+	.	.	.	.	.
	A					**B**					

Tab. 7 *The Artemisia jordanica community ('adhir' shrubland) of the sands, dunes and inter-dune depressions of the Great Nafud.*

الجدول ٧ مجتمع العاذر *Artemisia jordanica* للرمال و الكثبان و المنخفضات البينية في صحراء النفود الكبير.

Plot no.	30	31
Locality (Fig. 1)	13	13
Plot size (m^2)	25	25
Altitude (m)	802	802
Cover (%)	30	30
Total number of species	10	11
Halophytic character species		
Aeluropus littoralis	1m	1
Frankenia pulverulenta	1	1
Ruderals and introgressives		
Hyoscyamus muticus	2a	3
Suaeda aegyptiaca	2b	2a
Oligomeris linifolia	1	1m
Tamarix passerinoides var. *macrocarpa* (seedlings)	1	1m
Zygophyllum simplex	1	1
Atriplex dimorphostegia	+	1
Trigonella hamosa	+	+
Bassia eriophora	.	+
'Weedy' species		
Atriplex suberecta (synanthrop)	+	+

Tab. 8 *The Aeluropus littoralis community of the Taymāʾ* sabkha.

الجدول ٨ مجتمع العكرش الساحلي *Aeluropus littoralis* لسبخة تيماء.

Appendix 3. Floristic inventory

GYMNOSPERMAE
Ephedraceae
Ephedra alata Decne,
Ephedra foliata Boiss. ex C.A.Mey.
ANGIOSPERMAE
Aizoaceae
Aizoon canariense L.
Mesembryanthemum forskahlii Boiss.
Amaranthaceae
Aerva javanica (Burm.f.) Juss. ex Schultes
Anacardiaceae
Rhus tripartita (Ucria) Grande
Apiaceae
Anisosciadium lanatum Boiss.
Ferula communis L.
Asclepiadaceae
Pergularia tomentosa L.
Periploca aphylla Decne.
Asteraceae
Anthemis scrobicularis Yavin
Anvillea garcinii (Burm.f.) DC.
Artemisia jordanica Danin
Artemisia judaica L.
Atractylis carduus (Forssk.) C.Christ.
Calendula tripterocarpa Rupr.
Centaurea pseudosinaica Czerep.
Conyza stricta Willd.
Gymnarrhena micrantha Desf.
Ifloga spicata (Forssk.) Sch.-Bip.
Koelpinia linearis Pallas
Lasiopogon muscoides (Desf.) DC.
Launaea capitata (Spreng.) Dandy
Launaea mucronata (Forssk.) Musch. subsp. *cassiniana* (Jaub. & Spach) N.Kilian
Leysera leyseroides (Desf.) Maire
Osteospermum vaillantii (Decne.) Norlindh
Picris babylonica Hand.-Mazz.
Pulicaria crispa (Forssk.) Benth.
Reichardia tingitana (L.) Roth
Rhanterium epapposum Oliv.
Scorzonera tortuosissima Boiss.
Senecio breviflorus (Kadereit) Greuter
Senecio glaucus L.
Boraginaceae
Arnebia hispidissima (Lehm.) DC.
Arnebia linearifolia DC.
Arnebia tinctoria Forssk.
Gastrocotyle hispida (Forssk.) Bunge
Heliotropium crispum Desf.
Heliotropium digynum (Forssk.) Aschers. ex C.Christ.
Lappula sinaica (DC.) Aschers. ex Schweinf.
Microparacaryum intermedium (Fresen.) Hilger & Podlech
Moltkiopsis ciliata (Forssk.) I.M.Johnston
Trichodesma africanum (L.) R.Br.
Brassicaceae
Anastatica hierochunitica L.
Brassica tournefortii Gouan
Cakile arabica Velen. & Bornm.
Diplotaxis acris (Forssk.) Boiss.
Eremobium aegyptiacum (Spreng.) Aschers. & Schweinf. ex Boiss.
Farsetia aegyptia Turra
Farsetia burtonae Oliv.
Horwoodia dicksoniae Turrill.
Lepidium aucheri Boiss.
Matthiola arabica Boiss.
Matthiola longipetala (Vent.) DC.
Morettia parviflora Boiss.
Savignya parviflora (Del.) Webb
Schimpera arabica Hochst. & Steud.
Schouwia purpurea (Forssk.) Schweinf.
Sisymbrium orientale L.
Zilla spinosa (L.) Prantl
Caesalpiniaceae
Senna italica Miller
Caryophyllaceae
Gymnocarpos decandrus Forssk.
Gypsophila capillaris (Forssk.) C.Christ.
Paronychia arabica (L.) DC. subsp. *breviseta* (Aschers. & Schweinf.) Chaudhri var. *breviseta*
Polycarpaea repens (Forssk.) Aschers. & Schweinf.
Pteranthus dichotomus Forssk.
Sclerocephalus arabicus Boiss.
Silene arabica Boiss.
Silene villosa Forssk.
Spergularia marina (L.) Bessler
Chenopodiaceae
Atriplex dimorphostegia Kar. & Kir.
Atriplex halimus L.

Atriplex suberecta Verdoorn
Bassia eriophora (Schrad.) Aschers.
Chenopodium glaucum L.
Cornulaca aucheri Moq.
Cornulaca monacantha Del.
Haloxylon salicornicum (Moq.) Bunge ex Boiss.
Salsola imbricata Forssk.
Salsola tetrandra Forssk.
Suaeda aegyptiaca (Hasselq.) Zohary
Suaeda aff. *monoica* Forssk. ex J.Gmel.
Suadea vermiculata Forssk. ex J.Gmel.

Cistaceae
Helianthemum lippii (L.) Dum.-Cours.

Cleomaceae
Cleome amblyocarpa Barr. & Murb.

Convolvulaceae
Convolvulus buschiricus Bornm.
Convolvulus pilosellifolius Desr.

Cucurbitaceae
Citrullus colocynthis (L.) Schrad.

Cynomoriaceae
Cynomorium coccineum L.

Cyperaceae
Cyperus conglomeratus Rottb.

Dipsacaceae
Scabiosa palaestina L.

Euphorbiaceae
Euphorbia retusa Forssk.

Fabaceae
Astragalus caprinus L.
Astragalus corrugatus Bertol.
Astragalus hauarensis Boiss.
Astragalus kahiricus DC.
Astragalus sieberi DC.
Astragalus schimperi Boiss.
Astragalus tribuloides Del.
Hippocrepis areolata Desv.
Hippocrepis constricta Kunze
Lotononis platycarpa (Viv.) Pichi-Serm.
Medicago laciniata (L.) Mill.
Onobrychis ptomelaica (Del.) DC.
Retama raetam (Forssk.) Webb
Trigonella anguinea Del.
Trigonella hamata L.
Trigonella stellata Forssk.

Frankeniaceae
Frankenia pulverulenta L.

Fumariaceae
Hypecoum geslinii Coss. & Kral.

Geraniaceae
Erodium laciniatum (Cav.) Willd. var. *pulverulentum* (Cav.) Boiss.
Erodium oxyrrhynchium M.Bieb.
Monsonia nivea (Decne.) Decne. ex Webb

Hypericaceae
Scrophularia hypericifolia Wydl.

Lamiaceae
Lavandula coronopifolia Poir. in Lam.

Liliaceae s. l.
Asphodelus tenuifolius Cav.
Bellevalia flexuosa Boiss.
Dipcadi erythraeum Webb & Berth.

Loranthaceae
Plicosepalus acaciae (Zucc.) Wiens & Polhill

Malvaceae
Malva parviflora L. var. *parviflora*

Mimosaceae
Acacia gerrardii Benth.
Acacia tortilis (Forssk.) Hayne

Neuradaceae
Neurada procumbens L.

Orobanchaceae
Cistanche tubulosa

Plantaginaceae
Plantago afra L.
Plantago amplexicaulis Cav.
Plantago boissieri Hausskn. & Bornm. ex Bornm.
Plantago ciliata Desf.
Plantago cylindrica Forssk.
Plantago maris-mortui Eig
Plantago psammophila Agnew & Chalabi-Ka‘bi

Poaceae
Aeluropus littoralis (Gouan) Parl.
Aristida adscensionis L.
Avena barbata Pott ex Link
Brachypodium distachyum (L.) P.Beauv.
Bromus sericeus Drobow
Cenchrus ciliaris L.
Centropodia forskalii (Vahl) Cope
Centropodia fragilis (Guinet & Sauvage) Cope
Cutandia memphitica (Spreng.) K.Richter
Cynodon dactylon (L.) Pers.
Hyparrhenia hirta (L.) Stapf
Panicum turgidum Forssk.
Parapholis incurva (L.) C.E.Hubb.

Pennisetum divisum (J.F.Gmel.) Henrard
Phalaris paradoxa L.
Phragmites australis (Cav.) Trin. ex Steud.
Schismus arabicus Nees
Schismus barbatus (L.) Thell.
Stipa capensis Thunb.
Stipagrostis ciliata (Desf.) De Wint.
Stipagrostis drarii (Täckh.) De Wint.
Stipagrostis obtusa (Del.) Nees
Stiparostis plumosa (L.) Munro ex T.Anders.

Polygalaceae
Polygala negevensis Danin

Polygonaceae
Calligonum comosum L'Hér.
Rumx vesicarius L.

Resedaceae
Ochradenus baccatus Del.
Oligomeris linifolia (Vahl) J.F.Macbr.

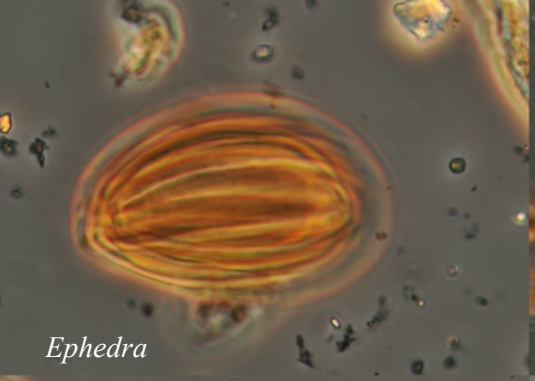
Rubiaceae
Crucianella membranacea Boiss.

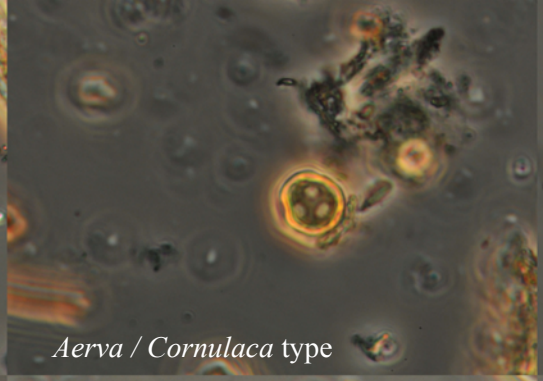
Scrophulariaceae
Kickxia aegyptiaca (L.) Nab.
Linaria simplex (Willd.) DC.
Scrophularia hypericifolia Wydl.

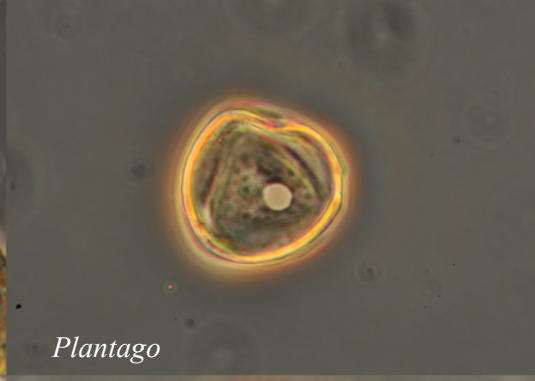
Solanaceae
Hyoscyamus aureus L.
Hyoscyamus muticus L.
Hyoscyamus pusillus L.
Lycium shawii Roem. & Schult.

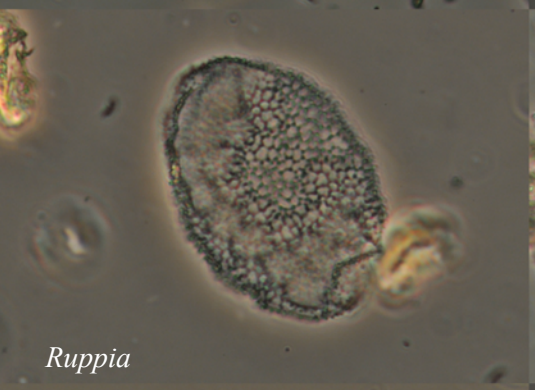
Tamaricaceae
Tamarix aphylla (L.) Karsten
Tamarix passerinoides Del. ex Desv. var. *macrocarpa* Ehrenb.

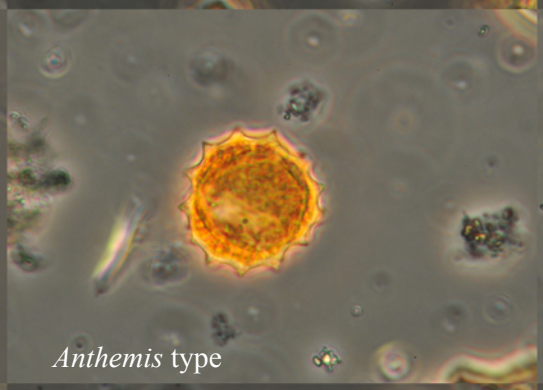
Zygophyllaceae
Fagonia arabica L.
Fagonia bruguieri DC.
Fagonia glutinosa Del.
Fagonia indica Burm.f.
Fagonia schweinfurthii (Hadidi) Hadidi
Seetzenia lanata (Willd.) Bullock
Zygophyllum simplex L.
Tribulus terrestris L. var. *terrestris*

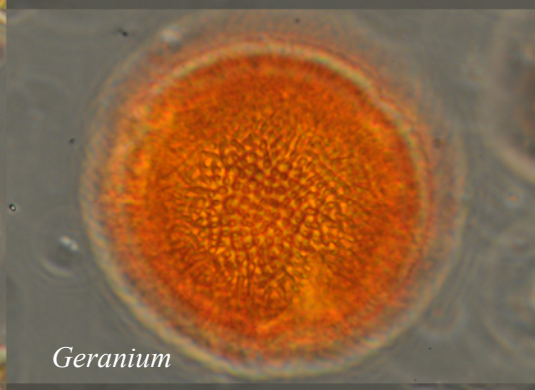

Ephedra

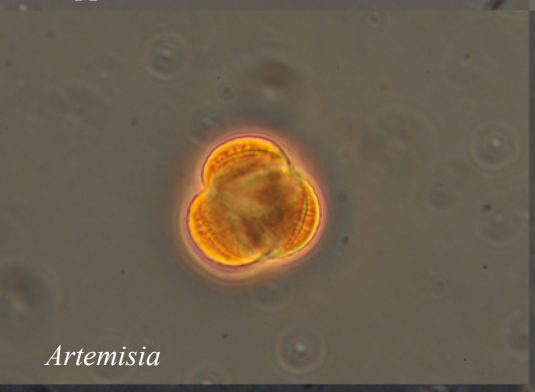

Aerva / Cornulaca type

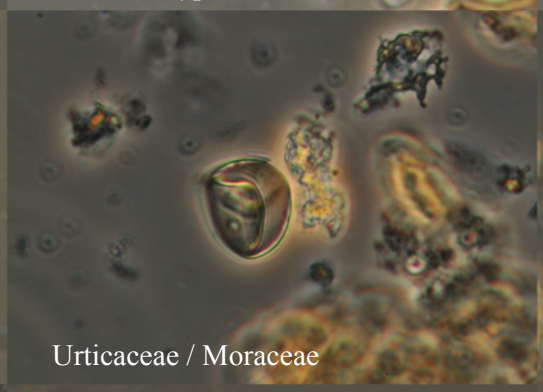

Plantago

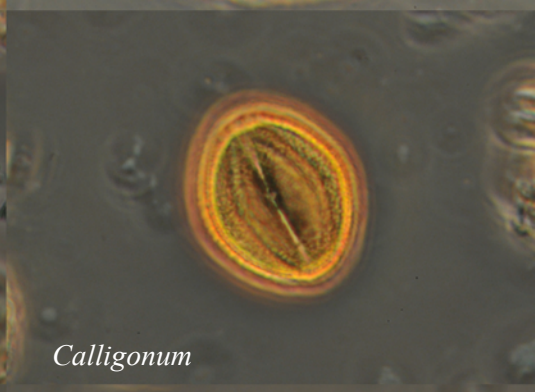

Ruppia

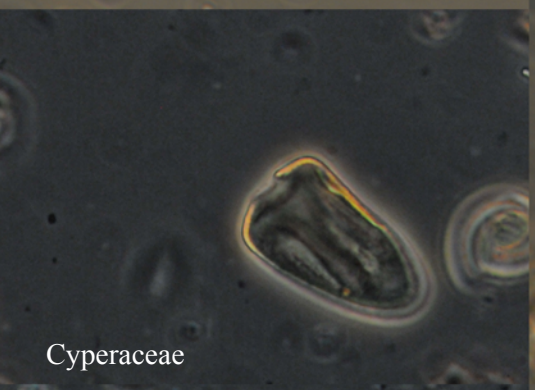

Anthemis type

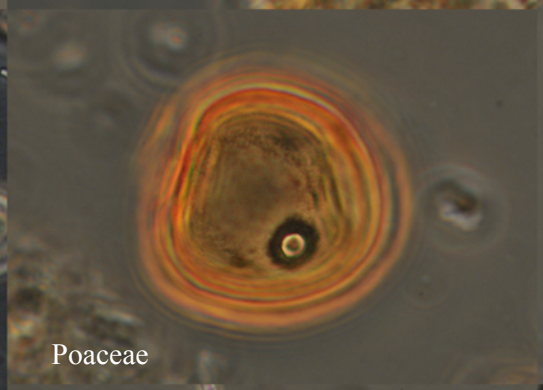

Geranium

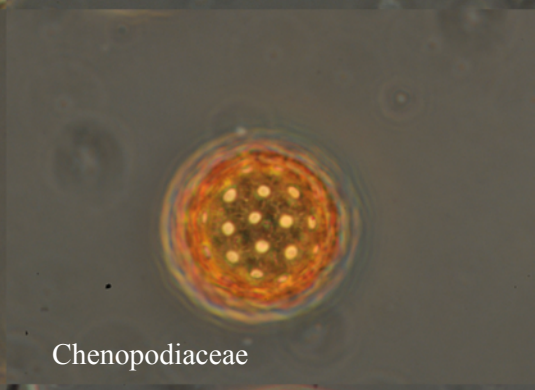

Artemisia

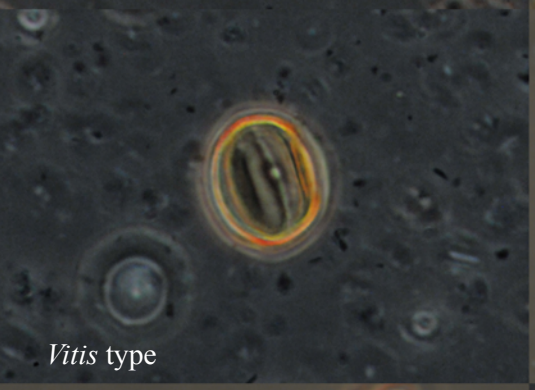

Urticaceae / Moraceae

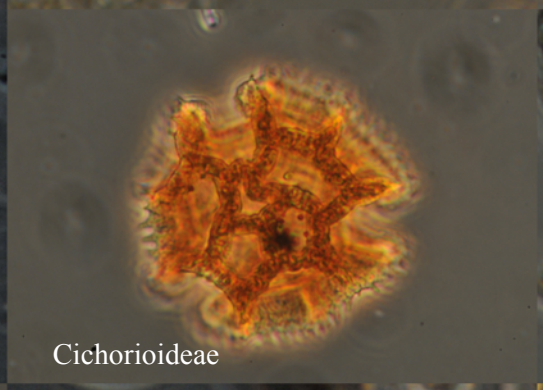

Calligonum

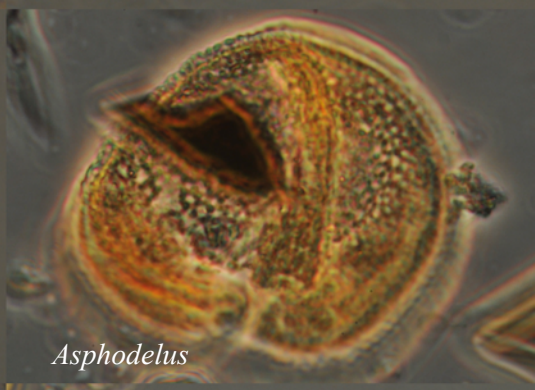

Cyperaceae

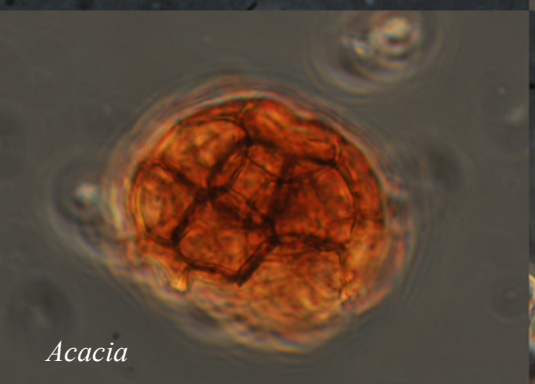

Poaceae

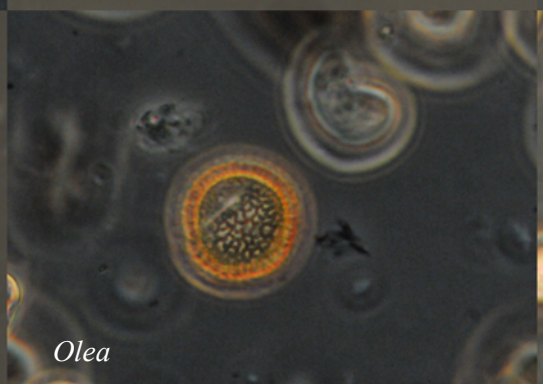

Chenopodiaceae

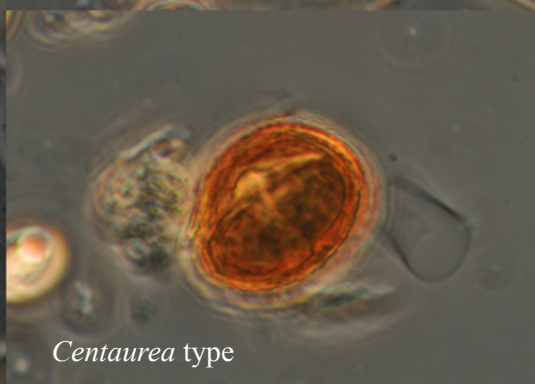

Vitis type


Cichorioideae


Asphodelus


Acacia


Olea


Centaurea type

Early to Middle Holocene Vegetational Development, Climatic Conditions and Oasis Cultivation in Taymāʾ, North-Western Saudi Arabia. First results from Pollen Spectra out of a *Sabkha*

Michèle Dinies, Reinder Neef, and Harald Kürschner

***Abstract*:** *A large palaeolake in the north of the modern city of Taymāʾ attests increased available humidity during the early and middle Holocene. Cores from this large palaeolake, together with the analysis of botanical macroremains out of archaeological features and surveys of the actual vegetation, provide excellent records for the reconstruction of the Holocene vegetational development, land use and oasis cultivation. Here we focus on the vegetational development recorded by the first pollen spectra.*

The preliminary pollen data suggest a short early Holocene humid period and a moderately denser vegetation cover during middle Holocene, because of higher frequencies of steppe ecosystems (Artemisia). Slightly increased frequencies of trees may point to a greater expansion of montane woodlands in the west of the Taymāʾ region. These are indications that increased precipitation affected the ecosystems in the Taymāʾ region and adjacent areas.

However, the fluctuating but high frequencies of desert vegetation (Amaranthaceae, Poaceae, Plantaginaceae) *throughout the sequence show the persistence of desert ecosystems in the Taymāʾ region. Agricultural practices thus probably always depended on irrigation.*

Grapevine pollen indicates oasis cultivation at least since the second half of the 4th millennium BCE. Whether the aridisation – and thus the probably reduced density of the natural resources – reflected by the lower frequencies of steppe vegetation (Artemisia) during this time was the main trigger for oasis cultivation or only one among several reasons has to be discussed after further analysis.

***Keywords**: vegetation history, oasis cultivation, palaeoclimatology, Holocene, Arabian Peninsula*

ملخّص: تشهد بحيرة قديمة واقعة إلى الشمال من مدينة تيماء الحديثة على ارتفاع الرطوبة المتاحة خلال عصر الهولوسين المبكّر والأوسط. توفّر لبابات الحفر المأخوذة من البحيرة القديمة الواسعة إلى جانب تحليل البقايا النباتية المكتشفة ضمن السياق الأثري وعمليات المسح للكساء الخضري الحالي سجلّات ممتازة من أجل استخلاص المعلومات عن تطوّر الكساء الخضري واستخدام الأراضي واستصلاح الواحة خلال عصر الهولوسين. نركّز هنا على تطوّر الكساء الخضري الذي سجّلته الأطياف الطلعية الأولى.

تشير المعطيات الأولّية لتحليل غبار الطلع إلى وجود كساء خضري معتدل الكثافة خلال عصر الهولوسين المبكّر والأوسط و ذلك بسبب الشيوع الكبير لنظم البادية البيئية (البعيثران *Artemisia*). وقد يدلّ الانتشار المتزايد بشكل طفيفٍ للأشجار على وجود توسّع أكبر للأحراج الجبلية في غرب منطقة تيماء. وهذه دلائل على أن زيادة هطول المطر قد أثّرت على النظم البيئية في منطقة تيماء والمناطق المتاخمة لها. ومع ذلك فإن الانتشارات المتذبذبة ولكن الكبيرة للكساء الخضري الصحراوي (الفصيلة السرمقية Chenopodiaceae / الفصيلة القطيفية Amaranthaceae، البواسية Poaceae، الحملية Plantaginaceae) على اختلاف تسلسلها تظهر استمرار النظم البيئية في منطقة تيماء وتؤكّد أن الأنشطة الزراعية فيها قد اعتمدت دوماً على الري.

يشير غبار طلع العنب إلى وجود زراعة في الواحة منذ النصف الثاني للألف الرابع ق. م.

فيما إذا كانت القحولة – وما يترتب على ذلك من انخفاض محتمل لكثافة الموارد الطبيعية – والتي تعكسها الانتشارات المنخفضة لكساء البادية الخضري (البعيثران) خلال هذا الزمن هي السبب الرئيسي لاستصلاح الواحة زراعياً أو سبباً واحداً فقط بين عدّة أسباب فإن مناقشة هذا الأمر واجبة بعد إجراء المزيد من التحليل.

كلمات البحث: تاريخ الكساء الخضري، زراعة الواحة، علم المناخ القديم، الهولوسين، شبه الجزيرة العربية.

1 Introduction

To learn more about past environments and human living conditions, the reconstruction of vegetation development as a fundamental part of the landscape is of great importance. The vegetation history of a region provides information about changing ecosystems and thus changing availability of natural biotic resources, as well as climate and settlement.

Up to now, for the whole Arabian Peninsula, information about Holocene vegetation history is very scarce (Lézine *et al.* 2007; Parker *et al.* 2004). The same is true for the Taymāʾ region in the northwest of Saudi Arabia, where nearly nothing is known about the past Holocene vegetation and its changes (Schulz – Whitney, 1986).

The pollen record of cores from a *sabkha* in the immediate vicinity of Taymāʾ now provides the possibility of reconstructing Taymāʾ's local and regional vegetation for the period between 10,000 and 4,000 BP. Here we report the first results of preliminary palynological analyses of a *sabkha* core, which show changes in vegetation and indicate wetter conditions in the past. The records of vine pollen in the upper part of the sequence very probably mark plant cultivation in the oasis of Taymāʾ. This enables us to learn more about vegetation development, environmental conditions and climate change during the early and middle Holocene in the Taymāʾ region and about the beginnings of its oasis economy.

Climate development during early and middle Holocene in Arabia

Geomorphological and isotope studies as well as deep sea records prove that wetter conditions existed during the early to middle Holocene in the Arabian Peninsula, due to an intensification and northward shift of the Indian Ocean Monsoon and variations in winter cyclonic rainfall input from the northern Westerlies. High resolution δO^{18} curves from speleothoms illustrate the fluctuation of the Indian Monsoon (Neff *et al.* 2001; Fleitmann *et al.* 2003; 2007), while the reconstruction of the large-scale development of the Indian Monsoon is mainly based on marine records (e.g. Gupta *et al.* 2003; Staubwasser *et al.* 2002; Overpeck *et al.* 1996; Sirocko *et al.* 1993). Nevertheless, our understand of the impact of the Indian Monsoon on terrestrial Arabian ecosystems is scarce, because continuous continental records are very rare (e.g. Lézine *et al.* 2007; Parker *et al.* 2004).

Ancient lake sediments, fluviatile terraces and speleothoms reveal an early Holocene humid period from about 10,000 to 6,000 cal BP (e.g. McClure 1976; Schulz – Whitney 1986; Lézine *et al.* 1998; Lézine *et al.* 2007; Parker *et al.* 2004; 2007; Neff *et al.* 2001; Fleitmann *et al.* 2003; 2007; Davies 2006). However, neither the beginning and end of this humid period in Arabia nor possible fluctuations in humidity during this period are well established. The earliest evidence of increased humidity comes from lake sediments from south Arabia (Lézine *et al.* 1998; 2007). Delayed records, attesting to the onset of increased humidity, are found in the north and west of Arabia (Parker *et al.* 2006; Davies 2006). Another time shift appears at the end of the humid period. While in the north lake sediments are recorded until about 6,000 cal BP, and in the east even until about 3,000 cal BP, the record of lacustrine sediments ends in south Arabia by about 8,000 cal BP (e.g. McClure 1976, Lézine *et al.* 1998; 2007; Parker *et al.* 2004; 2006; Schulz – Whitney 1986; Garcia Anton – Sainz Ollero 1999; McLaren *et al.* 2009). These regional differences may be explained by the influence of the Westerlies on northern and eastern Arabia as well as by the buffer capacity of ecosystems (Parker *et al.* 2004; Blanchet *et al.* 1997; Sanlaville 1992).

Vegetation development during the early and middle Holocene in Arabia

While the number of geomorphological and isotope studies in Arabia increased slightly in recent decades (e.g. McLaren *et al.* 2009) there are still very few palynological studies. The lack of suitable sequences for pollen analysis in arid regions in general is the main reason for our ignorance of Holocene vegetation development patterns (e.g. Lézine *et al.* 2007; Parker *et al.* 2004; Horowitz 1992). Deviating methodological approaches and interpretation of pollen spectra of arid regions compared to temperate and tropical pollen diagrams are further reasons. These discrepancies are a result of the scarce vegetation cover, the low pollen production of the plants and the strongly underrepresented pollen types of the mainly insect pollinated trees in arid lands (e.g. Horowitz 1992). Thus, the interpretation of vegetation development is mainly based on the pollen types of herbs and shrubs and not on pollen of trees as in humid regions. However, this may even be an advantage, because the life cycles of herbs and shrubs are shorter than those of trees and thus may better reflect so-called climax vegetation, the plant cover in equilibrium with the prevailing environmental conditions (e.g. el-Moslimany 1987).

Most studies on the vegetation history of arid subtropical and tropical regions have been carried out in Africa. For the Arabian Peninsula only four Holocene pollen diagrams are published (Schulz – Whitney 1986; Lézine *et al.* 2007; 1998; Parker *et al.* 2004; Garcia Anton – Sainz Ollero 1999). During the early Holocene, these pollen diagrams are characterized by slightly elevated arboreal pollen frequencies, indicating wetter conditions. The pollen spectra, however, do not indicate such drastic changes of vegetation as are recorded in North Africa during the early and middle Holocene (e.g. Lézine *et al.* 2007; 1998; Inizan *et al.* 1998).

Beginning of oasis cultivation

Agri- and horticulture in arid lands like Saudi Arabia is restricted to oases and other permanent water sources like lakes and rivers, compensating for the instability of the arid rain regime (Horowitz 1992). Whether wetter conditions or increasing aridity triggered the beginning of oasis cultivation or socio-cultural developments like irrigation techniques made oasis cultivation possible remains controversial (e.g. Cleuziou – Tosi 1998; McCorriston *et al.* 2002; Lézine *et al.* 2010).

Aims of the palynological investigations

High resolution pollen diagrams in combination with AMS-dates of the sequences from the *sabkha* near Taymāʾ will contribute essential information to our understanding of the regional vegetation history, climate development, and the beginning of oasis cultivation.

In the following, the first results of the few pollen samples analysed thus far will be presented and discussed. They already give some clues as to what early to mid-Holocene vegetation and climate development has been like, and when oasis cultivation was established in Taymāʾ. Detailed results and conclusions must, however, await further analysis and AMS-dates.

2 Study area

The study area Taymāʾ is characterized by an arid to hyperarid climate with precipitation of 50 mm or less per year (Zohary 1973; Barth 1976). It is part of the Arabian Shield (Geographic region: sandstone plateau, Barth 1976).

Today, different types of desert vegetation predominate in the Taymāʾ region. Most common and widespread in northern Saudi Arabia are so called 'rimth' shrublands, dominated by *Haloxylon salicornicum*, of the family Amaranthaceae and the so called 'arfaj' shrublands, dominated by *Rhanterium epapposum*, a representative of the Asteraceae. On sand dunes the so called 'adhir' shrublands with *Artemisia jordanica* are widespread. For a detailed description of the recent vegetation in the Taymāʾ region see Kürschner – Neef (2011) and Kürschner – Neef (this volume).

The samples used for this preliminary study are sediments out of the *sabkha* in the north of the modern city of Taymāʾ and the ancient town (Fig. 1). This depression, which is today only intermittently flooded, was a large lake during early- to mid-Holocene times (Wellbrock – Grottker, 2010; Engel *et al.* 2012 and see below), providing a unique archive for palynological investigations in this now very arid region.

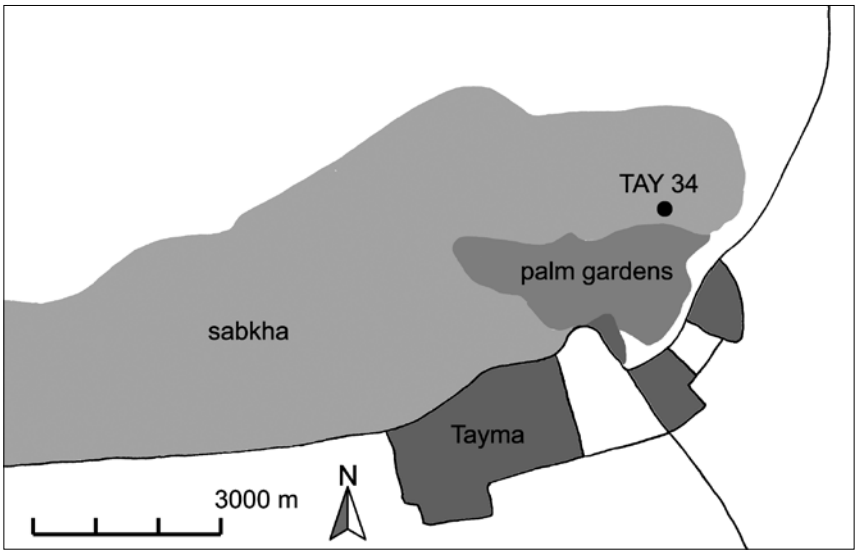


Fig. 1 *Coring site in the sabkha near Taymāʾ.*

الشكل ١ موقع حفر اللبابات في السبخة قرب تيماء.

3 Methods

Ten samples were taken of a sediment core of the *sabkha's* south-eastern part and prepared following standard methods (e.g. Faegri – Iversen 1989; Moore – Webb – Collinson 1991; Eisele – Haas – Liner 1994). We thank the Institute of Geography, University of Cologne for the material.

Counting was performed using a Leitz microscope, magnification 400 and 1000. For the determination of the pollen types a reference collection and atlases of pollen types (e.g. Reille 1992; 1995; Bonnefille – Riolett 1980; El-Ghazaly n.d.) were available.

Because of high overrepresentation, the Chenopodiaceae/Amaranthaceae (goosefoots) and Poaceae (grasses) are excluded for the calculation of the percentage proportions.

4 Results

Radiocarbon dating

The AMS ages of two pollen concentrates from the core show that the sediments date to the early to mid-Holocene (Table 1).

Lab. Nr. UGAMS	Sample	Depth (cm below surface)	Material	Delta 13C	14C age, years BP	Years cal. BP (2σ)	Years BCE / AD
6101	Tay34 AMS-3	441–453 cm	pollen	-24,9	8190 ± 30	9310–9070	7310–7070
6102	Tay34 AMS-4a	240–251 cm	pollen	-24,8	4460 ± 40	5350–4940	3350–2940

Tab. 1 *AMS dates on pollen from the sediments of the sabkha. Ages in BP before the zero year of 1950 AD (Libby half life) and in cal. BP and BCE (OxCal4.1). Depths are measured from ground surface.*

الجدول ١ نتائج تأريخ غبار الطلع باستخدام قياس الطيف الكتلي. العصور مؤرّخة بـ BP (قبل الحاضر) قبل سنة الصفر ١٩٥٠ ميلادية (ليبي منتصف العمر) وبـ cal. BP (قبل الحاضر المعاير) و قبل الميلاد (وفقاً لمعايرة أوكسفورد OxCal4.1). تمّ قياس الأعماق اعتباراً من مستوى سطح الأرض.

Pollen analysis

Up to now, 90 pollen types have been recorded. For the first ten pollen spectra the frequencies of a few selected pollen types are presented in Figure 2. The different types are grouped according to their ecology.

All spectra are clearly dominated by desert and steppe types, Amaranthaceae, Poaceae, Plantaginaceae, Asteroideae, *Ephedra*, *Calligonum*, *Rumex* type and *Artemisia*. Pollen frequencies of trees are (very) low in the whole sequence; most types are, however, consistently present.

Zone 1: The two lowermost samples are characterized by (very) high frequencies of the Amaranthaceae, Poaceae and *Ephedra* pollen. Pollen frequencies of *Artemisia* do not exceed 10%. Tree pollen frequencies are very low.

Zone 2: Increased Poaceae frequencies in the third sample indicate a short early Holocene humid period (Dinies *et al.* 2015; 2016)

Zoe 3: The following 6 samples are characterized by high frequencies of *Artemisia* pollen, reaching a maximum of 38%, while pollen frequencies of Amaranthaceae and Poaceae decreased strongly. There is a maximum of tree pollen frequencies, due to higher records of *Olea* pollen, reaching a maximum of 4%, and pollen of *Dodonea*, fluctuating between 0.7–4%. Urticaceae/Moraceae pollen appear early and peak at 3% in this zone. Pollen of *Vitis* type and *Ficus vasta* type appear at least somewhat earlier than 3,200 cal BCE, with pollen frequencies up to 1–2%. Diatoms occur sporadically. At about 3,200 cal BCE a distinct peak of freshwater green algae (*Pediastrum*) is recorded.

Zone 4: The topmost sample is characterized by a marked decrease in *Artemisia* pollen frequency and an increase in Amaranthaceae pollen frequency.

To study the relationship between vegetation and pollen deposition, surface samples were first analyzed. Different pollen types dominate these few modern spectra, depending on the surrounding plant stands. High frequencies of Plantaginaceae, rather high frequencies of Amaranthaceae, and rather low frequencies of *Artemisia* seem to characterise all modern spectra analyzed so far. Tree pollen frequencies are low. Pollen of *Pistacia*, *Olea* and *Dodonea* are recorded.

5 Interpretation

For the interpretation of these first Holocene pollen spectra from the palaeolake next to Taymāʾ we have to keep in mind that we are discussing preliminary results. Therefore, we will focus on some prominent, some ecologically important and some economically interesting pollen types. An interpretation considering all pollen types will be offered after detailed analysis, based on high resolution diagrams and further ^{14}C dates.

Since the pollen-bearing sequence starts at about 10,000 cal BP and lasts until at least ca. 4,000 cal BP, the time resolution of the preliminary diagram is very low. At this stage we are not able to decide whether the sediments were deposited continuously or if there were phases of lower and higher deposition rates.

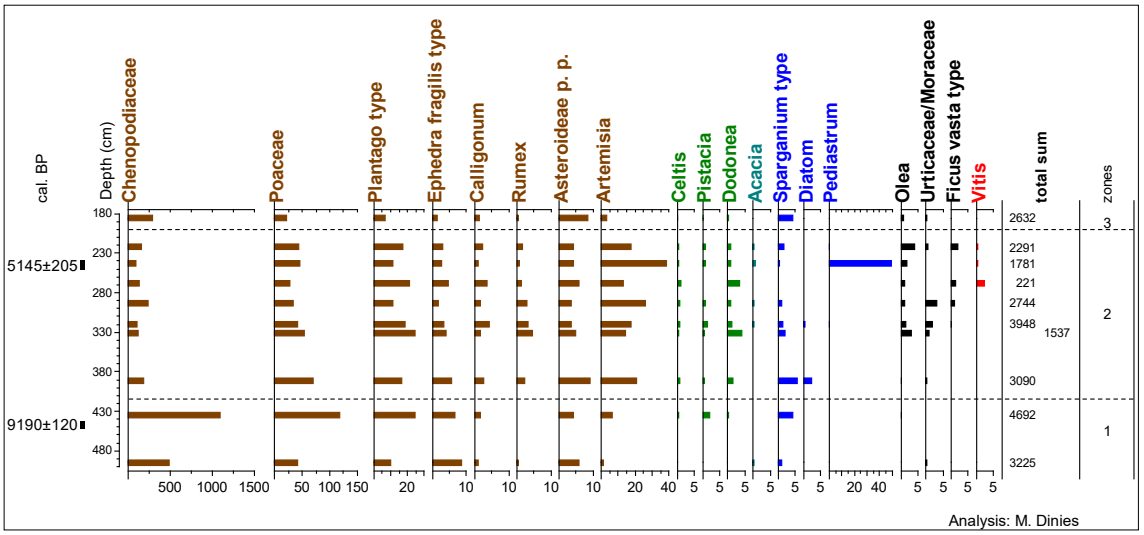


Fig. 2 *Preliminary percentage pollen diagram. All terrestrial pollen types are included in the sum for percentage calculation, exclusive* Amaranthaceae *and* Poaceae*, because of their high representation. Pollen types are grouped in representatives of: 1. desert* (Amaranthaceae, Plantaginaceae *(plantain and others), Ephedra, Calligonum, Rumex type,* Asteroideae*) and steppe (Artemisia) and grasslands* (Poaceae)*, 2.* wadi *(Acacia), lakeshore and freshwater (Sparganium type, Diatom, Pediastrum), 3. sclerophyllous woodlands (Pistacia, Olea, Dodonea, Celtis) and 4. synanthropic species / probably cultivated plants (*Urticaceae/ Moraceae*, Olea (olive), Vitis type (vine), Ficus vasta type (figs)). The diagram is subdivided in three preliminary zones.*

الشكل ٢ رسم بياني لنسبة غبار الطلع. تمّ إدراج جميع أصناف غبار الطلع الأرضية في مجموع حساب النسبة المئوية، تم استثناء الفصيلة القطيفية Amaranthaceae و البواسية Poaceae بسبب تمثيلهم المفرط. تمّ تجميع الأصناف الطلعية ضمن ممثلين: ١- الصحراء (القطيفية Amaranthaceae، الحملية Plantaginaceae (لسان الحمل *Plantain* وآخرون)، الإيفدرا *Ephedra*، الأرطى *Calligonum*، صنف الحمّاض *Rumex*، النجماويات Asteroideae) والبادية (البعيثران *Artemisia*) و مرج (Poaceae) ، ٢- الوادي (السنط *Acacia*)، شاطئ البحيرة والمياه العذبة (صنف القصب *Sparganium*، الطحالب العصوية *Diatom*، طحالب بديَستروم *Pediastrum*)، ٣- الغابات قاسية الأوراق (البطم *Pistacia*، الزيتون *Olea*، الدودونيا *Dodonea*، الميس *Celtis*) و٤- الأنواع المتعايشة مع البشر / ربما النباتات المزروعة (الفصيلة القراصية Urticaceae / الفصيلة التونية Moraceae، الزيتون *Olea*، صنف الكرمة *Vitis* (العنب)، صنف التين *Ficus vasta*). ينقسم الرسم البياني إلى ثلاثة نطاقات أولّية.

Regional vegetation development

The pronounced dominance of herbaceous pollen grains, especially of Amaranthaceae, Plantaginaceae, *Ephedra* and Asteraceae during the lacustrine period from about 9,500 to about 4,500 cal BP indicates the continuity of arid environmental conditions even during early and middle Holocene times.

The fluctuations of the Poaceae, Amaranthacdeae and *Artemisia*, however, suggest some not very pronounced, but perhaps ecologically and economically significant vegetation changes. Increased Poaceae frequencies in (semi)arid lands are commonly interpreted as indicating increased available moisture during the growing season (*e.g.* el-Moslimany 1990). The single so far analyzed early Holocene sample with distinct increased frequencies thus may indicate a short humid period (Dinies *et al*. 2015; 2016). Today, only *Artemisia jordanica* occurs on sand dunes in the Taymāʾ region (Kürschner – Neef 2011 and Kürschner – Neef this volume), while *Artemisia sieberi*, most common in the steppes and semi-deserts of Iran, Jordan and adjacent regions (Zohary 1973), does not occur nowadays in the Taymāʾ region.

In arid lands, high frequencies of Amaranthaceae pollen, together with Plantaginaceae, are commonly interpreted as indicating arid conditions. Semi-arid conditions are characterised by the dominance of *Artemisia* pollen and lower frequencies of Amaranthaceae pollen (e.g. van Zeist 1967; Bottema 1986; El-Moslymany 1990; Singh *et al.* 1990; Horowitz 1992; Rossignol-Strick 1998). Following this interpretation of *Artemisia* as an indicator of steppe vegetation, the higher *Artemisia* frequencies in the past indicate a more southerly expansion of steppe vegetation.

The basal pollen spectra of the *sabkha* of Taymāʾ, characterized by very high Amaranthaceae frequencies and low *Artemisia* values thus would suggest (hyper)arid conditions. The following sample with increased grass frequencies and decrased Amaranthaceae point to a short period of wetter conditions. The subsequent rise of *Artemisia* pollen may indicate an increase of steppe vegetation, due to an increase in moisture in the region. The increase of Amaranthaceae and decrease of *Artemisia* in the topmost sample would suggest further aridity. Detailed analysis of additional pollen samples and their interpretation, considering all recorded pollen types as well as the study of the present pollen rain, will help to confirm or reject this hypothesis.

The very high frequencies of Amaranthaceae throughout the whole Taymāʾ sequence probably reflect the regionally widespread 'rimth' shrublands (Kürschner – Neef 2011 and Kürschner – Neef this volume), both in the past and the present, as well as local stands of the salt tolerant goosefoots, built up on the shore of the permanent saline lake. Whether the plentiful Amaranthaceae at the beginning and end of the sequence occurred locally on extended saline habitats around the lake, or whether they occurred more frequently in the surrounding area, and whether the goosefoots were more abundant in both, is difficult to decide. In all cases, enforced aridity explains locally and regionally elevated frequencies of Amaranthaceae (e.g. Lézine *et al.* 2007; van Zeist 1967).

Development of the palaeolake & lakeshore, and wadi vegetation

The sediments of the *sabkha* show saline conditions throughout the whole sequence. Possible fluctuations in water plant composition may indicate changes in water input into the *sabkha*, either due to increased precipitation or to changed feeder systems. So far, only a few algae like diatoms and *Pediastrum* have been sporadically recorded. The green algae genus *Pediastrum* indicates freshwater conditions (Komarek – Jankovska 2001). Therefore, it is most probable that these green algae did not grow in the ancient salt lake itself but were washed in by feeders. Particularly noticeable are the high frequencies of the green algae *Pediastrum* about 3,200 cal BCE. Whether they originated from a natural reservoir and thus indicate wetter conditions or whether they came from an anthropogenic reservoir e.g. used for irrigation, has to be decided later.

Sparganium and plants like *Typha* and *Salix/Tamarix* (not shown in the diagram) occurred on the lakeshore, probably together with goosefoot species, as mentioned above.

Acacia woodlands probably dominated the *wadi*s. The low and inconsistent frequencies indicate the scarce occurrence of these trees. Thorn trees are known to be highly underrepresented in pollen diagrams (e.g. Horowitz 1992; van Campo 1975).

Low but nearly consistent frequencies of sclerophyllous trees and shrubs may indicate their larger extension in the past

Trees and shrubs in arid lands are generally underrepresented, but are of particular importance for palaeoecological reconstructions, as mentioned above. Thus far the half-evergreen Mediterranean and tropically distributed trees *Celtis, Pistacia, Dodonea* and *Olea* have been recorded consistently in the sequence, with slightly increased frequency in Zone 3. These frequencies exceed slightly those of modern surface samples – up to now, *Celtis* is not recorded around Taymāʾ and adjacent regions (Schulz – Whitney 1986; Gajewski *et al.* 2002; El-Moslymani 1990; Lézine *et al.* 1998). We may suggest that the slightly increased tree pollen frequencies during the early and middle Holocene indicate a wider distribution and/or increased occurrence of these trees. But where did these woodlands grow? Nowadays sclerophyllous half-evergreen woodlands built up by *Pistacia, Celtis, Dodonea* and *Olea* are documented in the mountains in the southwest of Arabia and the southern Asir (*e.g.* Kürschner 1998; Kürschner *et al.* 2008; El-Karemy – Zayed 1992). The occurrence of similar woodlands in the northern part of the southern Hijaz mountains, to the

west of Taymāʾ, is probable, today and in the past. Presumably sclerophyllous woodlands did not grow in close proximity to Taymāʾ. High frequencies of desert and steppe plants indicate that these biomes dominated in the surroundings of Taymāʾ during the entire Holocene. However, an east- and northward expansion of the montane sclerophyllous woodlands of the northern Hijaz mountains onto the plains to the west of Taymāʾ and/or an invasion of these woodland elements along certain routes (e.g. ancient rivers, lakes) seems possible. Sclerophyllous woodland elements hence would have been closer to Taymāʾ in the past, due to increased humidity during the lake period, complementing the persisting desert and steppe-desert vegetation.

Vine pollen records indicate oasis cultivation in Taymāʾ since the 4th millennium

The beginning of oasis cultivation is a crucial problem of archaeological research. It not only involved changes in the use of different natural biotic resources and land use but socio-cultural changes as well. To trace the beginning of oasis cultivation, a reliable indicator, a pollen type that includes only cultivated plants for the region under concern, i.e. a primary anthropogenic indicator *sensu* Behre (1981; 1990; Behre – Kucan 1986), has to be identified. Plants which are typically cultivated in oases, and especially the seeds and fruits of cultivated plants from archaeological contexts at Taymāʾ, might be such a reliable indicator.

In oases, today, plants are typically cultivated in different layers. Date palms (*Phoenix*) form the upper layer. In the shade of the palms smaller trees like *Punica* (pomegranate)*, Prunus dulcis* (almond) and *Ficus* (fig) are grown. Beneath the middle layer different vegetables, cereals and grape vines are cultivated. To date cereals, lentils, beets, blackberries, almonds, pomegranates, dates, figs, olives and grapes have been recorded for in the Taymāʾ oasis (see Table 2).

For various reasons, most of these cultivated plants are missing in the palynological record. To distinguish cereals from pollen of wild grasses is very difficult if not impossible in this region (e.g. Behre 1990). Pollen of beets cannot reliably be distinguished from pollen of other Amaranthaceae (Beug 2004). Thus, the frequencies of Poaceae and Amaranthaceae may include cultivated plants but cannot be used as primary anthropogenic indicators. No pollen of *Rubus fruticosus* agg. (blackberries), *Prunus dulcis, Phoenix* or *Punica* have yet been recorded. Pomegranate is known to be heavily underrepresented in pollen diagrams because it is insect pollinated and thus produces only very little pollen (Behre 1990). In the Middle East and Egypt, date palm plantations became increasingly important only from the 3rd millennium BCE onwards (Lézine *et al.* 2011). This may explain why *Phoenix* pollen are lacking in Taymāʾ. The spectra analysed thus far most probably represent an early state of oasis cultivation, when date palms were not yet cultivated.

Yet, in some of the samples from Taymāʾ pollen of *Ficus, Olea* and *Vitis* are present. *Olea* is recorded consistently throughout the sequence. Increased frequencies in the upper part may be due to cultivation or promotion of olive trees, as well as a further natural dispersal of woodlands with olive trees to the west of the Taymāʾ region (compare above). In the Jordan valley, cultivation of olive trees started about 4,500 cal BCE (Neef 1990). A conclusive interpretation of the elevated *Olea* frequencies must await further detailed analysis and dating. The records of *Ficus vasta* type pollen are rather astonishing because of the complex pollination of figs (e.g. Franke 1989; http://www.figweb.org). Perhaps whole inflorescences, fruits or pollinating gall wasps dropped in the water and pollen were dispersed. The three-pored *Ficus vasta* type do not include the species usually cultivated for human consumption, *Ficus sycomorus* and *Ficus carica,* but taxa like *Ficus vasta*. This fig, nowadays widespread in the south of the Arabian Peninsula, is reportedly used for animal fodder, medicinal purposes and human consumption (e.g. http://www.figweb.org; http://www.africa.upenn.edu). Thus, the cultivation or promotion of *Ficus vasta* and perhaps other figs native to southern Arabia like *Ficus salicifolia* seems possible. Yet, since pollen records of *Olea* and *Ficus* may reflect natural propagation as well, these pollen types are not reliable primary

Recorded cultivated seeds & fruits	Recorded pollen types
Hordeum vulgare	in Poaceae
Triticum aestivum	in Poaceae
Avena sativa	in Poaceae
Setaria italica	in Poaceae
Beta vulgaris	in Chenopodiaceae
Lens culinaris	
Vitis	*Vitis*
Ficus	*Ficus vasta* type
Olea	*Olea*
Phoenix dactylifera	
Punica granatum	
Rubus fruticosus agg.	
Prunus dulcis	

Tab. 1 *List of the so far recorded seeds and fruits of cultivated plants out of archaeological context in Taymāʾ and their records as pollen.*

الجدول ٢ لائحة بالبذار والثمار المسجّلة حتى الآن والعائدة للنباتات المزروعة من السياق الأثري في تيماء مع سجلّاتها الطلعية.

anthropogenic indicators – at least for this preliminary pollen diagram. Grape vines, however, comply with the requirements of a primary anthropogenic indicator. The southern margins of the natural distribution area of the wild grape vine clearly run far more to the north (e.g. Meusel *et al.* 1992; McGovern 2003) and seeds and charred wooden remains of grape vine are an unambiguous archaeobotanical evidence for its cultivation at Taymāʾ. According to Bottema – Barkoudah (1979) *Vitis* is overrepresented in pollen diagrams of (semi)arid lands, because of its rather high pollen production. Thus, a first record of vine its pollen should actually mark the beginning of grape cultivation.

AMS-dating of macrobotanical remains from an ash-layer beneath an archaeological feature reveals an age of about 2,500 BCE for oasis cultivation at Taymāʾ. The record of grape vine pollen in a sample at about 3,300 BCE put the beginning of oasis cultivation in the second half of the 4th mill. BCE.

As mentioned above, information about environmental conditions during the beginning of oasis cultivation are of special interest. The first grape vine record goes along with decreased *Artemisia* frequencies. If the interpretation of *Artemisia* as a steppe indicator holds true for the Taymāʾ region then the beginning of the cultivation of the oasis of Taymāʾ would have occurred during a period when vegetation became less dense and more scattered. This decline in forage may have been one reason for the emergence of a new source of livelihood.

6 Discussion and conclusions

Holocene vegetation development and climate changes

Our preliminary pollen data suggest a short early Holocene humid period because of increased grass frequencies and a moderately denser vegetation cover during the middle Holocene, because of higher frequencies of steppe ecosystems (*Artemisia*) than nowadays in the Taymāʾ region. Slightly increased frequencies of trees point to a greater expansion or invasion of montane woodlands to the west of the Taymāʾ region. This indicates that increased precipitation during the early and middle Holocene affected the ecosystems in the Taymāʾ region and adjacent areas. However, the fluctuating but high frequencies of desert vegetation throughout the sequence show the persistence of desert ecosystems in the area, from which we may assume a short early Holocene period with increased precipitation, fostering the spread of grasslands and slightly increased precipitation during the middle Holocene. Rainfall, which is enough for the spread of grasslands and steppe ecosystems (perhaps on edaphically favoured sites), but still rather low, because of the per-

sistence of the desert ecosystems in the Taymāʾ region, is implied. Palynological investigations in the adjacent Great Nafud, in Yemen and in the UAE revealed similar results: during the early to mid-Holocene the vegetation cover was denser. The records of trees indicate a slightly increased importance of woodlands, but desert vegetation persisted throughout the Holocene (Schulz – Whitney 1986; Lézine *et al.* 1998; 2007; Parker *et al.* 2004). Thus, our preliminary study of a core out of the *sabkha* in the north of Taymāʾ, northwestern Saudi Arabia, seems to corroborate the hypothesis of Lézine *et al.* (1998; 2007) that vegetation changes during the early to mid-Holocene in Arabia were less pronounced than in North Africa. Yet, we have to keep in mind that for Arabia only very few palynological studies exist.

Oasis cultivation

The persistence of desert vegetation during the whole sequence indicates that agricultural practices in the Taymāʾ region probably always depended on irrigation.

The analysis of the first pollen samples reveals grape vine pollen to be a reliable indicator of oasis cultivation. In combination with a first AMS date we can date the beginning of cultivation in the Taymāʾ oasis to ca. 3,300 BCE. Relatively low steppe vegetation suggests sparser vegetation cover and consequently somewhat reduced pasture supplies during this period. Whether this less pronounced, but perhaps economically significant change in vegetation was the main trigger for oasis cultivation or only one among several reasons for the beginning of oasis agricultural practices can only be determined after detailed analysis, and of course together with all other available proxies, particularly the archaeological and archaeobotanical evidence.

Acknowledgments

The project is financed by the Thyssen-Stiftung. The logistical support of the German Archaeological Institute (Orient Department, Berlin), the Saudi Commission for Tourism and Antiquities, the King Saudi University Riyadh and the Taymāʾ Museum for Archaeology and Ethnography is gratefully acknowledged.

The authors would like to express their special thanks to the following persons: Dr. habil. A. Hausleiter and his team for the great and sustained interest in and support of our project, Prof. Dr. H. Brückner and Dr. M. Engel for the drillings and V. Podsiadlowski and L. Hauser for laboratory assistance.

Michèle Dinies
German Archaeological Institute,
Scientific Department at the Head Office
Im Dol 2–6
14195 Berlin
michele.dinies@fu-berlin.de

Reinder Neef
German Archaeological Institute,
Scientific Department at the Head Office
Im Dol 2–6
14195 Berlin
reinder.neef@dainst.de

Harald Kürschner
Freie Universität Berlin
Institut für Biologie, Systematische
Botanik und Pflanzengeographie
Altensteinstr. 6
14195 Berlin
kuersch@zedat.fu-berlin.de

References

Barth, H. K.
1976 Klima und Vegetation, in: H. Blume (Ed.): Saudi Arabien. Natur, Geschichte, Mensch und Wirtschaft, Basel, 33–44.

Behre, K.-E.
1981 The interpretation of anthropogenic indicators in pollen diagrams, Pollen et Spores 23, 225–245.
1990 Some reflections on anthropogenic indicators and the record of prehistoric occupation phases in pollen diagrams from the Near East, in: S. Bottema – G. Entjes-Nieborg – van W. Zeist (Eds.), Man's role in the shaping of the eastern mediterranean land-scape, Rotterdam, 219–230.

Behre, K.-E. – Kucan, D.
1986 Die Reflektion archäologisch bekannter Siedlungen in Pollendiagrammen verschiedener Entfernung – Beispiele aus der Siedlungskammer Flögeln, Nordwestdeutschland, in: K.-E. Behre (Ed.): Anthropogenic indicators in pollen diagrams, Rotterdam, 95–114.

Beug, H.-J.
2004 Leitfaden der Pollenbestimmung für Mitteleuropa und angrenzende Gebiete, Munich, 482–487.

Blanchet, G. – Sanlaville, P. – Traboulsi, M.
1997 Le Moyen-Orient de 20000 ans BP à 6000 ans BP. Essai de reconstruction paléoclimatique, Paléorient 23(2), 187–196.

Bonnefille, R. – Riollet, G.
1980 Pollens des savanes d'Afrique orientale, Paris.

Bottema, S.
1986 A late Quaternary pollen diagram from lake Urmia (northwestern Iran), Review of Palaeobotany and Palynology 47, 241–261.

Bottema, S. – Barkoudah, Y.
1979 Modern pollen precipitation in Syria and Lebanon and its relation to vegetation, Pollen et Spores 21(4), 427–480.

Cleuziou, S. – Tosi, M.
1998 Hommes, climats et environnements de la péninsule arabique à l'Holocène, Paléorient 23(2), 121–135.

Davies, C. P.
2006 Holocene paleoclimates of southern Arabia from lacustrine deposits of the Dhamar highlands, Yemen, Quaternary Research 66, 454–464.

Dinies, M. – Plessen, B. – Neef, R. – Kürschner, H.
2015 When the desert was green: Grassland expansion during the early Holocene in northwestern Arabia. Quaternary International 382, 293–302.

Dinies, M. – Neef, R. – Plessen, B. – Kürschner, H.
2016 Holocene vegetation, climate, land use and plant cultivation in the Tayma region, northwestern Arabia, in: M. Luciani (Ed.), The archaeology of North Arabia – oases and landscapes. Proceedings of the international congress held at the University of Vienna, 5-8 December, 2013, Oriental and European Archaeology 4, Vienna, 57–78.

Eisele, G. – Haas, K. – Liner, S.
1994 Methode zur Aufbereitung fossilen Pollens aus minerogenen Sedimenten, in: B. Frenzel (Hrsg.), Über Probleme der holozänen Vegetationsgeschichte Osttibets, Göttinger Geographische Abhandlungen 95, 165–166.

el-Ghazaly, G. A.
n.d. Pollen flora of Qatar. Scientific and applied research center, Doha.

el-Karemy, Z. A. R. – Zayed, K. M.
1992 The vegetation and habitat types of Baha Plateau (Saudi Arabia). Journal of Islamic Academy of Sciences 5(4), 256–264.

el-Moslimany, A. P.
1987 The late Pleistocene climates of the Lake Zeribar region (Kurdistan, western Iran) deduced from the ecology and pollen production of non-arboreal vegetation, Vegetatio 72, 131–139.
1990 Ecological significance of common nonarboreal pollen: examples from drylands of the Middle East, Review of Palaeobotany and Palynology 64, 343–350.

Engel, M. – Brückner, H. – Pint, A. – Wellbrock, K. – Ginau, A. – Voss, P. – Grottker, M. – Klasen, N. – Frenzel, P.
2012 The early Holocene humid period in NW Saudi Arabia – evidence from sediments, micro-fossils and palaeo-hydrological modeling, Quaternary International 266, 131–141.

Faegri, K. – Iversen, J.
1989 Finding the grain. Laboratory technique, in: Faegri, K. – Kaland, P. E. – Krzywinski, K. (Eds.), Textbook of Pollen Analysis, 4th edition, Chichester, 69–89.

Fleitmann, D. – Burns, S. J. – Mudelsee, M. – Neff, U. – Kramers, J. – Mangini, A. – Matter, A.
2003 Holocene Forcing of the Indian Monsoon Recorded in a Stalagmite from Southern Oman, Science 300, 1737–1739.

Fleitmann, D. – Burns, S. J. – Mangini, A. – Mudelsee, M. – Kramers, J. – Neff, U. – Al-Subbary, A. A. – Matter, A.
2007 Holocene ITCZ and Indian monsoon dynamics recorded in stalagmites from Oman and Yemen Socotra, Quaternary Science Reviews 26, 170–188.

Franke, W.
1989 Nutzpflanzenkunde, Stuttgart.

Gajewski, K. – Lézine, A.-M. – Vincens, A. – Delestan, A. – Sawada, M.
2002 Modern climate-vegetation-pollen relations in Africa and adjacent areas. Quaternary Science Reviews 21, 1611–1631.

Garcia Anton, M. – Sainz Ollero, H.
1999 Étude palynologique menée dans le secteur de Mleiha, in: M. Mouton (Ed.), Mleiha I. Environnement, stratégies de subsistance et artisanats, Lyon, 83–87.

Gupta, A. K. – Anderson, D. M. – Overpeck, J. T.
2003 Abrupt changes in the Asian southwest monsoon during the Holocene and their links to the North Atlantic Ocean, Nature 421, 354–357.

Horowitz, A.
1992 Palynology of arid lands, Amsterdam.

Inizan, M.-L. – Lézine, A.-M. – Marcolongo, B. – Saliège, J.-F. – Robert, C. – Werth, F.
1998 Paléolacs et peuplements holocènes du Yémen: le Ramlat as-Sab'atyn, Paléorient 23(2), 137–149.

Komarek, J. – Jankovska, V.
2001 Review of the Green Algal Genus Pediastrum; Implication for Pollen-analytical Research, Bibliotheca Phycologica 108, Berlin.

Kürschner, H.
1998 Biogeography and introduction to vegetation. In: S. A. Ghazanfar – M. Fisher (Eds.), Vegetation of the Arabian Peninsula, Dordrecht – London, 63–98.

Kürschner, H. – Kilian, N. – Hein, P.
2008 The Tarchonantho camphoratae-Oleetum cuspidatae ass. nov. – an Afromontane evergreen sclerophyllous community of the Arabian Peninsula with strong relationships to E Africa, Phytocoenologia 38, 85–106.

Kürschner, H. – Neef, R.
2011 A first synthesis of the flora and vegetation of the Tayma oasis and surroundings (Saudi Arabia), Plant Diversity and Evolution 129(1), 27–58.

Lézine, A.-M. – Saliège, J.-F. – Wertz, C. R. – Wertz, F.
1998 Holocene lakes from Ramlat as-Sab'atayn (Yemen) illustrate the impact of monsoon activity in southern Arabia, Quaternary Research 50, 290–299.

Lézine, A.-M. – Tiercelin, J.-J. – Robert, C. – Saliège, J.-F. – Cleuziou, S. – Inizan, M.-L. – Braemer, F.
2007 Centennial to millennial-scale variability of the Indian monsoon during the early Holocene from a sediment, pollen and isotope record from the desert of Yemen. Palaeogeography, Palaeoclimatology, Palaeoecology 243, 235–249.

Lézine, A.-M. – Robert, C. – Cleuziou, S. – Inizan, M.-L. – Braemer, F. – Saliège, J.-F. – Sylvestre, F. – Tiercelin, J.-J. – Crassard, R. – Mery, S. – Charpentier, V. – Steiner-Herbet, T.
2010 Climate change and human occupation in the Southern Arabian lowlands during the last deglaciation and the Holocene, Global and Planetary Change 72, 412–428.

Lézine, A.-M. – Zheng, W. – Braconnot, P. – Krinner, G.
2011 A late Holocene pollen and climate record from lake Yoa, northern Chad, Climate of the Past Discussions 7, 2413–2444.

McClure, H. A.
1976 Radiocarbon chronology of late Quaternary lakes in the Arabian Desert, Nature 263, 755–756.

McCorriston. J. – Oches, E. A. – Walter, D. E. – Cole, K. L.
2002 Holocene paleoecology and prehistory in highland southern Arabia, Paléorient 28(1), 61–88.

McGovern, P. E.
2003 Ancient Wine, Princeton.

McLaren, S. J. – al-Juaidi, F. – Bateman, M. D. – Millington, A. C.
2009 First evidence for episodic flooding events in the arid interior of central Saudi Arabia over the last 60 ka, Journal of Quaternary Science 24(2), 198–207.

Meusel, H. – Jäger, E. – Weinert, E.
1992[3] Vergleichende Chorologie der Zentraleuropäischen Flora 1–3, Jena.

Moore, P. D. – Webb, J. A. – Collinson, M. E.
1991 Pollen Analysis, Oxford.

Neef, R.
1990 Introduction, development and environmental implications of olive culture: The evidence from Jordan, in: S. Bottema – G. Entjes-Nieborg – W. van Zeist (Eds.), Man's Role in the Shaping of the Eastern Mediterranean Landscape, Rotterdam, 295–306.

Neff, U. – Burns, S. J. – Mangini, A. – Mudelsee, M. – Fleitmann, D. – Matter, A.
2001 Strong coherence between solar variability and the monsoon in Oman between 9 and 6 kyr ago, Nature 411, 290–293.

Overpeck, J. T. – Anderson, D. M. – Trumbore, S. – Prell, W. L.
1996 The Southwest Monsoon over the last 18 000 years, Climate Dynamics 12, 213–225.

Parker, A. G.– Eckersley, L. – Smith, M. M. – Goudie, A. S. – Stokes, S. – Ward, S. – White, K. – Hodson, M. J.
2004 Holocene vegetation dynamics in the northeastern Rub' al-Khali desert, Arabian Peninsula: a phytolith, pollen and carbon isotope study, Journal of Quaternary Science 19(7), 665–676.

Parker, A. G. – Goudie, A. S. – Stokes, S. – White, K. – Hodson, M. J. – Manning, M. – Kennet, D.
2006 A record of Holocene climate change from lake geochemical analysis in south-eastern Arabia, Quaternary Research 66, 465–476.

Reille, M.
1992 Pollen et spores d'Europe et d'Afrique du nord. Marseille, Laboratoire de botanique historique et palynologie, Marseille.
1995 Pollen et spores d'Europe et d'Afrique du nord. Supplément 1. Marseille, Laboratoire de botanique historique et palynologie, Marseille.

Rossignol-Strick, M.
1998 Paléoclimat de la méditerranée orientale et de l'Asie du sud-ouest de 15000 à 6000 BP, Paléorient 23(2), 175–186.

Sanlaville, P.
1992 Changements climatiques dans la Péninsule arabique durant le Pleistocène supérieur et l'Holocène, Paléorient 18(1), 5–26.

Schulz, E. – Whitney, J. W.
1986 Upper Pleistocene and Holocene lakes in the An Nafud, Saudi Arabia, Hydrobiologia 143, 175–190.

Singh, G. – Wasson, R. J. – Agrawal, D. P.
1990 Vegetation and seasonal climatic changes since the last full glacial in the Thar desert, northwestern India, Review of Palaeobotany and Palynology 64, 351–358.

Sirocko, F. – Sarnthein, M. – Erlenkeuser, H. – Lange, H. – Arnold, M. – Duplessy, J. C.
1993 Century-scale events in monsoonal climate over the past 24 000 years, Nature 364, 322–324.

Staubwasser, M. – Sirocko, F. – Grootes, P. M. – Erlenkeuser, H.
2002 South Asian monsoon climate change and radiocarbon in the Arabian Sea during early and middle Holocene, Palaeooceanography 14(4), 1–12.

van Campo, M.
1975 Pollen analysis in the Sahara, in: F. Wendorf – A. E. Marks (Eds.), Problems in Prehistory: North Africa and the Levant, Dallas, 45–64.

van Zeist, W.
1967 Late Quaternary vegetation history of Western Iran, Review of Palaeobotany and Palynology 2, 301–311.

Wellbrock, K. – Grottker, M.
2010 Reconstruction of mid-Holocene climate conditions for north-western Arabian oasis Tayma. Proceedings of the 4th International Conference on Water Resources & Arid Environments, Riyadh, 6–8 December 2010, Riyadh, 694–703.

Zohary, M.
1973 Geobotanical foundations of the Middle East. 2 vols, Stuttgart.

Electrical Resistivity Tomography conducted in the vicinity of Qrayyah for investigating aquifers (© DAI, Orient Department, F. Mindt).

تصوير طبقي للمقاومية الكهربائية في منطقة القرايا بهدف تحرّي طبقات المياه الجوفية
(حقوق النشر محفوظة لمعهد الآثار الألماني، قسم المشرق، ف. منت).

The Water Management of Taymāʾ and Other Ancient Oasis Settlements in the North-Western Arabian Peninsula – a Preliminary Synthesis

Kai Wellbrock, Peter Voß, Benjamin Heemeier, Patrick Keilholz, Arno Patzelt, and Matthias Grottker

***Abstract**: The oasis of Taymāʾ may have been inhabited continuously since prehistoric times in spite of an arid environment. The presence of ground water close to the surface promoted the development and the durability of the oasis in this otherwise hostile-to-life area. Between 2007 and 2009 investigations on the water management of the oasis, including ground water sources as well as episodic surface runoff, were conducted. Active* wadis *not only provided water for irrigation purposes, but also endangered the settlement that was situated in its vicinity.*
The endorheic sabkha *of Taymāʾ also presents the opportunity to estimate annual precipitation rates for a more humid phase during the early Holocene (10,000 to 9,000 cal BP) by solving the hydrological book-keeping equation. Further investigations have been conducted in the oases of Qurayyah and Dumat al-Jandal in order to draw conclusions on common grounds as well as on differences of oasis water management in the northwestern part of the Arabian Peninsula.*
***Keywords**: Saudi Arabia, water management, palaeo-hydrology, archaeo-hydrology*

فيلبروك و آخرون: من المحتمل أن واحة تيماء كانت مأهولة بشكل مستمر رغم البيئة القاحلة منذ عصور ما قبل التاريخ. أدّى وجود المياه الجوفية القريبة إلى سطح الأرض إلى تعزيز تطوّر و استمرارية الواحة في هذه المنطقة ذات الظروف المعادية للاستيطان البشري عادةً. تمّت دراسة و تقييم إدارة المياه في الواحة و التي تشمل مصادر المياه الجوفية بالإضافة إلى جريان المياه السطحية العرضي. لم تكن الأودية المفعّلة توفّر المياه لأغراض الري فقط بل كانت تشكّل خطراً على المستوطنة الواقعة بجوارها.
تقدّم سبخة تيماء المحبوسة المياه الفرصة أيضاً لتحديد معدلات هطول الأمطار السنوية لمرحلةٍ ذات رطوبةٍ أكثر خلال منتصف عصر الهولوسين و ذلك عن طريق حلّ معادلة السجلّات المائية.
تم إجراء المزيد من الدراسات في واحات قريّة و دومة الجندل من أجل استخلاص النتائج حول القواسم المشتركة و الاختلافات في إدارة مياه الواحات في القسم الشمالي الغربي من شبه الجزيرة العربية.
كلمات البحث: المملكة العربية السعودية، إدارة المياه، علم المياه القديمة، الموارد المائية القديمة.

1 Introduction

The oases described here are located in the northwestern part of the Arabian Peninsula in what is today a hyper arid climate (mean annual precipitation: 40 to 90 mm a^{-1}; average annual temperature: approx. 22 °C; annual reference evapotranspiration: > 1,700 mm a^{-1}).[1,2] This situation required very careful handling of limited water resources over a long period of time. The typical desert-like climate exhibits high temperature differences between night and day.

The areas under study include the Taymāʾ oasis, which was investigated intensively during three field campaigns in the spring of 2007 to 2009 within the framework of the DAI-SCTH project at Taymāʾ (funding by DFG: GR 1835/3–2); the oasis of Dumat al-Jandal (spring 2007); and the now abandoned Qurayyah oasis (spring of 2008 and 2009) (locations cf. Fig. 1).

[1] Interpolated data from the weather stations in Tabuk, al-Jouf and Arar during the time period 1980–2007. Based on data provided by the Ministry of Defence and Aviation, Presidency of Meteorology and Environment Protection of the Kingdom of Saudi Arabia (cf. www.pme.gov.sa, retrieved 2009-09-22).

[2] Annual reference evaporation after Trabucco – Zomer 2009.

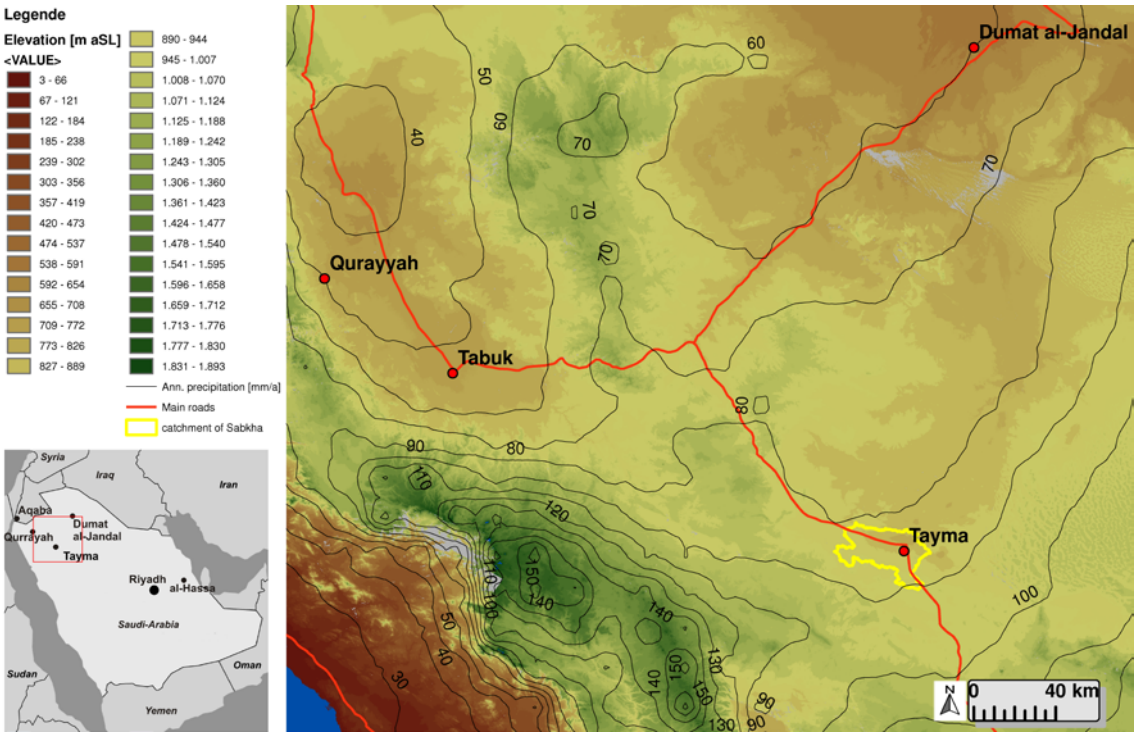


Fig. 1 *Map of the study area. The investigated oases Taymāʾ, Qurayyah and Dumat al-Jandal are located in the north-western part of the Arabian Peninsula (Digital Elevation Model [DEM] based on SRTM remote sensing data provided by the US Geological Survey with a grid of 3 arc seconds; precipitation data based on FAO 2004).*

الشكل ١ خريطة للمنطقة المشمولة بالدراسة. تقع الواحات المدروسة تيماء، قريّة و دومة الجندل في الجزء الشمالي الغربي من شبه الجزيرة العربية (يستند نموذج الارتفاعات الرقمي [DEM] على بيانات الاستشعار عن بعد SRTM و التي تقدمها الهيئة الأمريكية للمسح الجيولوجي مع شبكة من ثلاث ثوان قوسية؛ بيانات هطول الأمطار استناداً إلى معلومات منظمة الأغذية و الزراعة فاو ٢٠٠٤).

Previous investigations at Taymāʾ and other oasis settlements in northwestern Arabia revealed a large number of water-related features (e.g. Philby 1957; Parr *et al.* 1970; Bawden *et al.* 1980; Ingraham *et al.* 1981; Livingstone *et al.* 1983; Nasif 1983; Abu-Duruk 1986; al-Najam 2000). The origins of these ancient water management systems possibly date back 5 ka BP, however. Although many remains that are still recognizable have been described, neither a related concept concerning water management for each oasis nor a comparison of the different locations has been developed.

The investigations presented here concern water management systems as well as water resources management. Additionally, flood protection patterns and possible water harvesting methods used in neighbouring *wadi* streams have been examined. Finally, a reconstruction of prehistoric climate based on a digital elevation model combined with a precipitation-runoff-calculation solving the water balance equation has been performed. A comparison of the sites examined reveals differences among preconditions for settlement due to water sources and water management methods, respectively.

2 Methods

2.1 Survey of the landscape and implementation of a Digital Elevation Model (DEM)

The focus of the investigations was a hydrological survey. Thus, natural landscapes (e.g. geographical classification) were observed, documented and finally evaluated.

In this context topographical surveying with high spatial resolution is essential. The survey was performed using a Trimble Differential Global Positioning System (DGPS)[3] with an accuracy greater than approx. 20 mm in elevation as well as in location (depending on the quantity of available satellites). The system works in combination with a reference station at a fixed point. For surveying, a sufficient number of available satellites, for both the fixed reference station and the mobile survey unit, is essential. Furthermore, radio communication between both units is necessary.

The reference station at Taymāʾ was positioned on the roof of the Museum of Archaeology and Ethnography. Thus, nearly the whole study area was covered by terrestrial radio reception. For surveying the *sabkha* the reference station was positioned on its northern banks in a very elevated position, which was necessary for transmitting radio signals. Surveying in Dumat al-Jandal and in Qurayyah was performed in the same way.

In some minor areas the terrestrial radio signal was disturbed, possibly by mobile phone signals issuing from transmitter masts situated at Taymāʾ near Qrayyah. In these cases DPGS-survey could not be performed (or in the case of the palm garden, due to a lack of sufficient satellite signals [covering palm fronds or houses and street lines, respectively]); therefore, another survey method using a tachymeter was employed. As both survey methods are based on different geographic projections, the data gathered has to be transformed by a seven-parameter-transformation (Helmert-transformation) for compatibility. This transformation is based on an initial survey campaign, in which coordinates of certain fixed points were determined in both geographic projections[4].

All coordinates given in this report are in the Universal Transverse Mercator (UTM) coordinate system, zone 37N. Coordinates are projected using the common World Geodetic System (WGS 84) reference ellipsoid.

Hydrological parameters were deduced from the survey data acquired during the various field campaigns, especially from the topographical data. In addition, individual, presumed hydro-technical structures (i.e. canals, wells) on the surface could be recorded in this way. Moreover, surveying was needed to enable analysis and interpretation of the geophysical measurements (electrical resistivity tomography) taken.

The topographical data was downloaded to a Digital Elevation Model (DEM), which is the basis for hydrological calculations such as concentration of runoff or exposure to flood occurrence. The data was analysed using generic CAD and GIS applications. SRTM remote sensing data was used for the determination of large-scale elevation models (e.g. the catchment area of the *sabkha*)[5].

---

[3] Rover: Trimble R8 GNSS-Receiver; Controller: Trimble TSC2 assembled with Survey-Controller software; radio unit: Trimble PDL 450.

[4] The initial surveying was conducted by Florian Ziegler and Christian Bost (University of Applied Sciences of Karlsruhe, Germany) during the excavation seasons of autumn 2005 and spring 2006.

[5] SRTM-Data provided by the U.S. Geological Survey (grid of 3-arc-minutes).

2.2 Geophysical measurements: Electrical Resistivity Tomography (ERT)

Geoelectrics is an inexpensive and commonly used geophysical method for the investigation of shallow subsurface structures correlated with water. The basic principle of geoelectric (or resistivity) methods is to measure the apparent electric resistivity of the subsurface using a four-electrode array (Fig. 2a). Between two electrodes a current I is injected and among two others, the resulting voltage *U* is recorded. The ratio *U/I* multiplied with a geometric factor resulting from the electrode spacing provides the apparent resistivity of the subsurface in Ωm. As the spacing of the current electrodes is increased stepwise, the current will subsequently flow into deeper layers as well. In this way, increasing depth levels can be investigated.

In the case of the geoelectric profiling technique (or electrical resistivity tomography [ERT]), measurements are performed automatically along a profile with equidistantly spaced electrodes

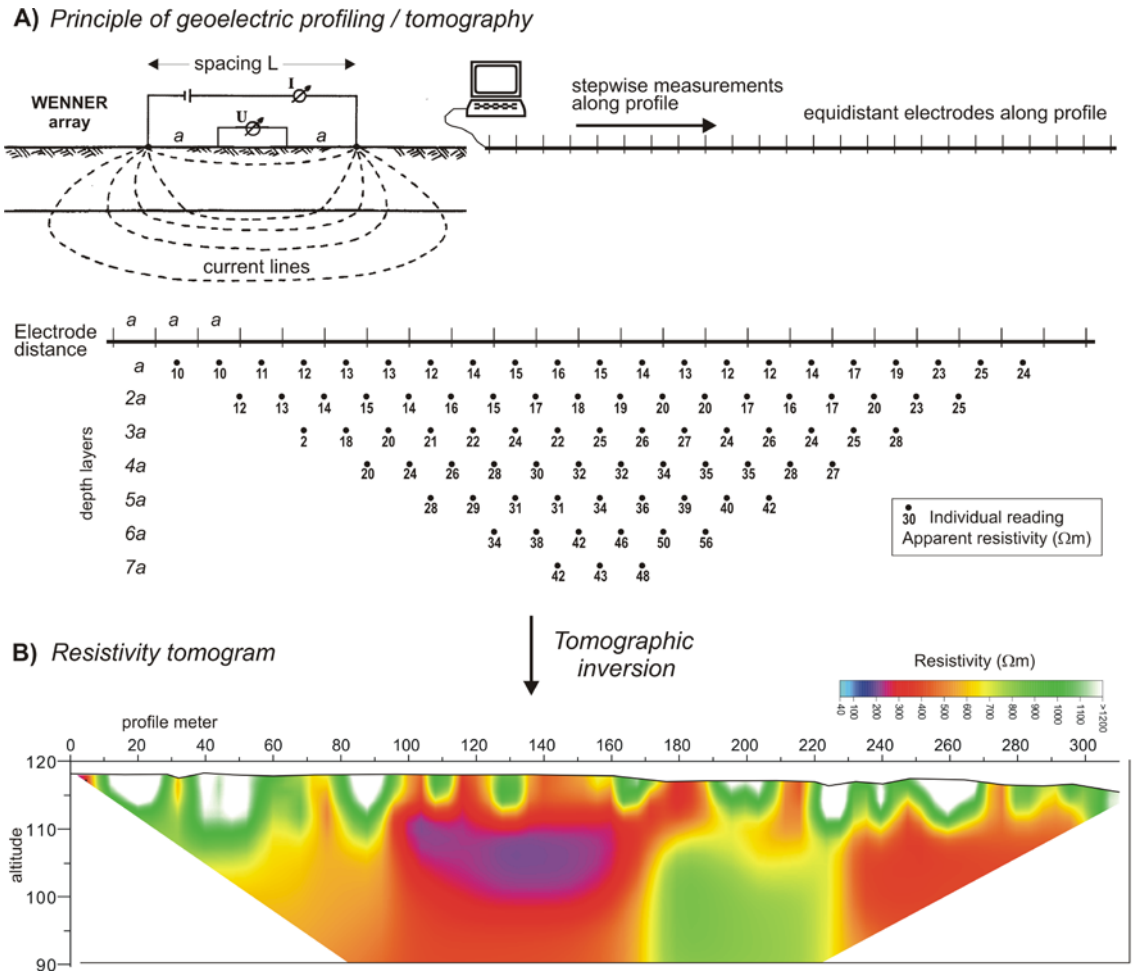


Fig. 2 *Geoelectric profiling/electrical resistivity tomography (ERT). (A) Principle of measurement with 4-electrode array (left). I: current, U: voltage. Measurement is automated along a profile with fixed electrodes at equidistant spacing. Result of measurement: two-dimensional section of apparent resistivities. a: spacing between two adjacent electrodes. (B) Tomographic inversion gives the final resistivity tomogram for interpretation.*

الشكل ٢ التحري الكهربي الأرضي/التصوير الكهربائي ثنائي البعد (ERT). (A) مبدأ القياس مع أربعة أقطاب كهربائية (يسار). I: التيار، U: الجهد. يتم القياس بشكل آلي و ذلك على امتداد قطاع ثُبّتت فيه أربعة أقطاب كهربائية متباعدة عن بعضها بمسافات متساوية. نتيجة القياس: مقطع ثنائي الأبعاد للمقاوميات الظاهرة. a: المسافة بين قطبين كهربائيين متجاورين. (B) رسم طبقي انعكاسي يقدّم الصورة الطبقية النهائية للمقاومية من أجل تفسيرها.

(Fig. 2a, right). The major advantage of the ERT technique compared to other geoelectric methods is its high spatial resolution. Resistivity readings are taken all along the profile, beginning with the smallest electrode spacing a. Then, the spacing is increased by one step to 2a, the profile is surveyed to its end, the spacing is increased once again, and so on.

In this way, a two-dimensional distribution of resistivities is obtained, which exhibits the measured values against electrode spacing (Fig. 2b, pseudo-depth diction). In order to attribute depth to the values, a tomographic inversion is applied, which transforms measured to true resistivities and relates them to depth. The calculation uses a numeric reconstruction algorithm and assigns resistivities to a given grid of x-z values. The result is a two-dimensional resistivity profile, a so-called resistivity tomogram, which constitutes an approximation of the true distribution of resistivity in the ground. The interpretation of tomograms is usually supported by drillings or outcrops.

3 Taymāʾ

Taymāʾ is situated in a flat plain surrounded by several ranges of hills. The deepest point is located north of the settlement with an elevation of about 801 m a.s.l. (= above mean sea level). Within the settled area the highest point is ca. 845 m a.s.l.

The presumed centre of the prehistoric settlement is present-day Qrayyah, which is located south of the palm oasis and the Old City of Taymāʾ. Qrayyah covers an area of approx. 73 ha and is the main focus of current archaeological research. North of the present-day palm-oasis lies the *sabkha*. This endorheic depression without surface runoff outflow represents one of the main hydrologic features of the whole investigation area. The modern-day city spreads to the west (see Fig. 3).

3.1 Geological and hydro-geological setting

Sedimentary rocks of the Taymāʾ region are part of an extensive, monotonously lying unit, which gently dips in a north-northeasterly direction with an incline of barely 1°. This uniform structure is interrupted by several graben systems which run from northwest to southeast, parallel to the Red Sea. The investigated area is affected by a tectonic depression, the so-called Taymāʾ graben. This ca. 2 km wide hollow is morphologically hardly formed. Only shallow hills at the edges of this graben system with a height of less than 50 m can be observed.

The area of Taymāʾ is underlain by Phanerozoic sedimentary and volcanic rock in the north-western part of the Arabian platform. This horizon consists of Ordovician sandstone alternating with finely grained siltstone. The grain size distribution of this sandstone is variable and ranges from fine to coarse-grained.

Mesozoic and Cenozoic (Tertiary[6] and Quaternary) sedimentary and volcanic rocks overlie the surface in a haphazard manner. The Quaternary top layer consists of rubble, stones, gravel and sand. The youngest deposits are of fluvial or aeolian origin and issue of Pleistocene to Holocene date (Vaslet *et al.* 1994).

A lack of systems for local conveyance (canals or aqueducts) or storage of water (cisterns[7] or reservoirs) suggests that there must have been a continuous supply of water through the use

[6] Tertiary includes the eras of Paleogene and Neogene.

[7] Cisterns are supposedly only successfully with an annual precipitation rate of more than 100 mm a^{-1} (cf. Keilholz 2009). Nevertheless, the operation of cisterns is conceivable with less annual precipitation rates, but reliable and intense singular rainfall events. However, until now no cisterns have been found at Taymāʾ.

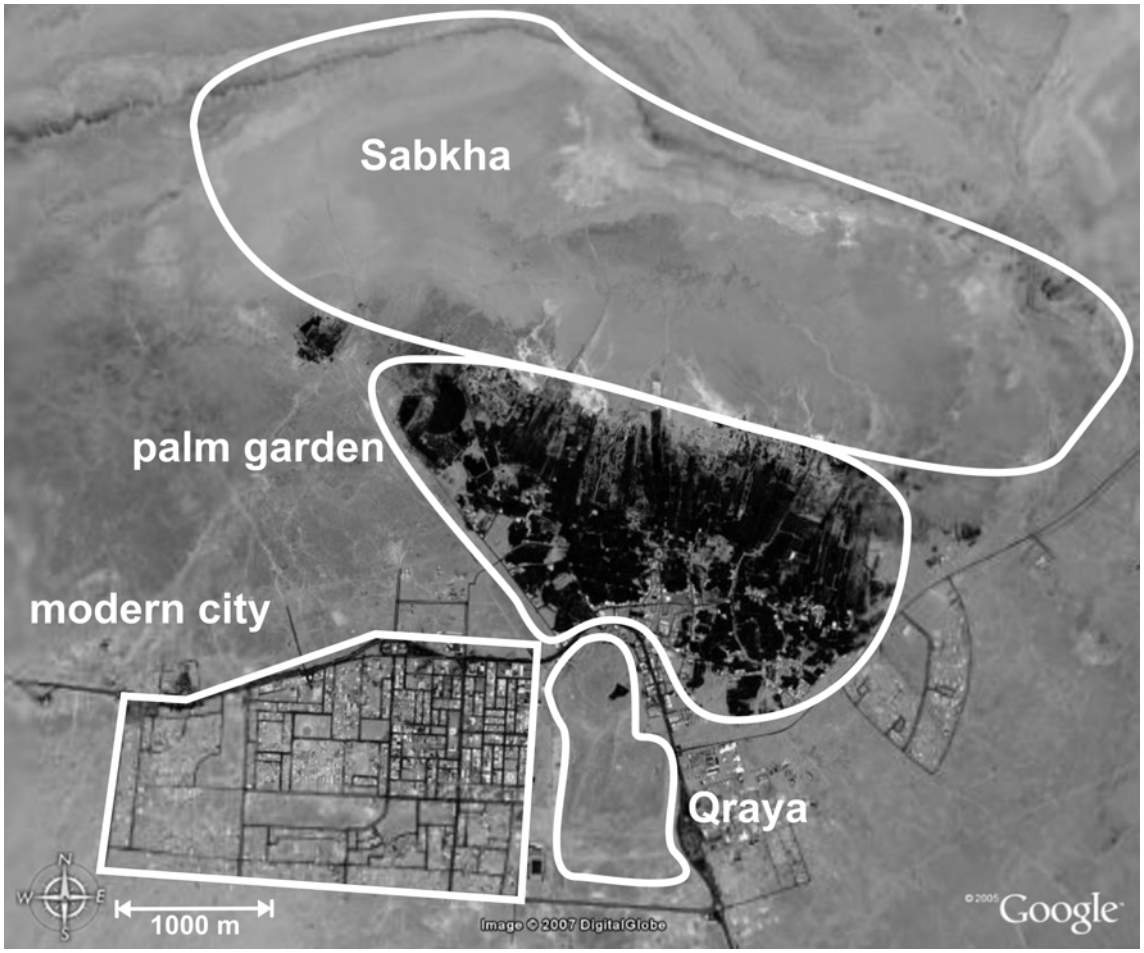


Fig. 3 *Hydrologically significant units at the site of Taymāʾ. Located in the north is the* sabkha. *Bordering to the south is the present-day palm oasis.* qrayyah *is the presumed centre of the prehistoric settlement. To the west spreads the modern city (source: Quickbird 2, Digital Globe, Google Earth 2007).*

الشكل ٣ وحدات مهمة من الناحية المائية في تيماء تقع شمال السبخة. يحدّها من الجنوب بساتين النخيل الحالية. القرايا هي المركز المفترض لمستوطنة عصور ما قبل التاريخ. إلى الغرب تنتشرالمدينة الحديثة. (المصدر: Quickbird 2، Digital Globe، Google Earth 2007).

of springs or wells in Taymāʾ in ancient times. This is all the more important for the early communities, because a supply of water from wells or springs would have been possible without any necessity for man-made structures.

Vincent (2008, 105–107) identified five different types of springs in the Arabian Peninsula: 1.) alluvial and sub-basaltic springs, mainly in the Arabian shield; 2.) solution opening springs associated with karstification in limestone or anhydrites; 3.) artesian aquifers due to the Arabian shield dipping gentle in eastern direction, in the eastern part of the Arabian Peninsula often associated with thin, discontinuous interbedded, aquicludes; 4.) near-surface water at locations with karstic limestone or dolomites[8]; and 5.) fracture springs, which issue from joints and faults in the bedrock. This last type of spring is most likely at Taymāʾ. Faults and fracture zones in the bedrock might have developed during the formation of the Taymāʾ graben (as illustrated in Fig. 4).

The locally heavy rainfall in the mountain range southwest of Taymāʾ was perhaps affected by the southwest monsoon as proposed by Burns *et al.* (1998, 262) during the mid-Holocene (approx. 8.4 to 5.4 ka BP). Staubwasser and Weiss (2006, 375) suggested that the North African

[8] e.g. the oasis Al-Hasa, location see Fig. 1, bottom left, cf. Voß 1979; Fahlbusch 2004b.

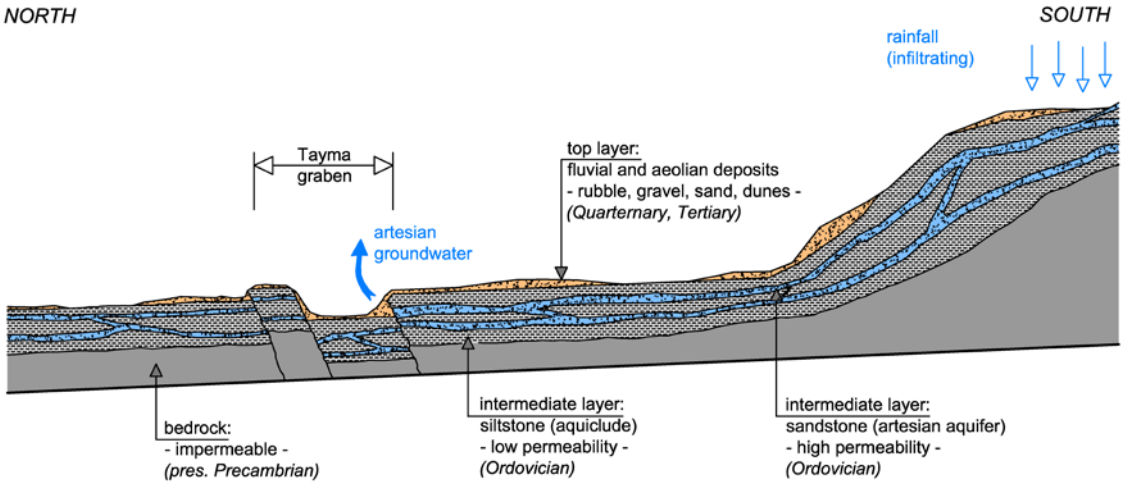


Fig. 4 *Schematic presentation of artesian ground water rising to the surface, linked to the Taymāʾ graben.*

الشكل ٤ عرض تخطيطي للمياه الجوفية الارتوازية التي ترتفع إلى سطح الأرض و ترتبط بمنخفض تيماء.

monsoon at that time was stronger than today and therefore may have reached farther northwards and possibly also affected the western part of the Arabian Peninsula. Rainwater in the mountain ranges partly infiltrates the soil. Higher annual precipitation rates in mountainous regions are often linked to convective phenomena. Infiltrated water in the mountainous region southwest of Taymāʾ then flows in a northeasterly direction following the gentle surface slope (cf. Fig. 1), while sandstone layers of relatively high permeability are considered to act as aquifers. These aquifers obviously are covered by layers of almost impermeable siltstone. Thus, the aquifer is pressurized. Linked to the Taymāʾ graben, this artesian ground water arrives at the surface at certain spots in the vicinity of Taymāʾ oasis (Fig. 4). Sites of upwelling ground water are assumed to be of very limited spatial distribution, as they are dependent upon fissures or cracks in the siltstone layers. The aquifer that underlies not only Taymāʾ, but also almost the whole Tabuk province, is known as the Saq-aquifer. It is considered to have a total thickness of several hundred meters. The age of the water itself is estimated at ca. 10,000 to 30,000 years (Edgell 1987; MAW 1984; MWE 2008). It is one of the most important water sources in Saudi Arabia.

Several findings in the vicinity of the oasis support the thesis of a northward-tending aquifer (cf. Fig. 17). The southernmost indication of ground water was found at Well 1 within Compound B (details see below). Here moist soil was detected at approx. 823.70 m a.s.l. Geoelectrical investigations at the presumed well within Compound A suggest a ground water level at approx. 825 m a.s.l. or lower (cf. Fig. 8, details below). At the assumed spring-lake within Compound E moist soil (perhaps the capillary fringe of an aquifer) was discovered at approx. 815.70 m a.s.l. (details see also below). At all of these locations the existence of moister soil or even ground water layers in deeper zones is indicated by several ERT-profiles (e.g. profiles 3, 5, 8, 17, 19, 30, 31, 34, 35, 37 and 40; location of profiles cf. Fig. 6). Perhaps an aquifer in the vicinity of Qrayyah can be assumed at a level of at least 815 m a.s.l.

During the excavation of the ditch along the western face of the inner city wall in Compound C (Square C4) the sounding had to be stopped due to infiltrating water at about 6.5 m below the surface (i.e. approx. 815.50 m a.s.l.)[9]. Also, ERT-profile 46, which runs 20 m north of Square C4, perpendicular to the ditch in an east-west direction, indicates a broad zone of low resistivity at a maximum level of approx. 816 m a.s.l.

[9] A. Intilia in Eichmann *et al.* 2010, 109–116, regarding excavations in Area C, Squares C4 and C5.

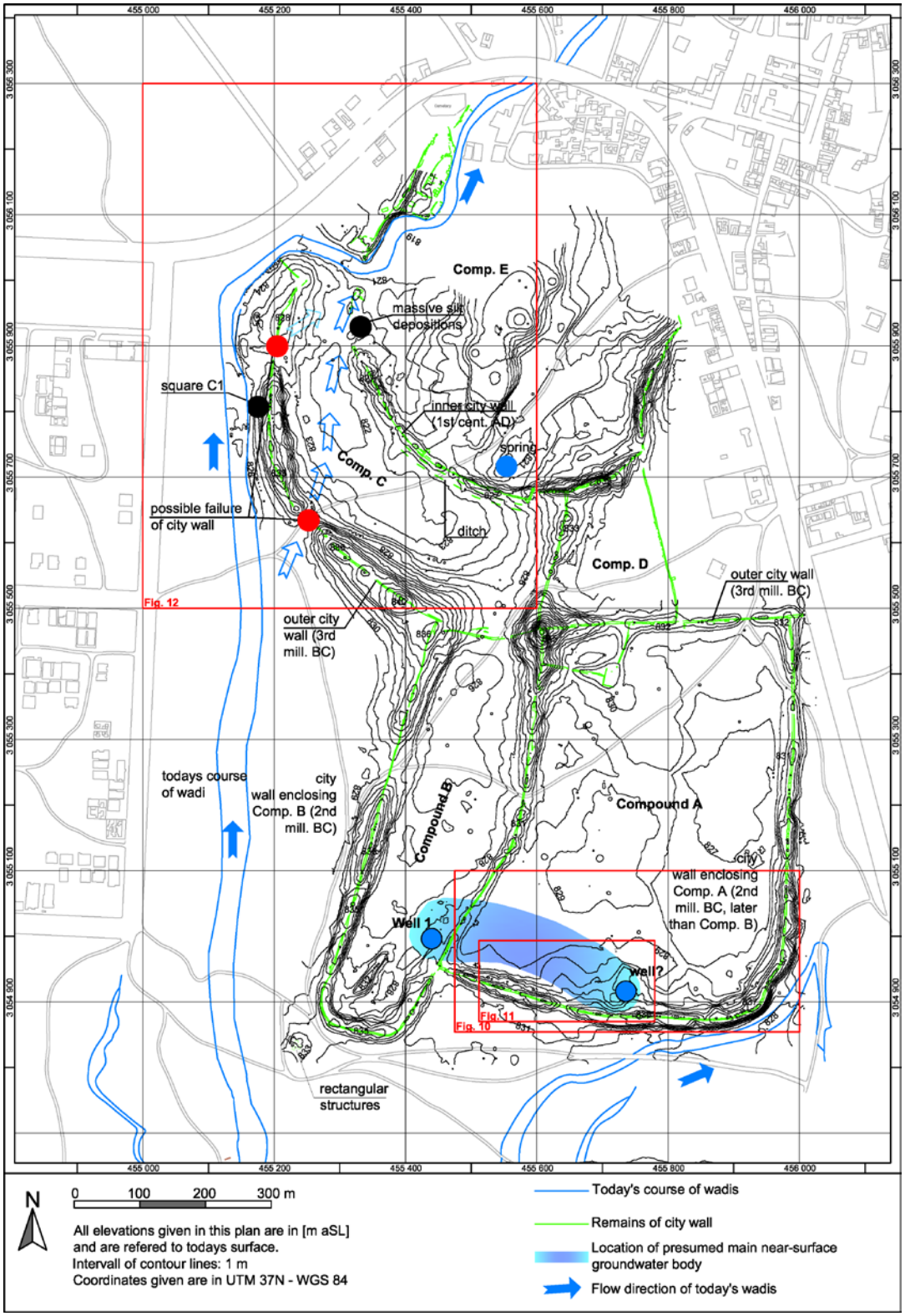


Fig. 5 *Map of Qrayyah. Denoted are the course of several sections of the city wall, the location of water supply units, and the course of* wadis *within the range of the settlement (The western and eastern stretches of the city wall system that run towards the* sabkha *are not shown in this figure).*

الشكل ٥ خريطة القرايا. تمت الإشارة إلى امتداد عدة أجزاء من سور المدينة و إلى مواقع وحدات إمدادات المياه و إلى اتجاه جريان الأودية داخل نطاق المستوطنة (لا تظهر في هذ الشكل الامتدادات الغربية و الشرقية لنظام سور المدينة المتجهة باتجاه السبخة).

Finally, the water table of several wells in the palm garden north of Qrayyah indicates the ground water level there. The most prominent is the Haddaj well. Here the water level was approx. 802 m a.s.l. The northernmost evidence for the ground water level was found in the course of geoarchaeological investigations within the southern part of the *sabkha* at 800.34 to 800.89 m a.s.l.[10]

Although the southern findings do not directly represent the top-level of the ground water layer itself but more probably its capillary fringe, a northward dipping of the aquifer is most likely. The difference of the aquifer level between the southernmost and the northernmost findings therefore is perhaps 20 m over a distance of barely 3.5 km. Due to the extraordinarily high inclination of the aquifer, it is likely that the ground water is pressurized at Taymāʾ. Local fissures or cracks in the covering layer, consisting of nearly impermeable siltstone, enable the ground water to rise up to near surface layers. Still today, the very shallow depth of the water table (distance between surface and groundwater table) in the northern part of the oasis confirms the availability of groundwater.

Obviously, in Taymāʾ the amount of artesian ground water attainable at or close to the surface diminished in recent decades because of less rainfall. Furthermore, due to the implementation of motor-driven pumps the ground water table and/or ground water-pressure are decreasing constantly.

3.2 Qrayyah and the central ancient settlement area

At the western edge of Qrayyah today's main *wadi* runs in a northerly direction. Probably also in ancient times this *wadi* was located west of and close to the settlement. At the eastern border of Qrayyah some smaller *wadi* beds can be recognised.

The whole settled area is surrounded by several walls, dating to different periods and differing in building material and structure. The presumed eldest part of the wall system is the so-called outer wall enclosing Compounds C, D and E (cf. Fig. 5).[11] By means of radiocarbon dating combined with optical stimulated luminescence (OSL) the outer city wall (Square C1, cf. Fig. 5) can be dated to the end of the third millennium BCE (Klasen *et al.* 2008; Engel *et al.* 2009). Schneider (2010, 4) pointed out that the outer wall as eldest part of the whole system was probably never conceived as a closed ring, but was open to the *sabkha* in its northernmost part. This northern section of the outer city wall system was built over by later settlements in the area of the present-day palm garden.

In a very early phase the wall enclosing Compound B (probably second half of the second millennium BCE) may have been added. The inner wall was built much later. By means of radiocarbon dating of a sample taken in Square C4/C5[12] the inner wall may have to be dated as late as the first century AD. The reason for building a second wall – within the outer city wall – remains unclear. One of the youngest parts of the whole city wall system in the vicinity of Qrayyah seems to be the stretch enclosing Compound A (Schneider 2010, 19).

From Qrayyah the wall system extends in two main stretches: one in a northwesterly direction facing the so-called Qasr al-Hamra as well as Compound W and another one that heads at first to the east before bending to the north. These sections of the wall are of secondary interest for the hydrological investigation. Finally, by connecting these stretches in the northernmost part of the area an earthwork dam separated the presumably periodically flooded *sabkha* from arable land at the borders of the present-day palm garden.[13]

---

[10] Geoarchaeological investigations performed a stratigraphic transect from the old town across the *sabkha*; it revealed the influence of a recent ground water layer at approx. 800.34 to 800.89 m a.s.l. (cf. Tay 58 in: Engel *et al.* 2011).

[11] The definition of the compound's names follow Bawden *et al.* 1980, pl. 61.

[12] For further information regarding the excavations in Area C A. Intilia in: Eichmann *et al.* 2010, 109–116.

[13] For further information concerning the wall system see Schneider 2010, see also Hausleiter 2018.

3.2.1 Water sources and water provisioning

General aspects

So long as no local, reliable water sources are available, systems for water conveyance are essential (Fahlbusch 2004a, 6). Conveyance mostly involves conducting water over long distances, for instance by means of aqueducts. Such systems have not yet been found near Taymāʾ. Also systems of temporal conveyance, i.e. the storage of water during times of high availability for the consumption in drier periods, have not been found on such a scale that they could have supplied the entire settlement with a reliable quantity of water.

Therefore, one or more local sources of water within the ancient city walls of Qrayyah should be assumed. Likely locations of such water sources (e.g. springs or wells) can be deduced from the topographical and geographical situation and from man-made structures. In addition, (vertical) zones of low resistivity in the subsoil, possibly correlating with upwelling water, can be detected by geoelectrical tomography.

Comprehensive results of geoelectrical prospection

Fig. 6 shows the locations of the geoelectrical profiles in Qrayyah, together with a simplified interpretation of the results. In total, 40 profiles were obtained during three field campaigns. Usually, 80 electrodes were used with electrode spacings varying from 1 to 4 m. Profile lengths using the roll-along-technique amounted to 560 m. In the southern part (Compounds A and B) mainly hard bedrock with high resistivity and very little or no permeability seem to prevail, while in the northern part middle to low resistive fine grained sandstone, silt- or claystone layers predominate.

Water supply by wells

In the southern part of the study area two significant spots with low resistivity values occur, indicated by light blue in Fig. 6. These zones coincide remarkably with the position of two presumed ancient wells (Well 1 in Compound B and a presumed well in Compound A, locations cf. Fig. 5). The corresponding tomograms are shown in Figs. 7 and 8. The funnel-shaped areas of low resistivity values are interpreted as deep fissures and fracture zones in the hard rock, at which ground water is able to rise like an artesian spring to the surface. In the past, during periods with more rainfall and a subsequently higher ground water table, the water pressure of the artesian aquifer was probably sufficient to feed these wells.

The structures at Well 1, located in Compound B, could be identified without doubt as the remains of a well (cf. Fig. 7). The ring-shaped structure was partly excavated in 2007. It was filled with loose aeolian sand. However, only about 1 m below the surface at approx. 823.75 m a.s.l. the soil in the well was moist, indicating the existence of free water at this spot even in the current dry, desert-like environment.

By means of georadar measurements in the southern part of Compound A some structures were identified as wells and canals as much as 3.5 m below surface (Neubauer – Löcker 2006, 22–23; Eichmann *et al.* 2010, 104–107). About 2 m below surface a horseshoe-shaped masonry structure was identified which is possibly the remains of a well. This structure has a diameter of nearly 6 m and access from the east. ERT profiles were performed to evaluate the possibility of near-surface ground water at this spot. Fig. 8 shows the geoelectrical tomogram of Profile 8 crossing the posited well at profile meter 115 (approx. in the middle of the profile). Like Profile 3 at Well 1 (like shown in Fig. 7), a funnel-shaped zone of low resistivity values appeared here. The

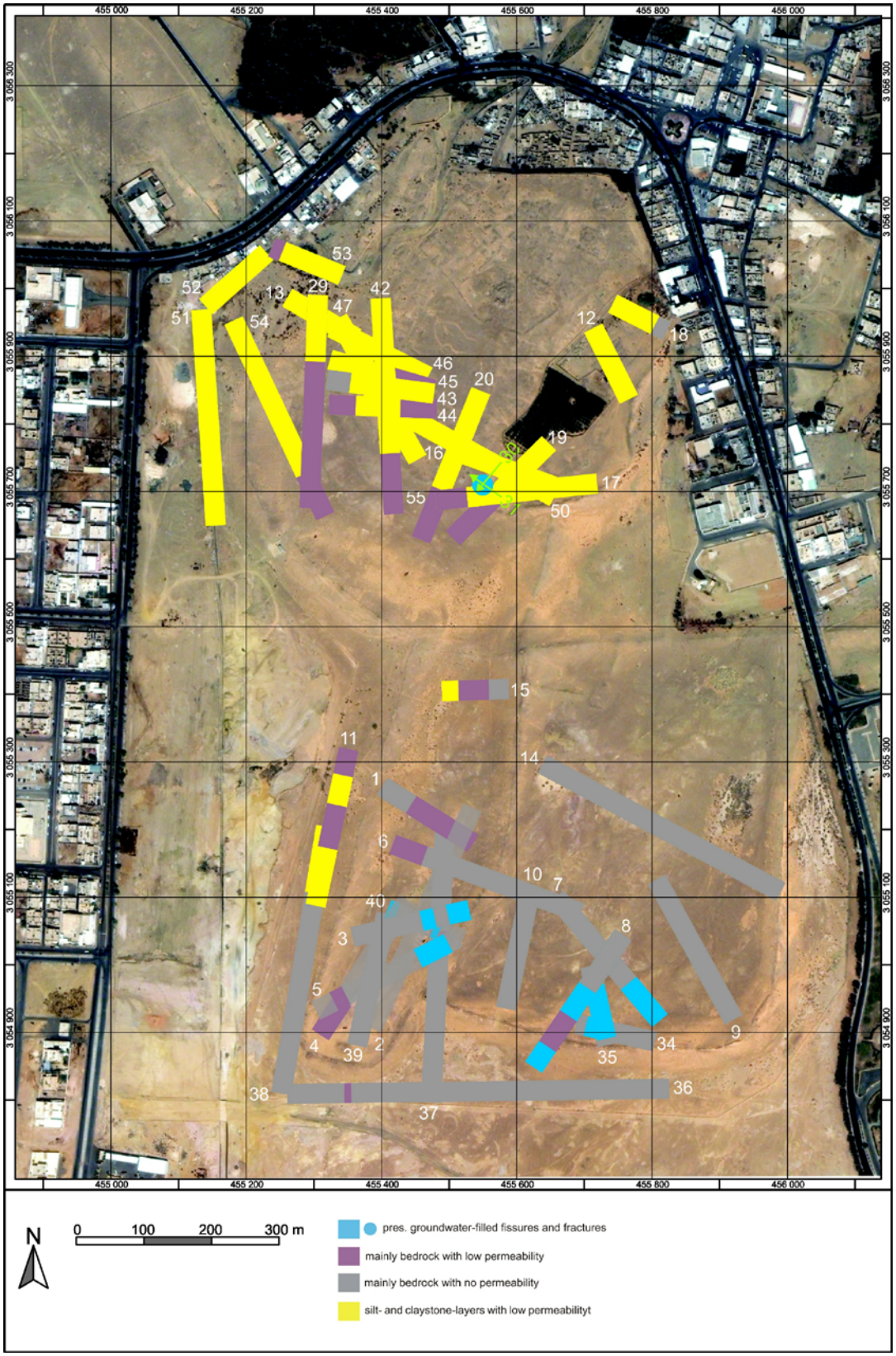


Fig. 6 *Location of recorded electrical resistivity tomographic profiles in Qrayyah. Numbered consecutively with colour illustrations of simplified hydro-geological units.*

الشكل ٦ موقع إجراء التحريات باستخدام تقنية التصوير الكهربائي ثنائي البعد و هي مرقّمة بالتوالي في محيط القرايا مع رسوم توضيحية ملوّنة للوحدات المائية الجيولوجية المبسّطة.

area of low resistivities at the presumed well is much larger and deeper than at Well 1, indicating a possible groundwater level at approx. 825 m a.s.l. Compared to the georadar measurements and the position of the presumed well, the centre of low resistivity lies about 10 m to the west. In 2008 excavation of the presumed well in Compound A began (Area H).[14] At the present time no clear evidence for the existence of a well has been found. Nevertheless, because of the existence of many water-related feature (for instance, canals) in the southern part of Compound A (see below), the presence of a local source of water is probable.

Additional ERT profiles south and west of Compounds A and B confirm the hypothesis of very local spots of ground water rising to near surface layers. Profiles 36, 37 and 38 show relatively high resistivity values as indicated by the grey colour in Fig. 6. Therefore, it could be assumed that in this area non-weathered bedrock without (open) fissures or cracks prevents ground water from rising to the surface. Also the area north of both wells (Profiles 6, 9, 10; cf. Fig. 6) shows high resistivity values indicating impermeable layers.

Water supply by a spring

Neither well (in Compounds A and B) is situated within the oldest settled area of Taymāʾ. According to Schneider (2010, 6) the so-called outer wall enclosing Compounds C, D and E to the west and south may be assumed to be the oldest part of the wall system. Therefore, another source of water within this oldest part of the settlement is likely. Livingstone *et al.* (1983, 192; Pl. 83) mentioned an ancient well in the modern palm oasis and therefore perhaps within this oldest part of the settlement.[15] Whether the numerous wells in the palm garden are ancient or not has not yet been clarified.

Although no clear evidence of a well or a spring within this area has been found, it is assumed that a topographic depression in the southern part of Compound E was a spring which perhaps even formed a small palaeo-lake in ancient times (location marked in Figs. 5 and 6).[16] Nowadays this hypothesized spring has vanished, perhaps due to climate change, less rainfall and the decreasing ground water level. The spot was conspicuous in spring 2008. After several rainfall events in the winter before, soil humidity must have risen to some extent. Even in February this humidity permitted a plant *(Aizoon canariense)* to inhabit this spot indicating still relatively high soil humidity. Consequently, ERT profiles were performed there to evaluate the possibility of upwelling ground water. As shown in Fig. 9, a broad zone of low resistivity values was found in Profiles 19 and 31.

Therefore, during the campaign in spring 2008 a prospecting pit was dug using a wheel loader to a depth of approx. 4.5 m below the surface (= 815.7 m a.s.l.) at this spot (cf. Fig. 9c). The excavated earth consisted of dry, sandy to silty sediments, which became denser and showed some moisture with increasing depth. Single thin layers, obviously of lacustrine origin and, thus, indicating the former presence of water, were detected (cf. Fig. 9d). At the bottom of the pit the soil seemed to be moister. Unfortunately, the pit could not be dug any deeper due to time constraints.

The superposition of the location of this prospecting pit with the nearby resistivity tomograms indicates even moister soil layers in deeper zones. An aquifer can perhaps be assumed at 815 m a.s.l. at this location.

---

[14] For detailed results of these archaeological investigations see the contribution by F. Weigel on Area H in vol. IV of the Taymāʾ series.

[15] The location of this well could not be determined exactly during recent investigations. According to Livingstone et al. (1983, Pl. 83) it is situated southeast of Haddaj well and about 1 km east of Qrayyah at approx. E 456600; N 3056150 (UTM 37N, WGS84). It is not certain whether this part of the oasis was enclosed by the city wall in ancient times.

[16] The location of the considered paleo-lake is E 455553; N 3055716 (UTM 37N, WGS84).

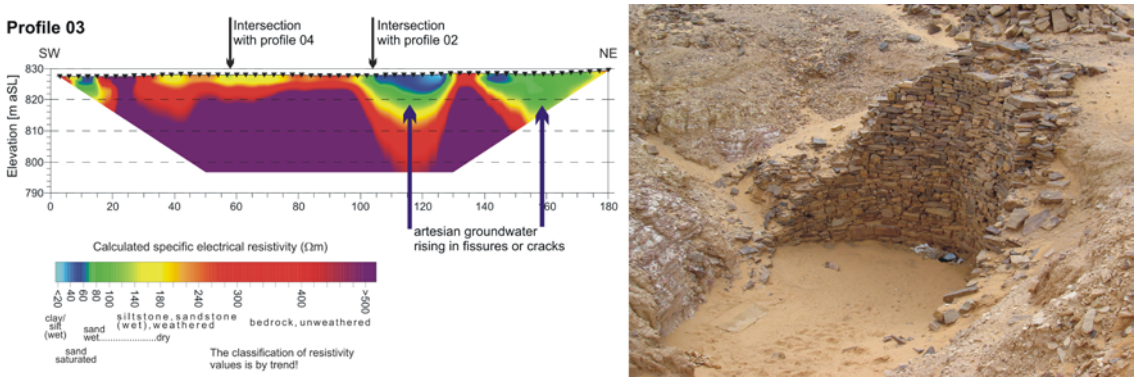


Fig. 7 *Well 1 in Compound B. On the left: Resistivity tomogram of Profile 3 crossing the presumed Well 1 at profile meter 115 (location* cf. *Fig. 6). Light red to light blue zones indicate low resistivity values of the subsurface and are interpreted as artesian ground water rising into fissures and cracks. On the right: excavated relicts identified as Well 1 (view towards the southeast). The sandy soil inside Well 1 was moist about one meter below surface.*

الشكل ٧ البئر 1 الواقع في المجمّع B. إلى اليسار: صورة طبقية للمقاومية في المقطع 3 الذي يقطع البئر 1 المفترض عند المتر ١١٨ (راجع الشكل ٦ لمشاهدة الموقع). تشير المناطق ذات الألوان المتدرجة من الأحمر الفاتح إلى الأزرق الفاتح إلى قيم منخفضة للمقاومية لما تحت سطح الأرض و قد تم تفسيرها على أنها مياه جوفية ارتوازية تتصاعد داخل الشقوق و التصدّعات. إلى اليمين: بقايا مكتشَفة تم التعرّف عليها على أنها البئر 1 (اللقطة باتجاه الجنوب الشرقي). كانت التربة الرملية داخل البئر 1 رطبةً ابتداءً من حوالي متر واحد تحت سطح الأرض.

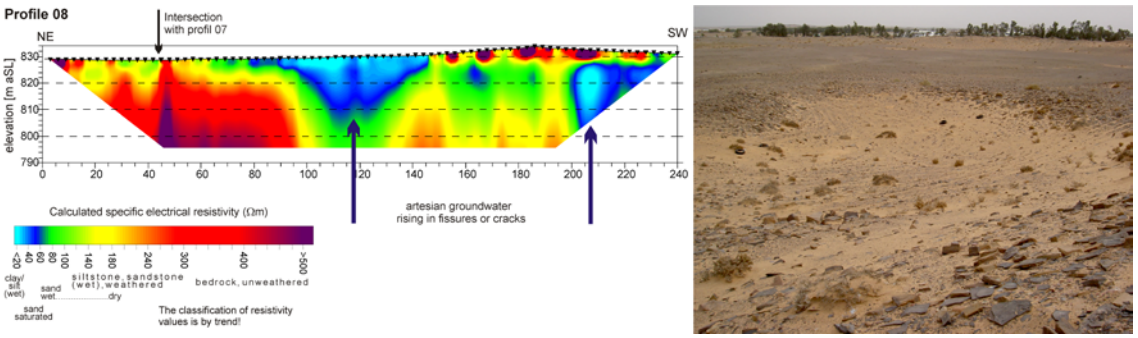


Fig. 8 *Presumed well in Compound A. On the left: Resistivity tomogram of Profile 8 indicating a broad zone of low resistivities. The centre of this funnel-shaped zone lies slightly west of the presumed well (location* cf. *Fig. 6). On the right: Topographic depression of presumed Well 2 in February 2007, prior to archaeological excavations conducted by the German Archaeological Institute.*

الشكل ٨ البئر المفترض 2 الواقع في المجمّع A. إلى اليسار: تشير الصورة الطبقية للمقاومية في المقطع 8 إلى وجود منطقة واسعة ذات مقاوميات المنخفضة. يقع مركز هذه المنطقة القمعية الشكل إلى الغرب قليلاً من البئر المفترض (راجع الشكل ٦ لمشاهدة الموقع). إلى اليمين: انخفاض طبوغرافي للبئر المفترض 2 في شباط/فبراير ٢٠٠٧ و ذلك قبل البدء بأعمال التنقيبات الأثرية من قبل معهد الآثار الألماني.

The existence of moist soil even today as well as thin, alternating layers of sandy and silty material indicates a palaeo-lake or former spring in this topographic depression. Of course, the yield of the source has decreased over the millennia due to climate shifts, less rainfall and decreasing ground water level. But, it is conceivable that this kind of palaeo-lake or spring once promoted the development of the early settlement, because the provisioning with water would have been obtained without any human effort.

In the final analysis discussing the locations of potential water sources within the presumed oldest part of Taymāʾ is unproductive, because the northern part of the historic settlement is built over by later and even modern houses. Thus, these areas cannot be taken in the considerations. It is very likely that in the area of the present-day palm garden, where some wells are still in operation, wells existed in ancient times as well.

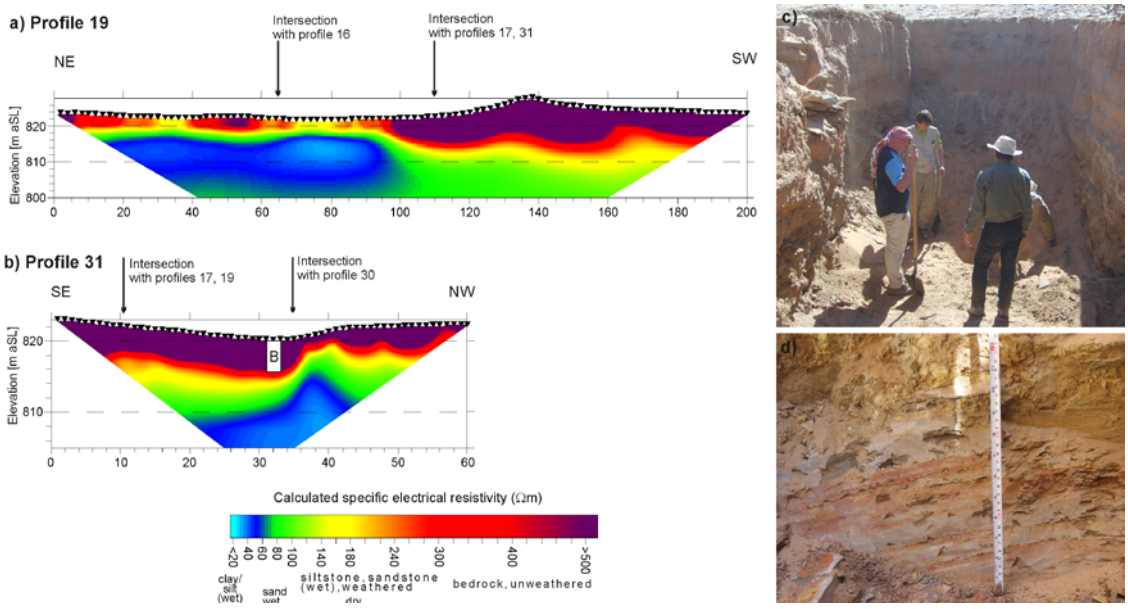


Fig. 9 *Presumed spring in Compound E. a) and b) Resistivity tomograms of Profiles 19 and 31 (location* cf. *Fig. 6). Light blue colours indicate areas of low resistivity and are interpreted as artesian ground water rising into fissures and cracks to layers close to the surface* [*the letter 'B' in Profile 31 indicates the location of the prospection pit, which was performed in spring 2008*]*; c) View into the prospection pit with a depth of approx. 4.5 m; d) Stratigraphic section that indicates fine grained, thin layers of lacustrine origin.*

الشكل ٩ النبع المفترض في المجمّع E. a) و b) الصور الطبقية للمقاومية للمقاطع 19 و 31 (راجع الشكل ٦ لمشاهدة الموقع). تشير الألوان الزرقاء الفاتحة إلى وجود مناطق ذات مقاومية منخفضة و قد تم تفسيرها على أنها مياه جوفية ارتوازية تتصاعد داخل الشقوق و التصدّعات إلى الطبقات القريبة من سطح الأرض. [يدلّ الحرف "B" على مكان حفرة السبر التي حُفِرت في ربيع عام ٢٠٠٨]؛ c) منظر داخل حفرة السبر التي يبلغ عمقها أربعة أمتار و نصف تقريباً؛ مقطع للتتابع الطبقي يظهر طبقات رقيقة من الحبيبات الناعمة ذات الأصل البحيري.

3.2.2 Irrigation within Qrayyah (Compound A)[17]

At several locations in Compounds A and B line-shaped remains of stonework on the surface could be found, which were perhaps associated with hydro-technical installation. However, the structures are different in both compounds. In Compound B mainly massive, single-leafed structures could be detected. These walls may have marked fields or living quarters. The structures in Compound A are constructed of roughly-hewn sand stones, most of them standing upright which may have functioned as canals sealed with clay. It is conceivable that water from the presumed well in the southern part of Compound A was distributed by these canals for irrigation or other purposes. The supposed canals that issue from the presumed well and that take a fan-shaped course support this hypothesis.

Fig. 10 shows the location of these probable canal in the southern part of Compound A in dark blue. In light blue are likely sections of canals, reconstructed in relation to the local topography. Furthermore, the georadar survey indicated remains of hydro-technical structures in this area, such as the presumed well, at approx. 2 m below the surface. In the southwestern part of Compound A another structure interpreted as a canal, running from the presumed well in a westerly direction, was found some 50 cm below the surface (Neubauer – Loecker 2006, 21–23; Eichmann *et al.* 2010, 104–107).

In addition, west of the presumed well, after some winter rainfall, a denser population of *Aizoon canariense* could be observed in spring 2009. This species prefers sandy soils and is able to

[17] For details of archaeological investigations of these features in Area H see the contribtuion of F. Weigel in Volume IV of the Taymāʾ series.

deal with high salinity and to survive without rainfall for a relatively long time.[18] A higher density of *Aizoon canariense* in the alignment of obvious canal trace seems to indicate its course for about 100 m (Fig. 11). Apparently both the density, that is, the crude number of individuals, and size of this plant differed in comparison to zones alongside this water course. By surveying each individual plant in this particular area west of the presumed well, it became clear that the population had developed better in this small, straight corridor due to the ancient canal. It may be assumed that the canal's cross section prevents water infiltration and therefore provides a much better habitat for *Aizoon canariense* compared to the surrounding area. Thus, the canal-like structure may prevent the loss of water and thus preserve water for a longer period. Therefore, higher plant density can be taken as a kind of crop mark as known from aerial photographs. As pointed out in Fig. 11, the survey of individual *Aizoon canariense* plants is a strong indication of a straight corridor suggesting ancient canal remains west of the presumed well. Nevertheless, one cannot exclude that this higher density was caused by other structures, e.g. walls.

Tentatively, the following interpretation of the hydrological investigations in Compounds A and B can be offered. A major trading point on the incense road Taymāʾ would certainly have had to deal with a large number of guests with mounts and pack animals, which had to be supplied with water. It seems possible that either Compound A or B, lying at the edge of the settlement, was used for this purpose. Perhaps one of the wells was utilized to supply a drinking trough for animals.

3.2.3 Flood endangerment, flood protection and flood control

General Aspects

From prehistoric times onwards Taymāʾ may have been endangered by several *wadi* stretches running in a north-northeasterly direction and it must have been an ongoing challenge to deal with these hazards. In spite of this danger, the oasis was in close proximity to these *wadi* stretches. Therefore, there must have been good reason for settling in the area, today known as Qrayyah. Certainly the main reason must have been the easily accesible, reliable supply of water from several sources within Qrayyah as described above.

Flash floods often occur in arid environments and are a result of heavy rainfall, mostly in mountainous regions. Since there is little vegetation in these rocky areas with high surface slope and low permeability, which could retain the rainwater, most of the rain water becomes surface runoff immediately. This then forms a flash flood which sometimes reaches a settlement with high impact, even though no rainfall may have occurred in the area itself. The destructive potential of these flash floods is based not only on high flow velocity (and with that on high shearing stress), but also on enormous bed loads that are transported with them. Therefore, flash floods in arid environments are considered to be one of the most dangerous hazards for communities living in the sphere of influence of such *wadi*s.

Endangerment of the western wall

Considering the many sections of the wall system at Taymāʾ in combination with the topographic situation, it is noteworthy that the southernmost part of Compound B was particularly exposed to flash floods. Furthermore, the whole western part of the wall (enclosing Compounds B and

[18] Personal communication with Drs. Reinder Neef (German Archaeological Institute, Scientific Department at the Head Office) and Prof. Dr. Harald Kürschner (Free University of Berlin, Faculty of Biology). See also contribution of Kürschner – Neef in this volume.

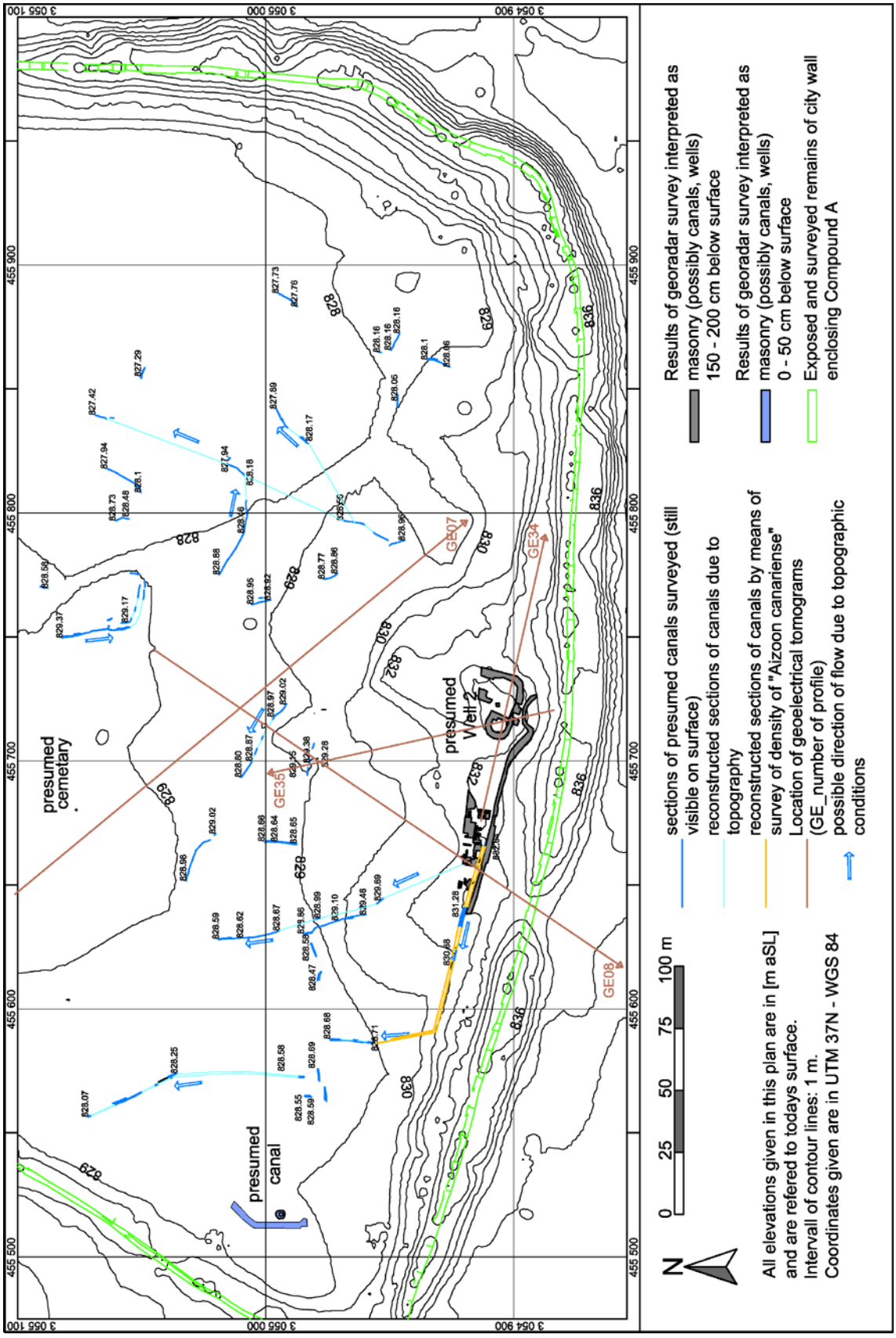


Fig. 10 *Map of the southern part of Compound A showing contour lines (interval 1 m) as well as several hydro-technical findings. Surveyed as well as reconstructed canal sections may indicate a possible system for water distribution in this area.*

الشكل ١٠خريطة الجزء الجنوبي من المجمّع *A* و التي تُظهر خطوط التسوية ذات مسافة بينية ١ م بالإضافة إلى عدة مكتشفات مائية تقنية. قد تشير أجزاء القناة التي تم مسحها و إعادة تشكيلها إلى وجود نظام محتمل لتوزيع المياه في هذه المنطقة.

C at their western façade) was and still is endangered by flash floods. Before the addition of Compounds A and B, the southern stretch of the outer city wall was extremely exposed, too.

The specific courses of former *wadi* beds could not be determined for they are dynamic and, thus change frequently. In particular, west of today's main *wadi*, which is situated west of Qrayyah, a flat plain some 200 m wide probably enabled the *wadi* to change its course after certain flooding events. To locate the former courses of the *wadi*, the level of outcropping bedrock must be evaluated. The supposed Precambrian bedrock has a higher resistivity against shearing stress than fine grained sand of Holocene origin. High shearing stress rates occur during flooding events.

South of Compound B (approx. 40 m outside of the city wall) some rectangular structures on the surface were found (location *cf*. Fig. 5) which might have been employed as wave traps to protect the city wall against occurring flash floods. However, they rather seem to be burials similar to those discovered south of the walled settlement at the sites of al-Nasim and Rujum Saʿsaʿ (A. Hausleiter, personal communication).

As confirmed by geoarchaeological investigations, the construction of the outer wall enclosing Compound C was accompanied by the first permanent settlement at Taymāʾ and therefore with a regulation of the nearby *wadi*s. The wall in Square C1 (Fig. 5) was built on top of fluvial *wadi* deposits. After the outer wall was constructed, sand dunes accumulated very quickly due to prevailing westerly winds. This part of the outer wall was buried under sand dunes until the first half of the 2nd millennium BCE, giving a *terminus ante quem* for the erection of the outer city wall as confirmed by OSL-dates (Klasen *et al.* 2008; Engel *et al.* 2009).

Excavations outside of the outer wall in Area A (location cf. Fig. 12), ca. 150 m south of Square C1, also revealed sand dunes with very little shearing stress resistivity (Eichmann *et al.* 2006b, 107). A building in Area A dated to the late 2nd or early 1st millennium BCE was built on these dunes.

Thus, the outer city wall at these specific sites (between Square C1 and Area A) presumably never had the function of flood protection, albeit its erection perhaps was intended to block flash floods. The aeolian sediments, forming the sand dune, would have been eroded by hydraulic sluicing during each flash flood. Hence, this part of the city wall was probably never exposed to such flooding over the past ca. 4 millennia. This hypothesis does not apply to other sections of the outer city wall, of course. To prove this thesis, similar investigations determining the age of sand dune deposits along the outer façade of the city wall are needed.

Compound C

Compound C is enclosed on the western side by the outer wall and on the eastern side by the inner wall. The outer city wall bends in the southernmost part of Compound C in an easterly direction, while the inner city wall was perhaps erected as a fortification with a ditch in front of it. The situation at the presumed intersection of both walls north of Compound C remains unclear yet.

There are some indications that not only Compound C, but also parts of Compound E were flooded, possibly after the erection of the outer wall. Perhaps the installation of the inner city wall with the ditch along its western face was a flood protection measure. The aforementioned shift of the settlement from Compound C to Compound E during the Middle to Late Iron Age (i.e. approx. 9th to 7th century BCE) may perhaps be explained by the ongoing threat of flood.

Indications of one or several flood events in Compounds C and E consist of partly massive silty packages, such as those deposited during floods, when the runoff is retained or calmed down, respectively. Within Compound C in a small sounding in Square C8 (location *cf*. Fig. 12) silty sand layers with a thickness of more than 1 m were found. The level of this layer was between ca.

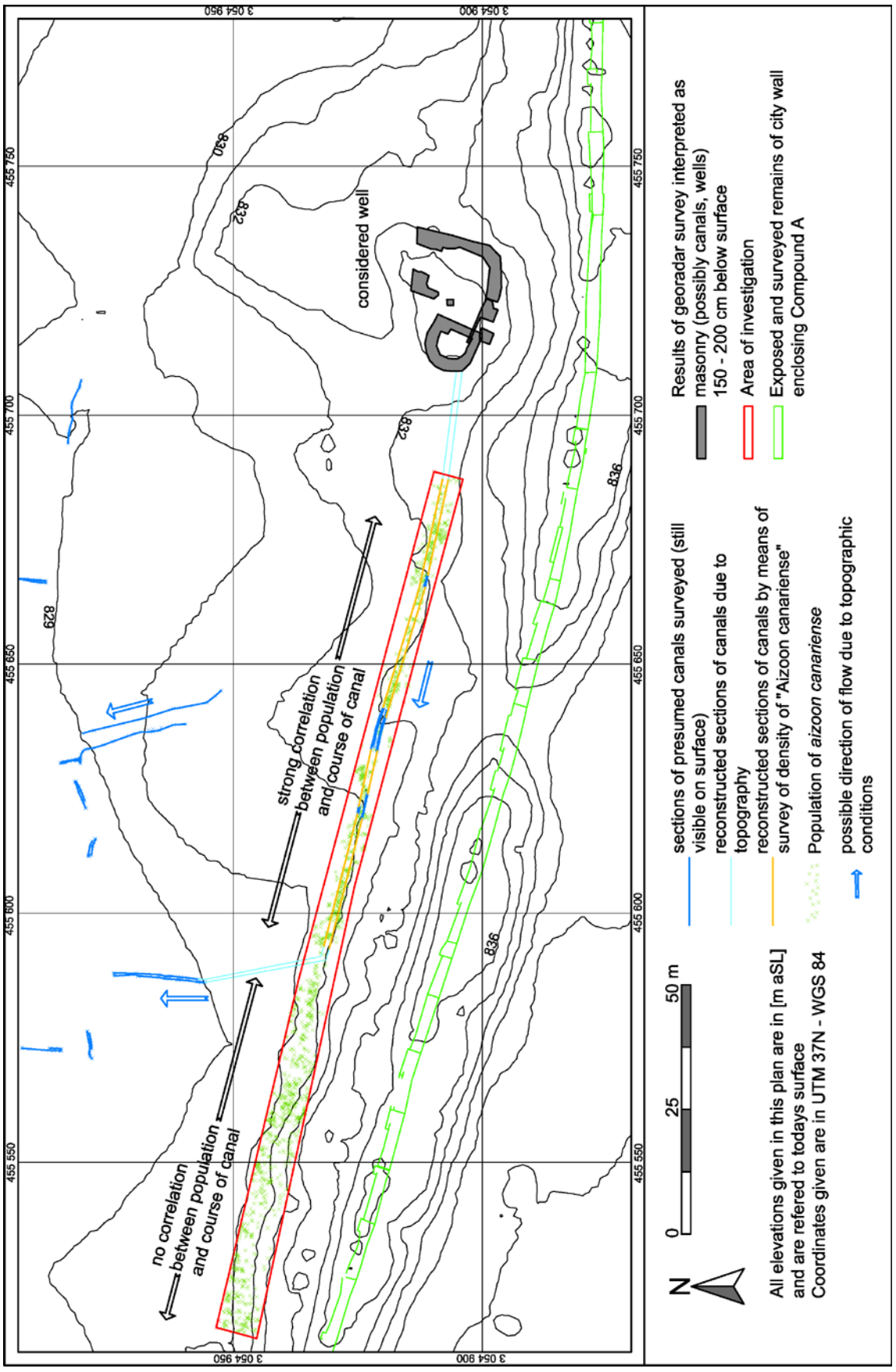


Fig. 11 *Detail of area west of presumed well in Compound A. Along the alignment of one studied canal the population of certain species* (Aizoon canariense) *prevailed in higher density. This indicates the course of the canal for a stretch of nearly 100 m.*

الشكل ١١ تفاصيل المنطقة الواقعة إلى الغرب من البئر 2 المفترض. لوحظ انتشار مجتمع نوع *aizoon canariense* بكثافة عالية بمحاذاة امتداد إحدى القنوات المدروسة. يشير هذا الأمر إلى امتداد مجرى القناة على مسافة مئة متر تقريباً.

822 and 823 m a.s.l.[19] Finally, east of the inner wall (already in Compound E) such silty packages were also found in Square C4/C5 (Schneider 2010, 15; cf. Fig. 13b).

A rather likely spot for a breach in the outer city wall is a gap ca. 120 m southeast of Area A (cf. Fig. 12) for which no archaeological explanation (e.g. a gate) exists. Runoff would have tended in a northeasterly direction across Compound C and finally reached the original *wadi* bed again at the supposed intersection of inner and outer city wall southwest of Area Z. The surface in the gap itself is today ca. 827.50 m a.s.l. Georadar prospecting indicated that the bedrock here is only 2 m below the surface (Neubauer – Loecker 2004, 19–21; Eichmann *et al*. 2010, 104–107). This correlates with the *wadi* bed east of the gap, which is at 825.50 m a.s.l. The deepest point within Compound C was approx. 821.60 m a.s.l. immediately south of Squares C2 and C3. And finally, between this point and the northern *wadi* bed a small barrier was observed with an elevation of 821.80 m.a.s.l at its lowest point (cf. Fig. 12).[20]

The georadar prospection performed in the gap in the outer wall south of Area A also suggests a linear structure parallel to the outer wall only 50 cm below the surface. This has been interpreted as a mud brick wall.[21] Further, georadar prospection indicate further walls to a depth of 2 m below the surface just west of the gap in the outer wall (cf. Fig. 12).

If a failure of the outer wall happened at this spot, quite likely no remains that had been erected before would be preserved. Whether these walls are younger than the presumed flooding of Compound C remains to be demonstrated. To prove this, detailed archaeological investigations are necessary. Nevertheless, the dating of these presumed mud-brick remains will provide a *terminus ante quem* for the last possible flood event in this gap.

It is also possible that the deposits came into the Squares C8 and C4/C5 accidentally, in the course of a flood from the north. This could explain why deposits have been found inside the inner wall.

Such an event seems conceivable in a backwater (perhaps higher than usual during the peak flow), which might have been caused by a blockage in the downstream reaches of the *wadi*. In such case the water level in Compounds C and E was perhaps barely 823 m a.s.l. In this state bed loads would have been deposited in Squares C8 and C4/C5, but not in Area O due to its higher elevation (see the flood plain in Fig. 12). Also, similar deposits should be found in the central area of Compound C where the level today is less than 822 m a.s.l. Furthermore, low-lying areas in Compound E (e.g. the hypothesised spring lake at approx. 819.80 m a.s.l.) would not have been affected, because a small barrier running east-west and perpendicular to the inner wall at a level of at least 824 m a.s.l. would have prevented this.

A rather small gap directly south of Square C1 may also be related to the flooding of Compound C. But, in light of the modern topographic situation and for hydraulic reasons,[22] a failure of the outer wall near C1 is unlikely.

Finally, whether Compound C was flooded or not after the erection of the outer wall could not be verified. An investigation of the gap south of Area A is particularly needed. Also, with regard to the function of the ditch at the western base of the inner wall, no clear idea was gained as to whether or not it had a hydraulic function at all.

---

[19] A sounding in the southwestern corner of C8 reached bedrock at 2.4 m below the surface. According to a recent survey the surface lies approx. at 233.40 m a.s.l. (cf. Fig. 12). Above the bedrock the layer of sand mixed with silt was identified (cf. A. Intilia in Eichmann *et al.* 2011, 71–79, Square C8).

[20] This survey is correlated with today's surface and, therefore, does not consider morphodynamic changes (e.g. moving sand dunes) of the last millennia.

[21] cf. Square F of Neubauer – Löcker 2004, 19–21.

[22] Square C1 is not situated at the undercut slope of the *wadi* stream. Therefore, the erosion of the sand dune and finally of the wall seems rather unlikely.

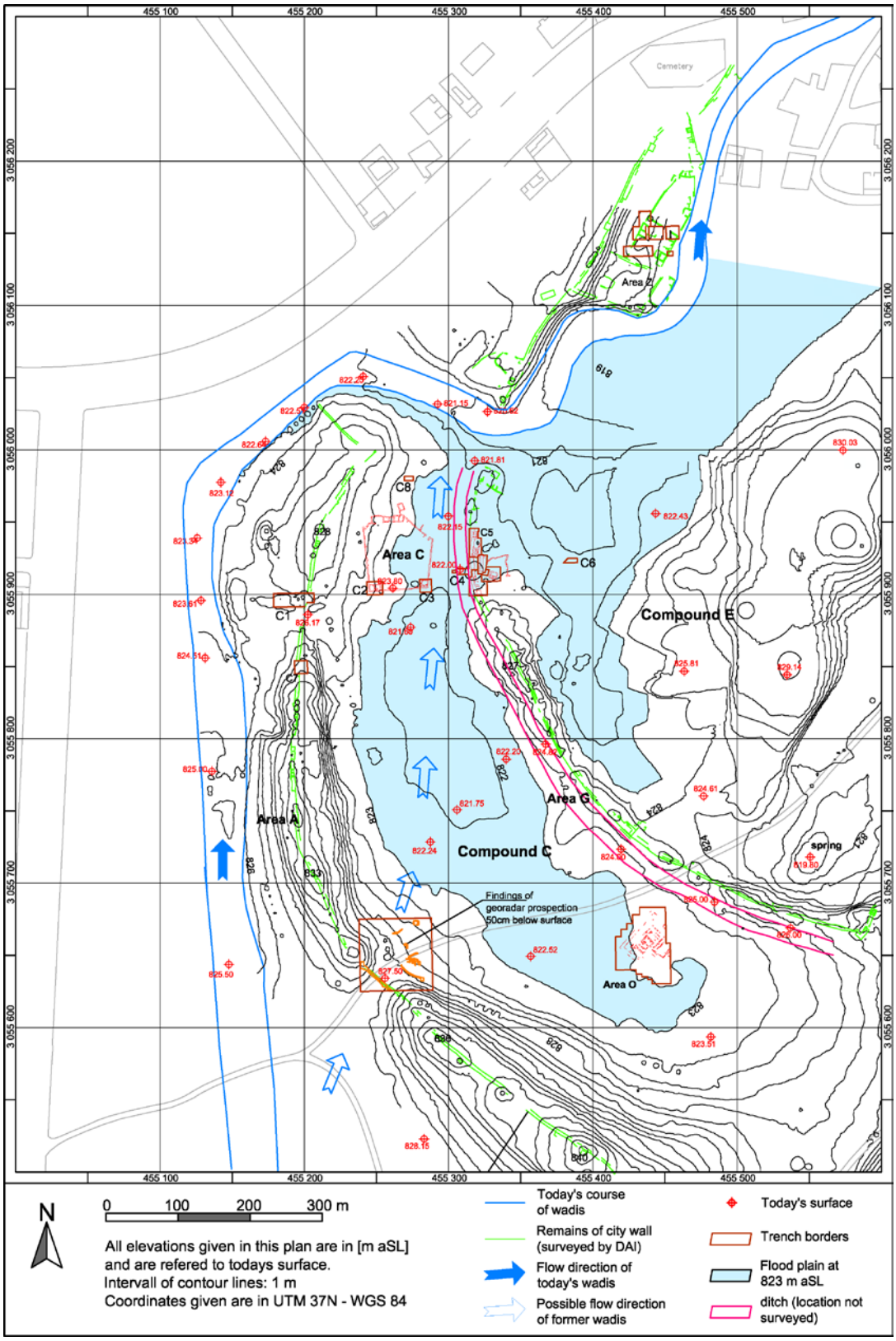


Fig. 12 *Topographic map indicating different phases of sections of the wall, probable flood protection measures, as well as possible locations for gaps in the outer wall in the vicinity of Compound C.*

الشكل ١٢خريطة طبوغرافية تظهر مراحل مختلفة لأجزاءٍ من سور المدينة من المحتمل أنها وسائل للوقاية من الفيضانات بالإضافة إلى مواقع محتملة لثغرات في سور المدينة الخارجي ضمن نطاق التجمع C.

Fig. 13 *Massive silt deposits east of the inner wall within Compound E (in Square C4/C5). a) The sediments have a thickness of partly more than 1 m; b) The wall was set against the sediments indicating that the wall is younger than the deposits.*

الشكل ١٣كميات ضخمة من ترسبات الغرين إلى الشرق من سور المدينة الداخلي داخل التجمع E (في المربّع C4/C5). a) تبلغ سماكة الترسبات جزئياً أكثر من ١ م؛ b) يشير بناء السور أمام الترسبات إلى أنه أحدث عهداً منها.

3.3 Water management outside of Qrayyah

3.3.1 General aspects

Since Taymāʾ played a prominent role in trade along the incense road, it may be assumed that the oasis had a demand for a huge amount of irrigation water in ancient times. Irrigation water at Taymāʾ must have been obtained from ground water or surface runoff. The possibility of rainfed agriculture can be excluded in view of annual precipitation rates of less than 150 mm a^{-1}.

A large number of presumably ancient wells are found in the palm garden, some of which are still in operation today, suggesting irrigation by means of ground water, although several features at Taymāʾ and elsewhere in the area hint at for the use of surface water as well.

It should be noted that the amount of water needed for irrigation in arid environments far exceeds that required by human communities. Also, the yield of the wells should be compared with the volume of surface runoff after *wadi* systems are activated. This is normally much larger than a well yield. However, ultimately the seasonal difference in water availability of both systems has to be considered in tandem with the growing seasons of agricultural plants. In many cases, therefore, conveyance of water is essential, as proposed by Fahlbusch (2004a, 6). On the other hand, one or two reliable rainfall events each year might provide sufficient water for irrigation, if the soil is suitable. Such a system, based on two monsoonal rainy seasons each year, was exploited at Marib during the late Bronze/Early Iron Age (Schmidt 1993; Vogt *et al.* 2003; Brunner 2004). An outstanding example of the application of multiple water management strategies in order to use and retain a *wadi*'s surface runoff is provided by Jawa, northern Jordan, in the Bronze Age (Helms 1981).

3.3.2 Previous investigations

East of Qasr al-Hamra (i.e. east of Compound W) is a large area that covers almost 100 ha, which was identified by Bawden *et al.* (1980, 79–80, pl. 61b) as a system of agricultural fields (location cf. Fig. 17). It was described by Bawden *et al.* as several parallel ridges, each with a height of about 50 cm and consisting of *sabkha* sediments and linear arrangements of stones. The raster of this straight scheme oriented in a southwest-northeast direction according to the surface slope was determined at 25–40 m. The ridges were identified over a length of about 500 m, before their lower reaches disappeared into the *sabkha*. The whole system was interpreted as a gravity-flow irrigation network with canals on top of the ridges. In their upper reaches a long ridge (interpreted as the main canal) with a total length of at least 850 m runs with a slight slope from southeast to northwest.[23] These features imply the existence of a rich water source somewhere southeast of this district. During an examination of this area at levels between approx. 803 to 807 m a.s.l. in 2008, the system as described by Bawden *et al.* was hardly recognizable. Only a few traces of possible ditches and several ridges were found, but no system as such could be reconstructed.

In the course of test soundings during the early 1980s at least two underground water canals were found (Livingstone *et al.* 1983, 102–103, Pl. 83). The first is located in the modern palm oasis about 1 km east of Qrayyah (cf. Fig. 17); it was discovered during work on an adjacent road. A tunnel was cleared to a total length of 13 m which had a height of 1.95 m and a width of 1.50 m; it runs from south to north. Pottery samples found within the tunnel are indicative of an ancient access hole. Also, an ancient well was situated just north of this tunnel (see above). There is no further information about the construction or the inclination of the tunnel; because it was not discovered during recent investigations, its function remains unclear. Most likely it was a tunnel for conducting water (not a *qanat* in the classical sense) linked to the aforementioned well to the north of it.

Further, another underground canal was found east of the western stretch of the wall immediately north of Qasr al-Radm (Livingstone *et al.* 1983, 103; see our Fig. 17). The top of this section was discovered 5 m below the surface. It was cut into the bedrock and had a width of 1.0 m and a height of 1.5 m. Like the underground tunnel mentioned above, this section was not discovered by recent investigations. Therefore, an assessment of it is hardly possible. Nevertheless, the advantage of an underground water distribution system is that it prevents the loss of water due to evaporation.

If the location of the second canal is reconstructed correctly and the level of the reconstructed canal bed was at approx. 809 m a.s.l.,[24] the conveyance of water to the agricultural area east of Qasr al-Hamra (see above) would seem possible in gravity-fed canals. This canal perhaps is to be aligned with the long ridge or canal noted by Bawden *et al.* (1980; see above). Such a canal would have had an estimated hydraulic capacity of perhaps 70 l/s (i.e. barely 6,000 m³ each day).[25] This amount of water would have supplied a huge area of farmland (e.g. an area of 30 ha could have been irrigated with 20 mm of water each day). Although these are rough estimates, they do seem plausible. Compared to the agricultural area east of Qasr al-Hamra, which, according to Bawden

---

[23] Bawden *et al.* (1980, 80) stated that the long ridge that ran perpendicular to the parallel series of ridges (these are in southwest-northeast orientation) slopes from southwest to northwest which is all but impossible. The location of this long ridge as seen in Bawden *et al.* (1980, Pl. 61b) in correlation with modern surveying strongly suggests a slope from southeast to northwest.

[24] The location of the tunnel is about 1.5 km northwest of Qrayyah at approx. E 454700; N 3057300 (UTM 37N, WGS84). The surface at this site is roughly 816 m a.s.l. (according to the DEM, Fig. 17). The cover of the tunnel with a height of 1.5 m was found 5 m below the surface. The covering itself had a thickness perhaps of approx. 50 cm.

[25] The hydraulic capacity of a rectangular canal with $b = 100$ cm; slope of 1/1000; k_{St}-value of 40 $m^{1/3}/s$ and assumed flow depth of 20 cm. Calculated after Manning and Strickler.

et al. was 100 ha (see above), this amount of water is not sufficient to supply the whole area. This suggests that there was another source of water to irrigate these fields.

However, the origin of the water that charged this canal remains in question. Most likely ground water from one or more wells was conducted to the palm garden. However, no estimate of the yield of such wells is possible until a geological outcrop in their vicinity reveals the soil's properties. Also, the possibility of obtaining ground water by means of a *qanat* should be considered. It is unlikely that this canal was supplied by surface runoff.

During his investigations at Qasr al-Radm, Abu-Duruk (1986, 31–32) found some hydraulic features which should also be mentioned (location cf. Fig. 17). Within Enclosure A in Qasr al-Radm was a well cut into the bedrock, but without any masonry. Although the well was filled with sand and rubbish which was not excavated, Abu-Duruk states that it is 'early'. In the vicinity of this well a stone with rope-marks was found, indicating long-term use of this water source. Further, Abu-Duruk describes a cistern with an area of 4 x 8 m, which he interpreted as a kind of a distribution basin for several nearby irrigation canals (*cf.* Knop – Hausleiter 2016).

Finally, further underground water distribution systems are described by al-Najam (2000).

3.3.3 Groundwater sources

Because artesian aquifers are most likely to be found in Taymāʾ (see above), the use of ground water for human needs as well as for irrigation is likely. Most ground water is supplied by wells, whose shafts extend to a ground water layer and, thus, enable the conveyance of water very easily. In today's palm oasis many wells can be found. Because the methods of obtaining water and transferring it to the fields have not changed significantly during the last centuries or perhaps even millennia, in many cases these structures can aid in developing an understanding of ancient irrigation techniques. Normally, ground water is lifted to the surface by the use of a pulley or a *shaḍuf* and then directed to the fields by means of gravity in canals. Such a system is thought to be attested in the southern part of Compound A, too (see above).

Another method of obtaining ground water is by means of *qanats*. It is widely accepted that *qanats* already played an important role in terms of water provision in Persia, northern Mesopotamia, Armenia, Pakistan, Oman and Afghanistan in the mid-1st millennium BCE. Since that time knowledge of this technique has become widespread in Arabia, the Middle East, north Africa and China (cf. Garbrecht 2004, 95–97).

Qanats have an underground gallery with a very low slope. This gallery cuts into an aquifer and, thus, leads the ground water to the surface, which requires that the surface's slope is greater than that of the gallery. Due to the inclination of the ground surface, dipping towards the north (cf. Fig. 1 and Fig. 17) and because the ground water level is not very deep, the employment of *qanats* at Taymāʾ generally seems possible although there is no evidence of any *qanats* at Taymāʾ, yet.

The most famous well at Taymāʾ is the so-called Bir Haddaj, a nearly rectangular draw well with a diameter of ca. 18 m.[26] Located in the centre of the present-day palm garden, this well is supposed to be one of the largest in the Arabian Peninsula (Eichmann *et al.* 2006a, 165). Up to 99 camels were able to draw ground water by means of an inclined plane and a pulley for irrigation purposes at the same time (Philby 1957, 84; al-Najam 2000, 193).

On the western edge an opening in the well's shaft some 6 m below the surface was observed in 2008 directly above the water table which was at ca. 802 m a.s.l. Because local sources mention a *qanat*-system that perhaps fed the well, this orifice was examined more closely. The result was the discovery of a gallery with a height of barely 2 m and a width of ca. 1 m; its course runs for

[26] Al-Najam (2000, 193) quotes the inner diameter of the *Haddaj*-well to be 65 m. Surely the circumference was meant here.

3 m in a western direction before bending to the north for another 3 m (Fig. 14). Therefore, this structure is not a *qanat*, which normally has a length of several kilometres or more. Perhaps this gallery was hewn into the bedrock at a spot at which there was already a natural fissure in order to increase the infiltration area and, thus, the yield of the well.

Recent investigations have revealed neither evidence for *qanat*s nor any new findings of underground canals in Taymāʾ. *Qanat*s are in northwestern Arabia only known in northwestern Arabia at the present-day oasis of al-ʻUla some 130 km southwest of Taymāʾ (Nasif 1983).

3.3.4 Surface water sources

The use of surface runoff for irrigation entails a raising of the water level by means of a diversion dam or weir. By retaining the runoff and, thus, increasing the water level for a certain time span irrigation canals could be charged. This technique has a long history and presumably was first employed in the form of small check dams as early as the 7th millennium BCE on the Arabian Peninsula.[27] Evidence for diversion dams linked to an irrigation network and dated to the second part of the 3rd millennium BCE have also been found.[28] Also at Marib (Yemen) the earliest irrigation systems which utilized dams are dated to the 3rd millennium BCE (*cf.* Schaloske 1995, 3). Irrigation by means of *wadi* runoff was probably carried out already in the 4th millennium BCE at Tall Hujayrat al-Ghuzlan (Heemeier *et al.* 2009, 264).[29]

South of Compound W a small *wadi* about 400 m long was found which drains an area of perhaps 1.8 km² into the *sabkha* north of it.[30] It is cut nearly 4 m into the bedrock, which flanks the *wadi* on both sides. In the lower reaches of this *wadi* the remains of an earthen dam nearly 3 m high were found (Fig. 15a).[31] The length of the dam's crest, whose level is ca. 813.50 m a.s.l., is roughly 33 m, as is the narrow *wadi*. Today the dam is partly destroyed; remains showing its cross section exist only on both banks.

Obviously this dam was erected for raising the water level and charging irrigation channels. After surveying the *wadi* bed upstream from the dam by means of DGPS, the storage capacity of the dammed lake was estimated at ca. 10,000 m³. Taking a peak runoff-coefficient of 0.8 into account, the maximum precipitation height for a single rainfall event was calculated at 7 mm, before overtopping and presumably damage to or even the destruction of the dam would occur. It is likely that such precipitation height would have been exceeded several times each year. Since no indications of a regular outlet or spillway for the dam have been found, the overflow of water on top of both banks seems likely.

Indeed, on both banks of the *wadi* canal-like structures have been found (Fig. 15b). One of these leads to the west, the other one to the east, towards Qasr al-Hamra. Perhaps, the latter canal provided water for the *qasr* itself or for irrigation purposes linked to the aforementioned ancient farmland east of it, as described by Bawden *et al.* (1980; see above). Because the dam's crest is situated at least 8 m higher than the fields,[32] irrigation seems to be conceivable. As explained above another source of water for these fields, besides the canal coming from the

---

[27] Jafr basin, southern Jordan: Fujii 2007; southern Arabia: McCorriston – Oches 2001.

[28] In Maysar region and in Bat; cf. Häser 2004.

[29] For the evolution of water management strategies in the southern Levant and northern Arabia from the Neolithic Age through Antiquity see: Wellbrock *et al.* 2012.

[30] The catchment area of this *wadi* was estimated from remote sensing data using the SRTM-dataset.

[31] The location of these considered dam remains is: E 453250; N 3057850 (UTM 37N, WGS84).

[32] The level of the dam crest today is approx. at 815.30 m a.s.l. Due to erosion the crest could have been somewhat higher in former times. The level of the supposed ancient fields east of Qasr al-Hamra: 803 to 807 m a.s.l.

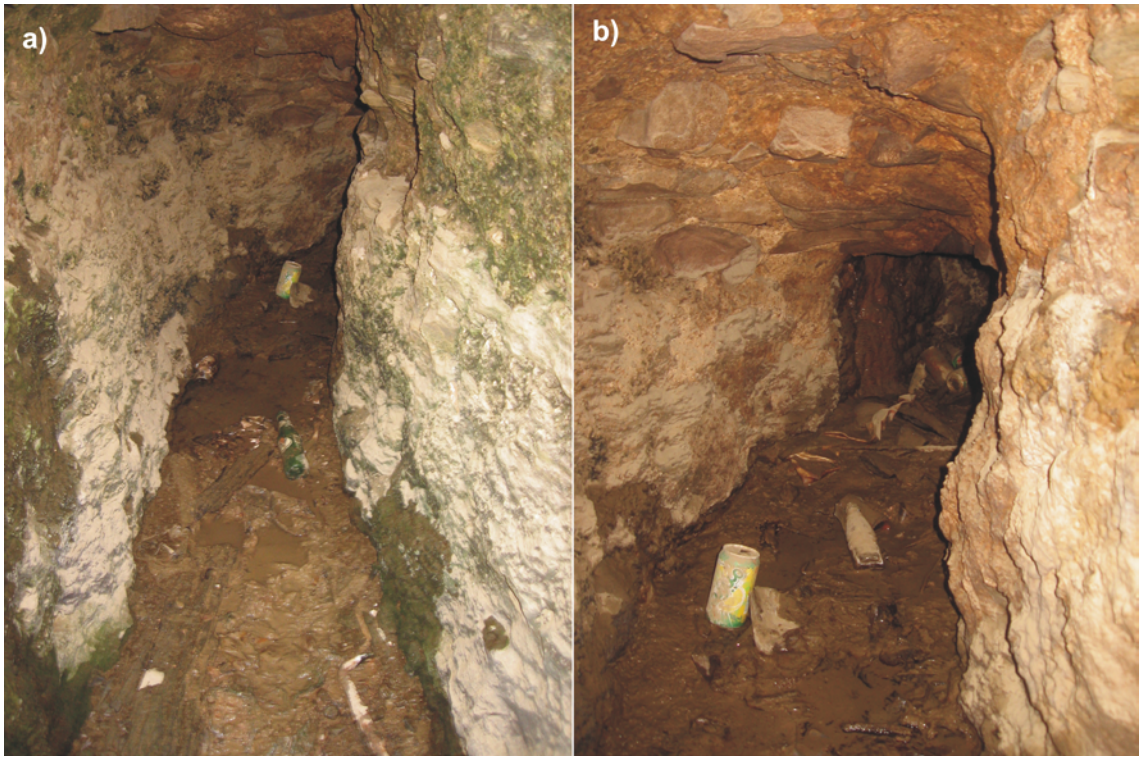


Fig. 14 *Orifice at the western side of Bir Haddaj shaft. a) First section that leads in westerly direction for 3 m; b) Second section of the gallery after bending in northerly direction for another 3 m.*

الشكل ١٤فتحة في الجانب الغربي لبئر هدّاج. a) الجزء الأول الذي يسير باتجاه الغرب بطول ثلاثة أمتار؛ b) الجزء الثاني من النفق بعد انعطافه نحو الشمال بطول ثلاثة أمتار أخرى.

southeast, is likely. This dam with its canal could have been such a water source. However, until detailed archaeological investigations of this dam have been undertaken and its remains dated, any hypothesis is speculative.

In general the operation of dams at Taymāʾ is conceivable, since this technique of water procurement was well known in Arabia by the Bronze Age (Fahlbusch 2001). During the Nabataean period the operation of such systems is likely, since the Nabataeans were famous for their waterworks (Bellwald 2008).

3.4 *Sabkha*

3.4.1 Environmental setting

The *sabkha* is an endorheic depression without outflow north of the modern palm-oasis of Taymāʾ. It covers about 20 km² (*cf.* Engel *et al.*, this volume; Dinies *et al.*, this volume). The deepest point of the *sabkha* is about 801.5 m a.s.l. The northern margins border a steep, partly vertical escarpment with an elevation of over 840 m a.s.l. Along the southern side of the *sabkha* a very gentle slope at the transition to the oasis can be seen at a level of about 804 to 820 m a.s.l.

The hydrological system of the *sabkha* represents a feature of the former water-management and cultivation systems at Taymāʾ. Surface water of the catchment area would have accumulated in the topographic depression and formed a paleo-lake during the early Holocene (ca. 10,000 to 9,000 cal BP). However, due to climate change and diminished rainfall the quantity of evaporating water exceeded the discharge; the water level decreased and finally caused a slow salinization of the *sabkha*. The decreasing water level probably enabled the agricultural use of farmland at

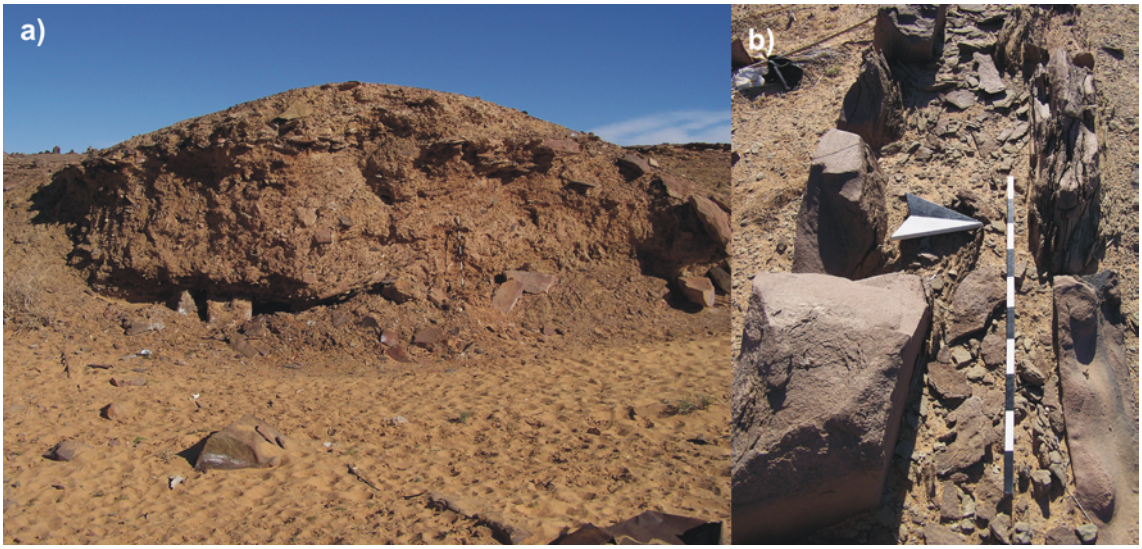


Fig. 15 *Remains of a dam about 500 m southwest of the Qasr al-Hamra. a) Eastern cross section of dam with a height of approx. 3 m; b) Remains of a conceivable canal with a course towards the east.*

الشكل ١٥ بقايا سدّ على مسافة ٥٠٠ م تقريباً إلى الجنوب الغربي من قصر الحمراء. a) المقطع العرضي الشرقي للسدّ مع ارتفاع ثلاثة أمتار تقريباً؛ b) بقايا قناة محتملة تتجه نحو الشرق.

the transition zone to the palm-garden and subsequently triggered the development of the oasis. Most likely, an earthen dam crossing the *sabkha* in a west-east direction was protecting farmland against episodic (or periodic) flooding during the mid-to-late Holocene (*cf*. Schneider 2010, 4–5). This assumption is supported by the finding of presumably ancient farmland east of Qasr al-Hamra (see above; Bawden *et al.* 1980, 79–80).

At present the depression is salty marshland, which is only flooded after episodic rainfall in winter. The bottom of the *sabkha* consists of thin layers of silt and clay. Intermediate layers consist of evaporates, *i.e*. gypsum, mineral salt or anhydrite.

In order to identify the level of the bedrock which likely underlies the Holocene sediments within the basin, several ERT-profiles were recorded. Because of very high salinity the sediments have exceptionally low resistivity values (< 20 Ωm). Therefore the assumed bedrock was not found but rather the location of a former shoreline of a saline, perennial or periodic lake. Fig. 16 shows a possible shoreline of a palaeo-lake where a transition from very salty to less salty areas is recognizable.[33] Interestingly, today's surface at this transition has a level of ca. 810 to 813 m a.s.l. and thus correlates with the minimum water level of the proposed perennial early Holocene lake (see below).

Today salinization continues due to very high reference evapotranspiration rates of approx. 1,700 mm a^{-1} (Trabucco – Zomer 2009). The drainage water of the palm-oasis causes a continuous supply of water and therewith salt minerals. Although this drainage water has a small discharge compared to surface runoff from the catchment after rainfall events, salinization continues permanently, particularly at certain spots along the *sabkha*'s southern margin.

In total, seven or even ten episodic *wadi*s are supposed to enter the *sabkha* today, which issue from different directions (Philby 1957, 83; al-Najam 2000, 193).[34] Additionally, a source of the 10th century AD mentions a perennial river (cf. *ibid*.). This 'river' is likely to have been fed by

[33] Profile 26 is situated in the north-western part of the *sabkha*. The centre of the profile is: E 453850; N 3060490). Profile 27 was recorded in the north-eastern part. The centre of this profile is: E 457730; N 3059380. Both are running from north to south. Coordinates are in UTM 37N, WGS84.

[34] Not all of the mentioned *wadi*s have been identified in the course of our recent investigations.

springs in the foothills south of Taymāʾ. But, because this is the only source which mentions a perennial 'river' this information should be handled carefully. Maybe this was a small creek rather than a river with little impact on the water budget of the *sabkha*. Today the entire catchment area of the *sabkha* adds up to barely 660 km².

By means of DGPS-surveying the topography of the *sabkha* was recorded in order to obtain the capacity curve (relationship between lake´s surface and stored water volume) of this depression. These data were merged with SRTM-Data for an area of the palm-oasis that could not be surveyed satisfactorily.[35] Finally a Digital Elevation Model (DEM) of the *sabkha* was made (Fig. 17).

3.4.1 Brief summary of climatic history

Holocene climate fluctuations are believed to have had a major impact on the palaeo-environment of the Arabian deserts and their margins. Fluvial and lacustrine geo-archives such as *wadi*s or palaeo-lakes, along with sand dunes, speleothems and marine basins offer an opportunity of reconstructing locally and regionally specific climate conditions. Although many palaeo-environmental investigations of the southern and south-eastern part of the Arabian Peninsula have been undertaken in recent years, there is still a lack of reliable information from northern Arabia. Generally, the northward shift of the Intertropical Convergence Zone (ITCZ) and thus monsoonal precipitation is accepted for the southern part of the Arabian Peninsula (Fleitmann *et al.* 2003; Burns *et al.* 1998; McLaren *et al.* 2009), but seems to be restricted to the area below approx. 23 to 24° N (Fleitmann *et al.* 2004).[36]

Geoarchaeological analyses provide evidence for the minimum water level of an early Holocene (approx. 10,000 to 9,000 cal BP) lake of at least 811.5 m a.s.l. based on barnacles attached to exposed bedrock already revealing a saline environment (cf. Engel *et al*., this volume), thus forming the basis of our palaeo-hydrological model.

Probably simultaneous with a climate shift during the early Holocene and a changed water resources pattern, settlement conditions changed as well. Therefore, climate shifts have to be seen in relationship to water management and settlement.

The early Holocene humid period was succeeded by a drier phase. In the mid-Holocene this general trend to today's hyper-arid climate was again interrupted by a more humid period which ended at around 5,200 BP (Bar-Matthews – Ayalon 2011, Weninger *et al.* 2009, Staubwasser – Weiss 2006). It is believed that this mid-Holocene humid phase was drier than that of the early Holocene.

3.4.2 Palaeo-hydrological modelling for the early Holocene humid period

The approach based on the water balance equation

The water balance equation assumes that the inflowing water volume must equal the outflowing water volume for a certain time span in a contemplated system. Assuming a constant water level

[35] In the palm-oasis DGPS-surveying hardly was possible due to shielding palm fronds. SRTM-data representing settled or plant covered areas have to be handled very carefully because the determination of the elevation of earth's surface in such areas is hardly possible by the used radar technology. Therefore SRTM-data has been compared with the little DGPS-data available in these areas. Afterwards a gentle elevation-adaption of SRTM-data to DGPS-data has been conducted before both datasets have been merged.

[36] For more detailed information regarding the climatic fluctuations of the Arabian Peninsula during Holocene and geoarchaeological investigations in the *sabhka* of Taymāʾ, see the contribution of Engel *et al.* (this volume) and Engel *et al.* 2012. For more recent investigations regarding the *sabkha* of Taymāʾ and the palaeoenvironment in general see Dinies *et al.* 2015, Enzel *et al.* 2015, Engel *et al*. 2016, Enzel *et al*. 2017).

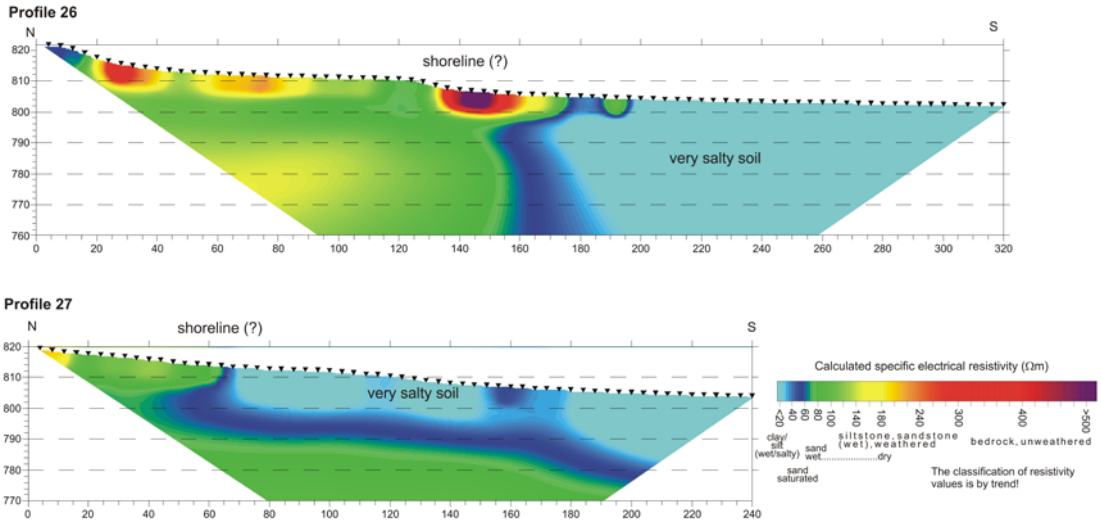


Fig. 16 *Geoelectrical tomographies performed at the northern escarpment of the* sabkha*, showing very salty material within the depression and the location of a conceivable former shoreline.*

الشكل ١٦صور طبقية جيوكهربائية تم إجراؤها على حافة السبخة الشمالية و هي تُظهر مواد مالحة جداً داخل المنخفض بالإضافة إلى مكان الشاطئ السابق المحتمل.

throughout the year this hydrologic water balance equation has to be solved. This means that the annual runoff volume of the endorheic drainage basin of the *sabkha* must be equal to the annual infiltration and evaporation rates. The *sabkha* itself simplifies the system because it has no surface outlet (*e.g*. a river or *wadi*).

The model was set up for the early Holocene humid phase for which the minimum water level of a stable lake was determined (see above).

Setting up of a Digital Elevation Model (DEM)

Based on the DGPS-survey of the *sabkha* the capacity curve could be determined using common GIS-applications. Fig. 18 shows the function of the lake's surface and stored water volume relying on the water level. Morphodynamic changes of the surface terrain within the *sabkha* which probably took place during the last roughly 9,000 years have been ignored since they would have only had a minor influence. Morphodynamic changes mainly would have resulted in a lifting of the *sabkha'*s bottom due to blown sand and bed loads transported by the *wadi*s, respectively, thus influencing storage capacity. The lake's surface is dependent only to a minor extent on the stored water volume if more than ca. 120 mio. m³ are already retained. Since infiltration and evaporation are depending on the lake's surface, the influence is not that relevant.

The surface is increasing very rapidly at low water levels of more than 804 m a.s.l. due to the very gentle slope of today's surface. Finally the lake's surface and the stored water volume for the assumed water level of the former Holocene lake of 811.5 m a.s.l. could be estimated at 1,845 ha and 116 mio. m³, respectively.

Determination of model parameters

To estimate annual infiltration the infiltration, capacity of the silty soil, sand- or limestone at the bottom of the *sabkha* of 10^{-10} m s^{-1} has been considered according to empirical val-ues. Since the annual infiltration volume has been found to be ca. 2% of the annual runoff volume for this assumption, further evaluation is unnecessary.

Runoff-coefficients *r* which represent the runoff concentration pattern in the catchment have been evaluated. Mean runoff-coefficients characterise the percentage of the annual amount of rainfall becoming surface runoff and therefore are essential for solving the water balance equation. The most important hydrological components during rainfall events in arid or semi-arid environments

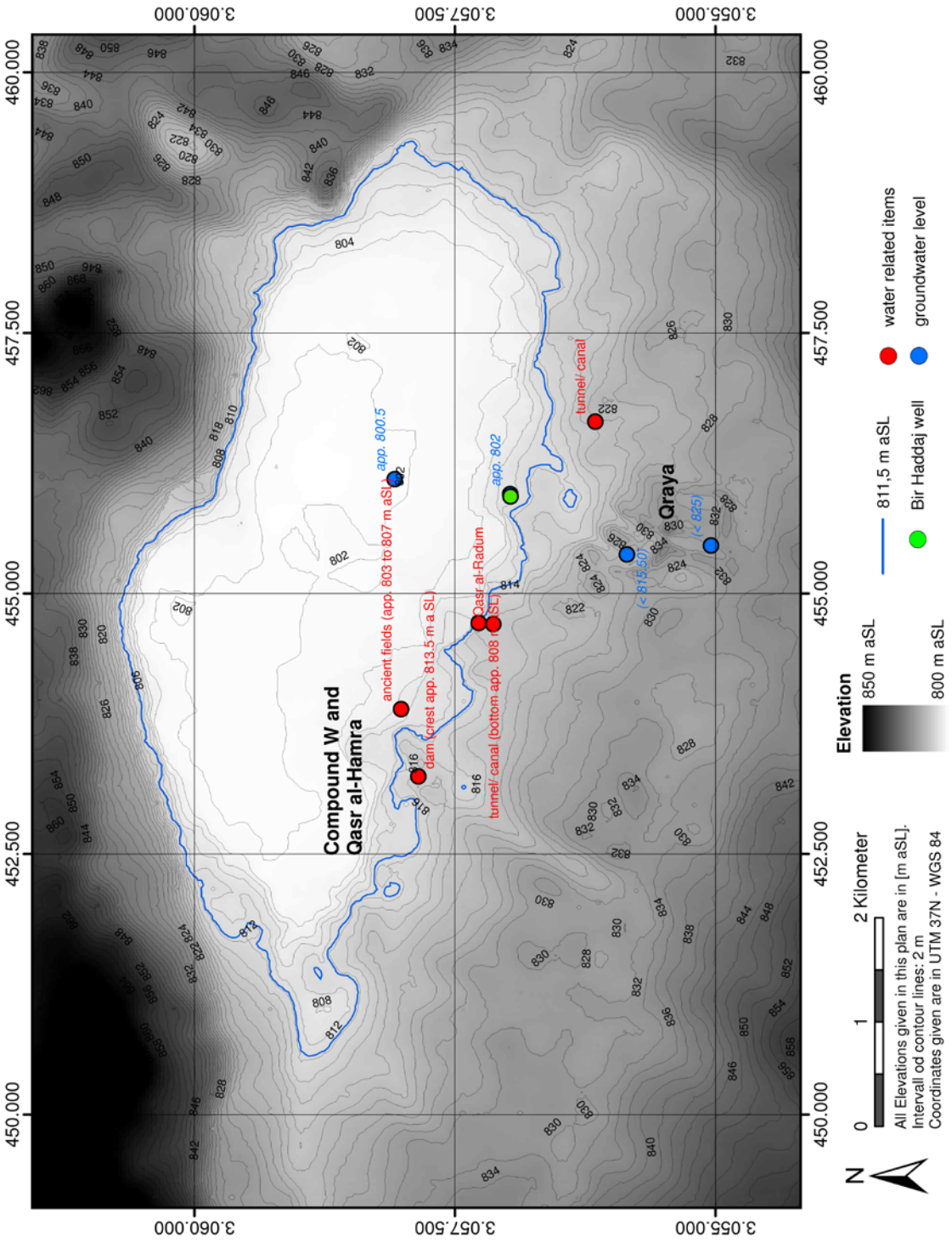


Fig. 17 *Digital Elevation Modell (DEM) of the* sabkha*, based on DGPS-surveying merged with SRTM-data. Marked in light blue is the assumed shoreline of the former lake at a water level of 811.5 m a.s.l.*

الشكل ١٧نموذج رقمي للارتفاعات (DEM) اعتماداً على مسح DGPS دُمج مع بيانات SRTM. تمت الإشارة إلى خط الشاطئ المفترض العائد للبحيرة السابقة بواسطة اللون الأزرق الفاتح و بارتفاع منسوب الماء ٨١١,٥ م عن سطح البحر.

are their intensity and duration, runoff and infiltration rates, hence evaporation and interception can be ignored because of little or no vegetation.

Runoff-coefficients take the soil type, the mean surface slope as well as vegetation patterns and seasonal as well as temporal distributions of singular rainfall events into account. Further the size of the catchment has an impact on the runoff coefficient. The bigger the catchment, the bigger the transmission losses of surface runoff in *wadi*s are considered to be.

To evaluate all these influences is hardly possible, particularly if a model represents a palaeo-scenario. But, because the inital hydrologic conditions of rainfall events in arid and semi-arid regions are extremely dry, only the soil type has a major impact on the runoff-coefficent. Şen (2007) established an empirical correlation which fits very well a long-term water balance in arid and semi-arid environments. For typical rock outcrops and surfaces in arid or semi-arid environments he gives empirical values to evaluate the runoff-coefficients (*cf.* Tab. 1).

The catchment of Taymāʾ exhibits mainly soil types B and C of Table 1. But, since quaternary deposits predominate, runoff-coefficients in a range from $r = 0.25$ to 0.35 have been taken as a basis for the calculations, whilst $r = 0.30$ is supposed to be most likely.

Solving the water balance equitation[37]

For solving the hydrologic water balance equation, at first a certain annual precipitation rate was chosen. Afterwards, the monthly distribution of rainfall and reference evapotranspiration reflecting today's climate was assumed (rainfall in winter, high evaporation rates in summer).

It should be noted that orbital parameters influencing solar insolation and potential evapotranspiration among other things, have varied since the Holocene (Claussen *et al.* 1999, 2037). Therefore, an annual reference evapotranspiration, of 1500 ± 100 mm a^{-1} seems plausible. Denser cloudiness during wetter periods would have decreased reference evapotranspiration in comparison to today's 1700 mm a^{-1}. The assumed monthly values for precipitation height and reference evapotranspiration are presented in Fig. 20.

Monthly rainfall was expected to occur as singular rainfall events in order to nullify transmission losses of light rainfall events. Finally the monthly runoff volume based on monthly precipitation rates was calculated. Using the capacity curve (Fig. 18) the surface relying on stored water volume for each month was determined and hence the monthly infiltration as well as the monthly evaporation volume could be calculated. For the calculation of the next month another initial water volume taking the changes of the previous month into account was applied, and so on. Finally, after the calculation of each month of a year, the hydrologic water balance equation is fulfilled (the initial stored water volume has to equal the final water volume). Therefore, the annual precipitation rates for certain reference evapotranspiration rates as well as runoff coefficients were varied until this balance was obtained. The results of these calculations for an initial water level of 811.5 m a.s.l. depending on these three parameters are shown in Fig. 19.

Therefore, the annual precipitation rate for the early Holocene humid period was estimated at 150 ± 25 mm a^{-1} assuming an annual reference evapotranspiration rate of 1500 ± 100 mm a^{-1}. These estimations are based on today's climate with certain annual distributions of rainfall and evapotranspiration (*cf.* Fig. 20).

For the Pleistocene and probably more humid lake-period (approx. 34,000 to 24,000 BP; cf. Schulz – Whitney 1986) an annual precipitation of 200 ± 50 mm a^{-1} was assumed by Wood – Imes (1995, 267) by means of groundwater-recharging models for the southern part of the Arabian peninsula. These results are in accordance with the estimate of annual precipitation in this investigation because the early Holocene lake period is supposed to be less humid than the earlier one.

[37] For a more detailed description of this approach see Engel *et al.* 2012.

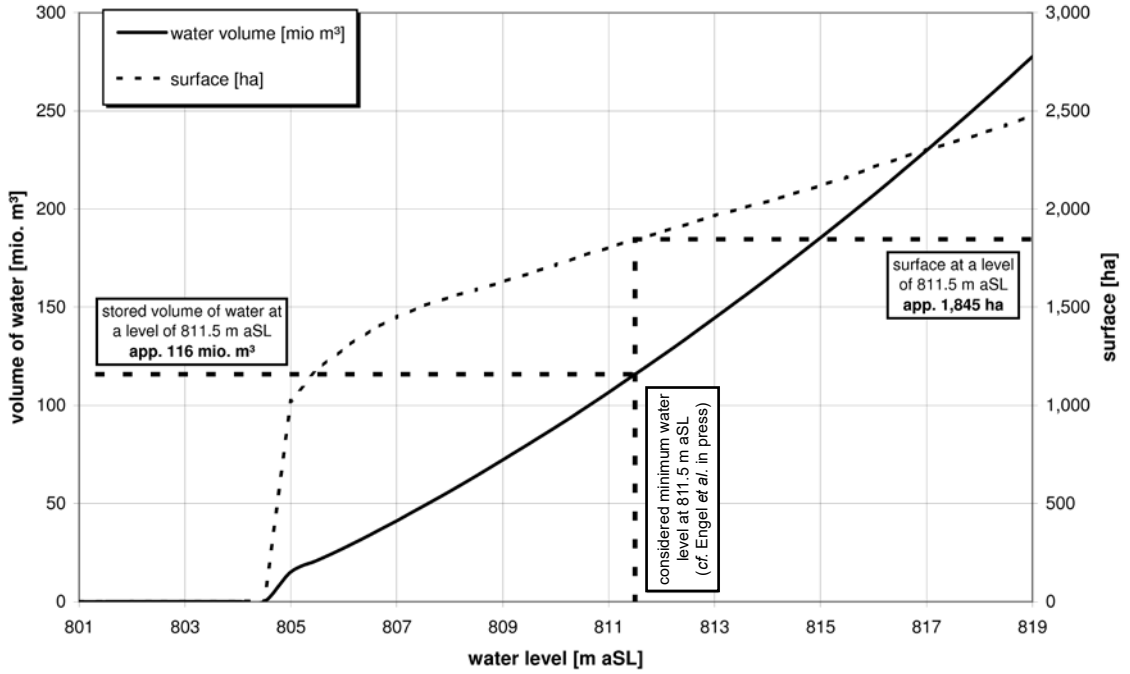


Fig. 18 *Capacity curve and function for the surface of the water body depending on the water level of the* sabkha*. Determined on the basis of the DEM (Fig. 17), derived from DGPS-surveying merged with SRTM-data. Also, the considered level of the former shoreline as well as its assigned surface and stored volume are aligned.*

الشكل ١٨منحنى سعة و وظيفة سطح الماء اعتماداً على مستوى مياه السبخة. تم التحديد على أساس DEM (راجع الشكل ١٧) الذي استُمد من مسح DGPS المدمج ببيانات SRTM. تم أيضاً قياس المستوى المحتمل لخط الشاطئ السابق بالإضافة إلى المساحة المشغولة و الحجم المخزّن.

Calculation of an annual water level hydrograph

By means of the seasonal distribution of runoff (calculated on the basis of monthly precipitation) and reference evapotranspiration (Fig. 20) it has been possible to determine the water level hydrograph for the *sabkha*. For this purpose the monthly evaporation volume as well as the monthly infiltration volume has been calculated out of the surface at certain water levels. Thus, considering the inflow to the *sabkha*, the monthly stored water volume was estimated. Using the capacity curve (*cf*. Fig. 18) the monthly water level could be determined (Fig. 21). Therefore a mean annual water level difference between winter and summer of approx. 80 cm has to be assumed.

The hydrograph shown in Fig. 21 is related to reconstructed mean annual precipitation rates. Probably there have always been variations in this pattern. It should be pointed out that due to runoff-concentration after intense rainfall the water level rose within a couple of hours by approx. 30 to 40 cm. Still today after singular rainfall events during wintertime the water level rises significantly.

Discussion of results

It could not be proven whether Taymāʾ actually was affected by the Indian monsoon or not. Since the model is very sensitive to an adjustment of runoff-coefficients, a monsoon-affected climate (rainfall during winter and high evapotranspiration rates during summer) leads to annual precipitation rates in the range of 136 ± 23 mm a^{-1}. This range seems to be plausible at its upper boundary. A monsoon perhaps favoured the oasis with reliable annual rainfall and surface runoff.

These statements are referred to the assumed shoreline of the *sabkha* at a level of 811.5 m a.s.l. which was stated to be the minimum water level of a persistent lake during the mid-Holocene. But a former shoreline at 818 m a.s.l. is also conceivable from a hydrologic point of view. In this case

Soil type	A	B	C	D
Surface	Gravel, cobbels, boulders, aeolian sand, sand dunes	Quarternary deposits, sand, fracture	Sedimentary rocks, weathered rocks, metamorphic rocks	Clay, silt, intact rock
k_s	0.15	0.30	0.50	0.75
r	0.14	0.26	0.39	0.53

Tab. 1 *Runoff exponent values and runoff coefficients for different soil types in arid and semi-arid environments (after Şen 2007).*

الجدول ١ قيم أسّ و معاملات الجريان السطحي للأنماط المختلفة للتربة في البيئات الجافة و الشبه الجافة (وفقاً لـ Şen ٢٠٠٧).

the lake's surface would have been ca. 22% larger. Due to a higher evapotranspiration volume the annual precipitation rates would be in the range of 180 ± 30 mm a^{-1}, which still seems to be plausible at its lower range. A persistent lake at a level of 818 m a.s.l. would have had its shoreline in close proximity to Qrayyah. For the development of the community this would have had a major impact even if the water of the *sabkha* was saline.

Our model aims for the reconstruction of early Holocene precipitation rates and thus the parameter of any hydrological investigations. Of course, also during the mid-Holocene humid phase, which is believed to be less humid, a palaeo-lake may have formed in the *sabkha* of Taymāʾ. With less precipitation, however, this was probably periodic rather than perennial. Since we do not have any archives representing this phase yet, we cannot verify this hypothesis. It should be pointed out that some of the results here have been questioned in the meantime (in particular: *cf*. Engel *et al.* 2012 and the answer Enzel *et al*. 2015). The authors agree that there is some revision necessary which is in preparation.

4 Dumat al-Jandal

4.1 General setting of the oasis

Dumat al-Jandal was the subject of hydrologic investigations during a three-day campaign in spring 2007 by kind permission of the (then) Deputy Ministry of Antiquities and Museums. Because of the short time available only a coarse idea of the hydrologic situation in the past could be gained. The settlement is located in Al-Jawf province some 270 km northeast of Taymāʾ (cf. Fig. 1; for most recent excavation results of the Saudi-Italian-French expedition see Charloux – Loreto 2014; Charloux – Loreto 2016).

Concerning the natural hydrological setting, the settlement can be divided into three different areas, as is the case with Taymāʾ: the *sabkha*, the palm oasis, and the ancient and modern settlement. These elements are located at different elevations: the *sabkha* is situated at the lowest level (580 m a.s.l.), the settlement at the uppermost (630 m a.s.l.), while the palm oasis is found in between (cf. Fig. 22).

The hydrologic system of the *sabkha* represents the probable precondition of former water management and cultivation at Dumat al-Jandal. Surface water could have accumulated in a topographic depression and formed a persistent, periodic or episodic inland lake. However, the evaporating water quantities exceeded the discharge, the water level decreased, and this caused a slow salinization of the *sabkha*. The system is comparable to that of Taymāʾ, and therefore is suitable for investigations similar to those presented above.

The palm garden represented an important part of the agricultural regime in the ancient oasis of Dumat al-Jandal. Perhaps a decreasing water level allowed the agricultural use of the palm garden and subsequently caused the development of the oasis, making irrigation and drainage systems necessary.

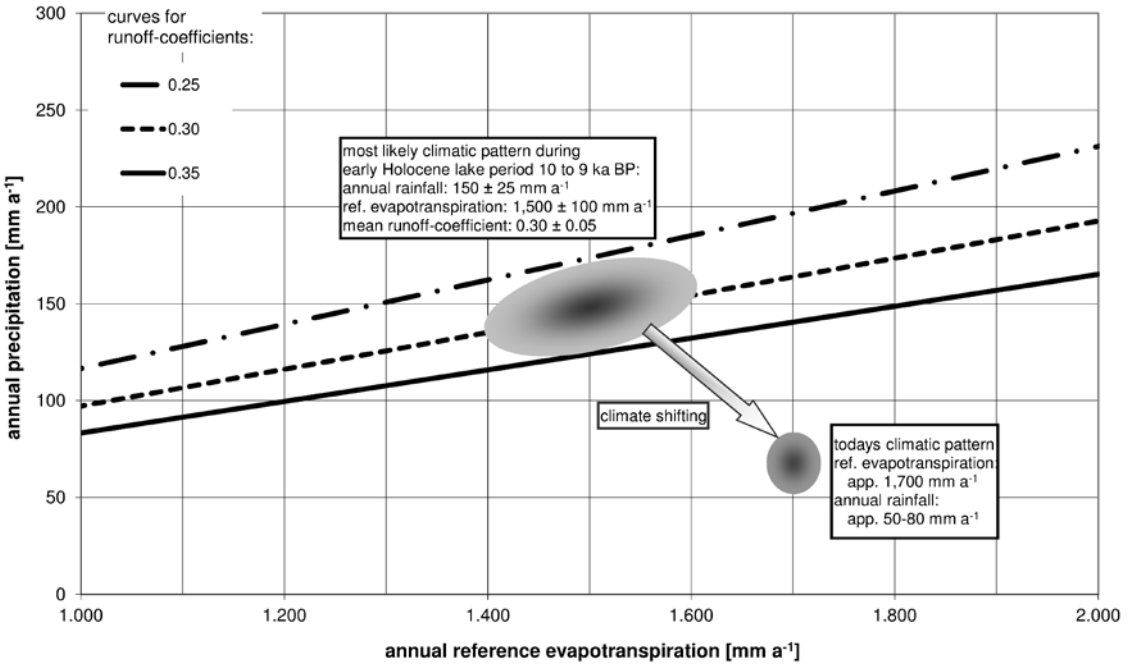


Fig. 19 *Reconstructed annual precipitation and reference evapotranspiration rates for different mean run-off-coefficients and an equal water balance at a water level of 811.5 m a.s.l. of the* sabkha*. As shown in this figure, a climate shifting from wetter conditions in early Holocene to nowadays hyperarid climate could be assumed.*

الشكل ١٩هطول الأمطار السنوي المستبنى مع معدلات التبخر و النتح المرجعية العائدة إلى متوسط مختلف لمعاملات الجريان السطحي و لتوازن مائي متساوي لمياه السبخة عند منسوب ٨١١,٥ م عن سطح البحر. كما هو مبين في الشكل، يجب افتراض حصول تحول مناخي من ظروف أبرد و أرطب خلال فترة البحيرة الثانية إلى مناخ الوقت الحاضر شديد الجفاف.

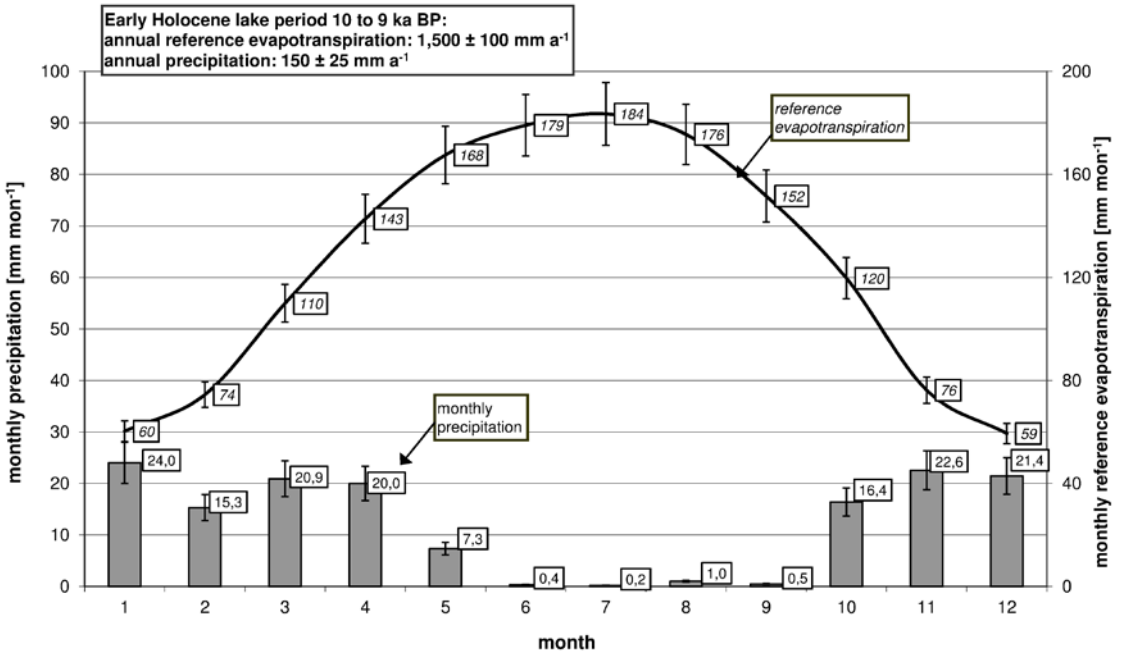


Fig. 20 *Reconstructed seasonal distribution of precipitation and reference evapotranspiration for early Holocene according to today's climate pattern.*

الشكل ٢٠ توزيع موسمي مستبنى لهطول الأمطار مع التبخر والنتح المرجعي خلال الهولوسين المبكر وفقاً للنمط المناخي الحالي.

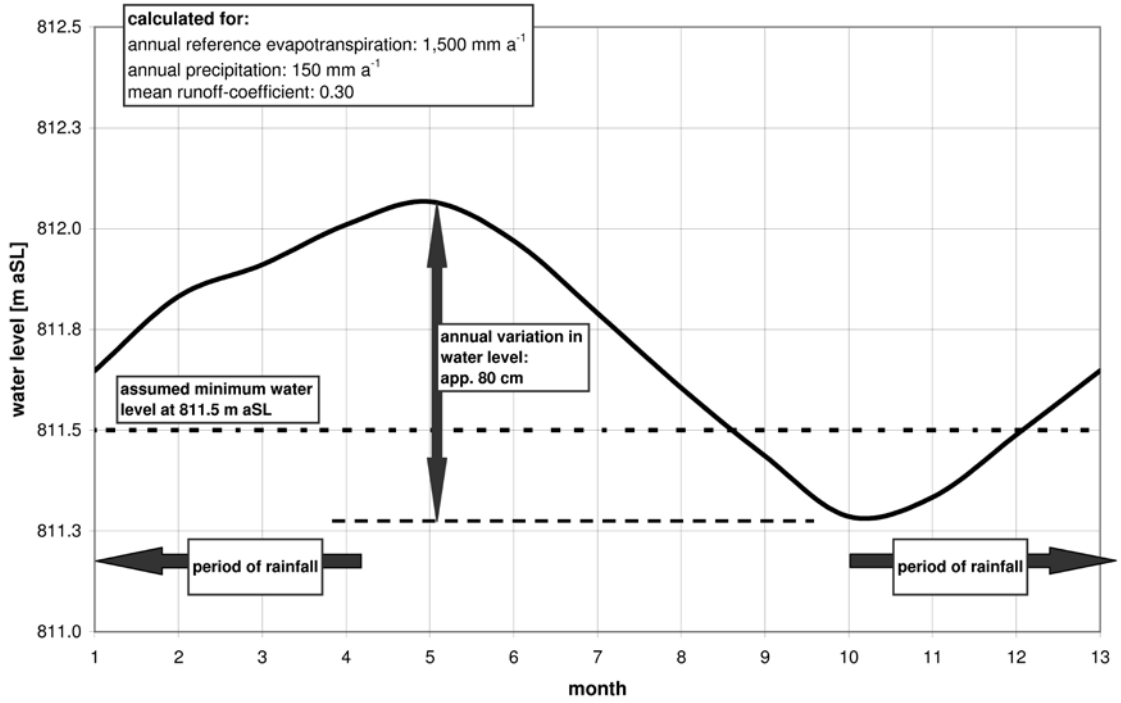


Fig. 21 *Annual water level hydrograph for the* sabkha *representing considered conditions during early Holocene lake period 10 to 9 ka BP.*

الشكل ٢١ رسم مائي لمنسوب المياه السنوي في السبخة يظهر الظروف المحتملة خلال فترة الهولوسين المبكر، ١٠٠٠٠ حتى ٩٠٠٠ عام قبل الوقت الحاضر.

The urban area was located on a significantly higher level above the *sabkha* and the palm garden. It can be assumed that this area had its own water supply which was independent of the other areas.

4.2 Water source

During the survey several elements of water supply systems were identified. The survey focused on two areas: the area west of the city wall and the area next to the fortress Qasr Marid (cf. Fig. 22).

In the western area outside of the city wall four, probably ancient wells were identified at 630 to 650 m a.s.l., close to the mountainside to the south of the valley. The wells are structurally similar. They consist of circular perimeter walls with diameters of 5 to 10 m. The walls are built of regular ashlar masonry. Two of the four wells have a stairway set behind the perimeter walls.

The gaugeable maximum depths of the wells depend on the level of spillage (up to 20 m). It is probable that all wells were fed by the same aquifer under the *wadi* flowing from west to east. By measuring the water level in each well the location and the flow direction of the main aquifer could be determined. The extension of the aquifer is of particular interest for evaluating the origin of surface-near water. The analysis of levelling data and the creation of a digital elevation model will help answer this question. Furthermore, it is recommended to examine the presumed aquifer by geophysical methods, especially geoelectric investigations, in order to draw further conclusions (e.g. thickness and extension of the aquifer).

During the survey four additional, possible ancient wells were identified next to the fortress. They are located at ca. 610 to 630 m a.s.l. Therefore, it is probable that all wells were fed by the same aquifer. It was generally noted that all of the wells are located in a very small area measuring ca. 100 x 100 m. One of them is partially filled with water. The others are filled with debris and

drift sand. In view of the high site density, it is quite evident that these wells in the first instance provided the water supply for the inhabitants of the urban area. Relicts of canals on the surface indicate a water distribution system in this area.

4.3 Flood protection

Another focus of research was the investigation of flood protection measures for the urban area. At least one *wadi* presents a danger to the settlement. The analysis of the topography and of the stratigraphy west of the city wall should provide information about the former *wadi* course and probable counter-measures taken, like the construction of walls or dams for flood protection (cf. Fig. 22).

The position, course and dating of the double city wall are important for answering this question. It is presumed that the city wall in this area was a part of the flood protection system for the prehistoric city. Perhaps something like a natural storage basin existed in a depression ca. 300 m in front of the city wall. With these features in place flash floods could have been slowed down, perhaps reinforced by diversion walls and dams.

In order to gain information on subsurface geologic structures, two geoelectrical profiles were carried out perpendicularly across the *wadi*. One profile with a length of 120 m in the central part of the *wadi* was located just west of the double city wall, while the other was about 1 km further west, with a total length of 320 m (locations cf. Fig. 22).

Figs. 23 and 24 show the resulting tomograms. The tomogram close to the ancient city wall (DUJ_01, Fig. 23) has a maximum penetration depth of about 15 to 20 m. A broad zone of light blue colour indicates very low resistivity values. This area continues from near the surface to depths of about 12 m below. Considering outcrops or rather drillings,[38] this could indicate fractured and weathered hard rock layers consisting of moist claystones and siltstones, perhaps with intercalated porous sandstone layers of higher permeability.

The tomogram DUJ_02 is shown in Fig. 24. A maximum depth of about 40 m was attained. The northern bank of the *wadi* is indicated by high resistivity values (red and purple colours showing dry, compact hard rock). Again, in the central part of the *wadi* (at profile meter 200 to 300) a zone with very low resistivity occurs. This zone could correlate with fractured and weathered moist claystones, siltstones and porous, water saturated sandstone layers.

Further investigations are necessary to evaluate possible flood protection measures as well as probable former *wadi* courses.

5 Qurayyah

5.1 General setting of the oasis

Qurayyah is located in the northwestern part of Tabuk province some 280 km northwest of Taymāʿ,[39] in an arid climate zone with an annual precipitation of about 50 mm a^{-1} (cf. Fig. 1). Nevertheless, at Qurayyah there are several structures that indicate an extensive water management system, operated throughout a long period in the past. There is no modern settlement built over the ancient remains. Thus, Qurayyah seems to be very suitable for further investigations. The site of Qurayyah is dominated by the so-called Qurayyah Rock, a massive formation of silt- and claystone with an area of 26 ha. The singular standing Qurayyah Rock

[38] Drillings at this spot were performed by a team of Prof. Brückner (University of Cologne, Institute of Geography) in spring 2007. They reached bedrock only after several meters.

[39] Location of Qurayyah is approx. E 207564; N 3187772 (UTM 37N, WGS84).

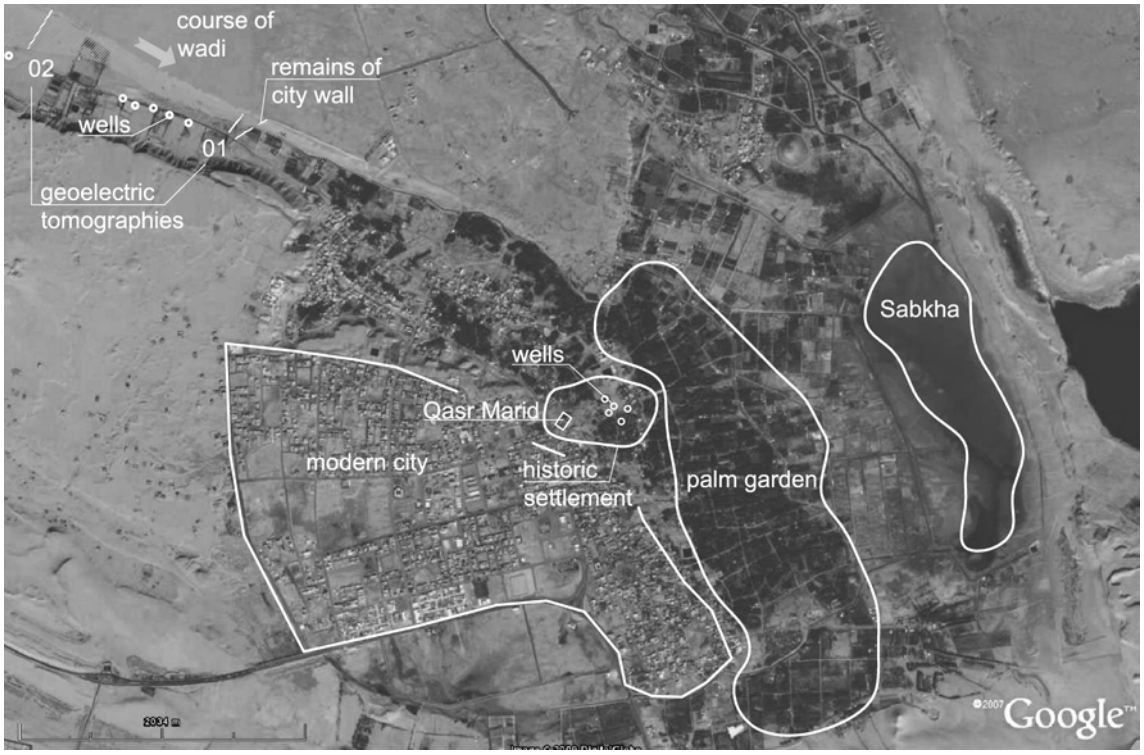


Fig. 22 *Spatial units of Dumat al-Jandal (Quickbird 2, Digital Globe, Google Earth 2007).*

الشكل ٢٢الوحدات المكانية في دومة الجندل (Quickbird 2، Digital Globe، Google Earth 2007).

rises some 60 m over the surrounding plain (for most recent excavation results see Luciani – Alsaud 2018).

During a first survey of the hydrological system in 2008, by kind permission of the (then) Deputy Ministry of Antiquities and Museums, different structures were investigated in order to get an idea of the whole system and its interactions with the social life in the Qurayyah settlement. The dimensions of the hydrological and agricultural system are so large, that Qurayyah must have been a dominant city in the region, providing living space for hundreds to thousands of people. Also, in 2008 the focus was on a *qanat* system, reported by Parr *et al.* (1970), north of Qurayyah Rock. Furthermore, wells or springs used for irrigation in the fields north of Qurayyah Rock and flood protection measures in the surroundings of the settlement were examined.

During the second survey in 2009 investigations were concentrated on the hydrological system of Qurayyah Rock itself, in particular on a spring at the base of this rock mentioned by Ingraham *et al.* (1981, 72). Irrigated fields further north of the aforementioned ones and the courses of the *wadi*s were investigated with regard to flood protection for the settlement and the feasibility of their use for irrigation in case of flash floods. Fig. 25 shows a map of Qurayyah including the spatial allocation of all parts of the water management system. As one can see, several stretches of different wall sections could be found at Qurayyah. The function of each of these has yet to be clarified.

In 1980 a two-day reconnaissance (*cf.* Ingraham *et al.* 1981) was undertaken as part of the Saudi Arabian Comprehensive Survey Program. The results of these investigations confirm the observations made by Parr *et al.* (1970) of a Nabataean and Roman presence at Qurayyah from the late 1st millennium BCE up to the early centuries AD. Although these survey programs were mainly concerned with the temporal and spatial extent of archaeological remains in northwest Arabia, some achievements in hydrological and water-related aspects were made as well. Since 2015 a Saudi-Austrian expedition has been investigating the site (Luciani – Alsaud 2018).

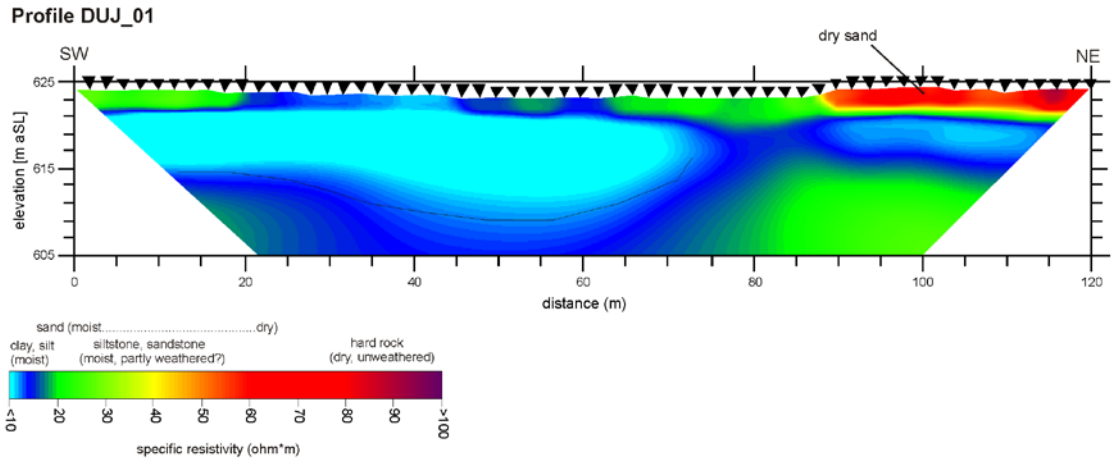


Fig. 23 *Dumat al-Jandal. Resistivity tomogram of Profile 01 (location* cf. *Fig. 22). Light blue colour indicates areas of very low resistivity, which are interpreted as fractured and weathered hardrock layers consisting of moist claystones and siltstones.*

الشكل ٢٣دومة الجندل. صورة طبقية للمقاومية في المقطع 01 (راجع الشكل ٢٢ لمشاهدة الموقع). يشير اللون الأزرق الفاتح إلى مناطق ذات مقاومية منخفضة جداً و التي تفسّر كطبقات صخور صلبة متفتتة و مجوّاة و تتكون من صخور غرينية و غضارية رطبة.

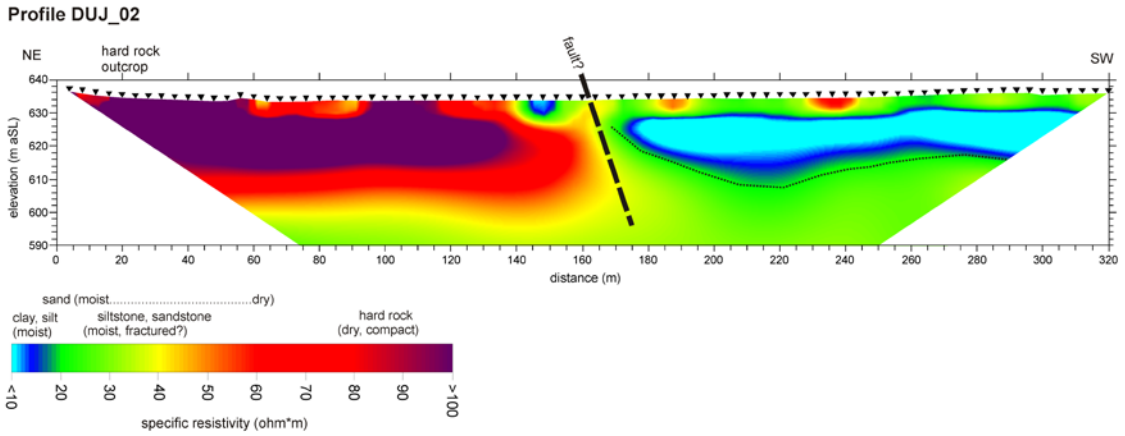


Fig. 24 *Dumat al-Jandal. Resistivity tomogram of Profile 02 (location* cf. *Fig. 22). The northern boundary of the* wadi *is indicated by high resistivity values (red und purple colours; dry, compact hard rock). Again, a very low resistivity layer occurs in the central part of the* wadi *(from about 180 m to 300 m). This zone probably correlates with moist clay and silt layers, with the possibility of intercalated fine sand layers of high permeability.*

الشكل ٢٤دومة الجندل. صورة طبقية للمقاومية في المقطع 02 (راجع الشكل ٢٢ لمشاهدة الموقع). تشير قيم المقاومية العالية (الألوان الحمراء و الأرجوانية؛ صخر صلب جاف و متضام) إلى الحد الشمالي للوادي. مرة أخرى تظهر طبقة ذات مقاومية منخفضة جداً في الجزء المركزي من الوادي (من حوالي ١٨٠ م و حتى ٣٠٠ م). من المحتمل ارتباط هذه المنطقة مع طبقات الغرين و الغضار الرطبة مع إمكانية وجود طبقات مقحمة من الرمل الناعم ذي النفاذية العالية.

5.2 Presumed *qanat* system

The location of the presumed *qanat* system identified by Parr *et al.* (1970) is approx. 200 m north of Wall A (cf. Fig. 25). About 20 round pits, each with a diameter of about 8 to 10 m and a distance of about 10 to 15 m to each other, are arranged in two chains forming a ‘Y’. These pits are shallow and have a depth of about 0.5 m (Fig. 26a). They are surrounded by brownish gravel, which seems to have a smooth and rounded shape in comparison to the gravel close by (Fig. 26b). The smooth surface of the gravel was probably caused by water or sand erosion.

A geoelectric profile (QQ_1, cf. Fig. 27) running from north to south over the presumed *qanat* was recorded, in order to obtain information about subsurface structures. The resulting tomogram shows predominantly medium to high resistivity values, indicating dry subsurface conditions. No vertical, funnel- or canal-like structures of low resistivity values are visible. Thus, there is no evidence for upwelling ground water from deeper zones in this section. However, in the area of the presumed *qanat* structure (profile meter 70 to 105), starting about 4 m below the surface and with a thickness of approx. 5 m, a zone of slightly lower resistivities (green colours) as compared to the surroundings appears. This zone could indicate some moist or more silty material.

For several reasons it is very likely that the identified structures are not a *qanat* system.

- The distance of 10 to 15 m between the single pits is too small. The average distance between the shafts of a *qanat* is normally about 20 to 200 m.[40]
- *Qanat*s drain the ground water down to a point of concentration. Even with a very gentle slope, there is no significant slope on the surface that could make the *qanat* outlet near the identified fields possible.
- The geoelectric tomogram QQ_1 (Fig. 27) shows no vertical, funnel- or canal-like structures of low resistivity values, as could be observed at locations of identified wells or springs at Taymāʾ.
- No larger stones used for the construction or repair of the shafts were found in the vicinity. Some indications of repairing the shaft are to be expected like those, for instance, in the *qanat*s of al-ʻUla (Nasif 1983).
- The chains of the visible pits end abruptly at every single leg of the Y-shaped structure. Normally the shafts of *qanat*s can be seen over a distance of several kilometres, even if they have been abandoned for a long time.
- *Qanat*s normally issue next to a mountainous region with a higher aquifer often several kilometres from the outlet. Because there is no indication of further shafts in line with the visible ones the identification of this feature as a *qanat* is unlikely.

Therefore, the hypothesis of abandoned *qanat*s in the vicinity of Qurayyah must be rejected. Also the theory that the pits are the remains of wells is unlikely, because there is no reason to dig that number of wells if a rich aquifer is presumed. It seems more likely that these pits are the remains of some kind of open-pit mining for obtaining clay for pottery production. Finally, the neigbouring *wadi* situated in a flood plain may have promoted the deposition of clay and silt in this area. Further investigations, e.g. a prospective drilling, are necessary to test this hypothesis.

5.3 The presumed ditch

In the alignment of Wall A Parr *et al.* (1970) suggested the existence of a ditch, which could transfer water from Qurayyah Rock to Fields A further north (cf. Fig. 25). For topographical reasons and because of the exceptional shape of the ‘ditch’, this hypothesis must be rejected. Although today there is a *wadi* in the northeastern alignment, there is no indication that the ditch was ever used or even built for the purpose of conducting water. Today the aforementioned branch of a *wadi* in the alignment of the ‘ditch’ is fed by another one coming from the east, transecting Wall A between Qurayyah Rock and the Nabataean settlement and afterwards circling the same on the western side.

As Fig. 28 shows, the banks of the ditch are very irregular in shape and seem to possess several singular pits, which overlap one another. This would be abnormal for a ditch built for water

[40] This average distance of the shafts of a *qanat* could be observed at systems in Iran, Morocco or Jordan. Normally the distance between shafts is greater than 20 m, but smaller than 200 m, depending on the depth of the *qanat* bottom below surface.

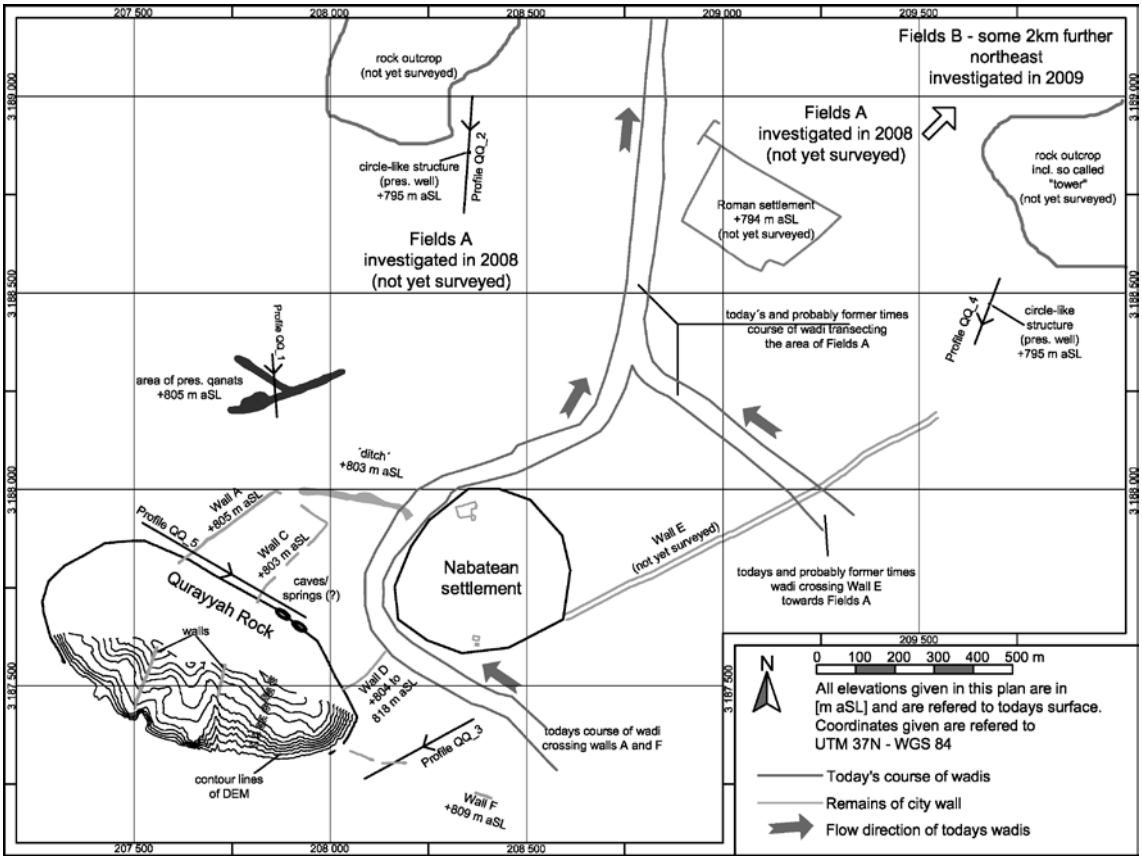


Fig. 25 *Map of Qurayyah showing the spatial distribution of several structures.*

الشكل ٢٥خريطة لقريّة تظهر التوزع المكاني لعدة بنى.

conveyance. It seems more likely that the ditch, like the presumed *qanat*s, are the remains of a ancient mining site for clay. This hypothesis is supported by the rounded gravel that surrounds the pits of the ditch although the grain size of the gravel is larger than that found next to the presumed *qanat*s. It should be noted that this kind of rounded gravel, found next to the *qanat*s as well as next to the ditch, differs from the common soil at Qurayyah. Typical grain sizes on Qurayyah's ground surface are smaller. Surprisingly, the biggest grain size was found at the top edge of the ditch's banks. Normal erosion would have caused quite a different distribution of grain size. This is a strong indication that the ditch was artificial, although its function is unclear.

5.4 Area between walls A, C, D, E and F (north of Qurayyah Rock)

The area between the Qurayyah Rock and the Nabataean settlement is divided into separate zones by walls A, C, D, E and F (Fig. 25). It is presumed that these zones were partly used as agricultural farmland. The irrigation of these fields was perhaps promoted by surface and/or infiltration water issuing from Qurayyah Rock. Under present-day climatic conditions, with no rainfall for years, the water volume seems insufficient for irrigation, whereas it may have been sufficient during more humid periods in the mid-Holocene.

In order to examine the possibility of upwelling ground water at the northern base of Qurayyah Rock, a geoelectrical profile was recorded (Fig. 29). Additionally, a short profile was measured at the vertical outcrop of some claystone layers at the northern base of Qurayyah Rock in order to evaluate the resistivities of the local claystone *in situ* (cf. Fig. 29, lower right). An average

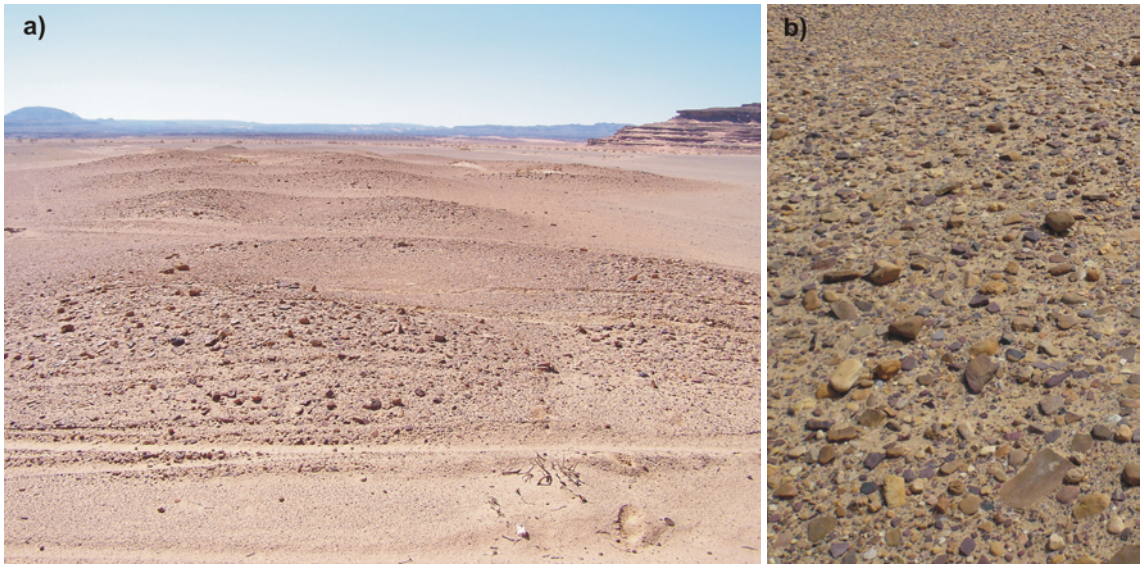


Fig. 26 *a) The presumed* qanat *system consists of approx. 20 round pits with a diameter of about 8 to 10 m and located at a distance of about 10 to 15 m from each other. They are arranged in two chains in the shape of a Y. The depth of the pits is shallow. b) They are surrounded by brownish, rounded gravel.*

الشكل ٢٦ a) يتألف نظام الفلج من ٢٠ حفرة دائرية تقريباً مع قطر يتراوح بين ٨ إلى ١٠ أمتار و تتباعد فيما بينها بمسافة ١٠إلى ١٥ م. تنتظم هذه الحفر في سلسلتين على شكل Y و عمقها ضحل. b) إن الحفر محاطة بحصى مستديرة بنيّة اللون.

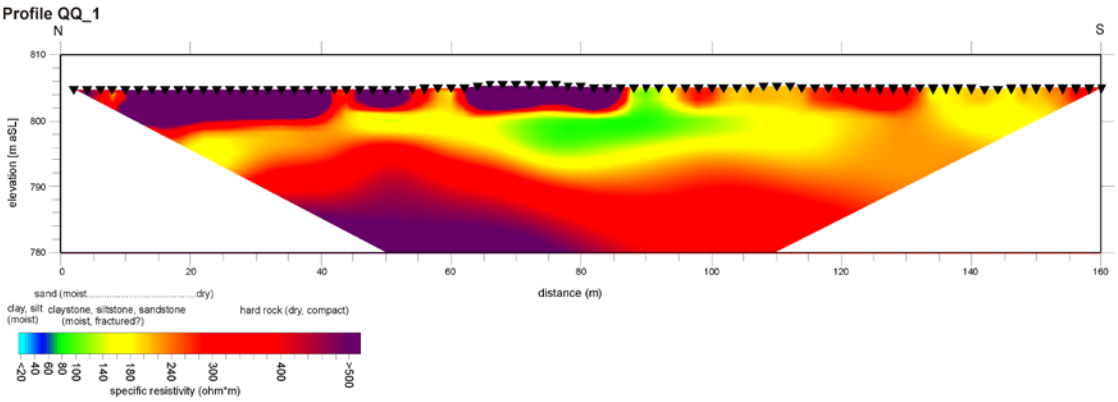


Fig. 27 *Tomogram QQ_1 shows predominantly medium to high resistivity values, indicating dry subsurface conditions. There are no vertical, canal-like structures of low resistivity values ranging to greater depths. Thus, there is no evidence for the up-flow of ground water from deeper subsurface zones in this profile.*

الشكل ٢٧تظهر الصورة الطبقية QQ_1 قيم مقاومية متوسطة إلى عالية في الغالب و مشيرة بذلك إلى ظروف جافة تحت سطح الأرض. لا توجد بنى عمودية شبيهة بقناة ذات قيم مقاومية منخفضة وتصل إلى عمق كبير. بالتالي لا يوجد في هذا المقطع أي دليل على وجود تدفق للمياه الجوفية من مناطق عميقة تحت سطح الأرض.

resistivity of about 90 Ωm for the claystone layers was obtained. It can be assumed that this claystone contains no free water or that existing water is bound by clay minerals.

In profile QQ_5 (Fig. 29) the resistivity values increase from the northwest to the southeast in distance as well as in depth. Most parts of the profile show medium to high resistivities. The values are within the range of the investigated claystone layer or higher. However, at the northwestern edge of the profile low resistivities of about 50 to 70 Ωm occur, comparable to low resistivities at the southern edge of profile QQ_2 (Fig. 31a). As this low resistivity zone lies at the edge of the profile QQ_5, no clear indications concerning the shape and maximum depth of this zone can be obtained. In accordance with the interpretation of the results from tomogram QQ_2 (Fig. 31a) and

with the additional results from the *in situ* measurements (Fig. 29, lower right), this subsurface low resistivity zone is interpreted as partly fractured clay- and siltstones with moist fissures and cracks. In principle, it seems possible that some ground water was available there in former times, although there are no indications of a well or a spring on the surface today. Nevertheless, the water flow might have been very limited due to low permeability of the subsurface's muddy and silty material.

Ingraham *et al.* (1981, 72) suggested that caves located at the northern base of Qurayyah Rock are springs. The water from these springs could have been led via Wall C towards Fields A north of the Nabataean settlement. The examination of the caves did not find clear evidence for the presence of a spring in former times. A natural origin of the caves cannot be excluded. Further investigations are necessary on this topic.

Nevertheless, on top of Wall C remains of a possible canal were found (Fig. 30a). Perhaps the water for charging this canal was obtained trom the water that trickled through the cracks of Qurayyah Rock. Alternatively, the remains on top of Wall C could be interpreted as the remains of a double-faced wall. Archaeological investigation of these structures is desirable.

Following another hypothesis, the water from the rock could have been drained via Wall D into the settlement to supply the population. However, the absence of any canal-like structures on top of this wall contradicts this hypothesis (Fig. 30b).

At present there is no indication of temporal storage units (cisterns, reservoirs) for storing rain water in the Nabataean settlement. Therefore, another system for conducting water (such as canals or aqueducts) or of a constant supply of water (wells or springs) is rather likely. Nevertheless, neither the Nabataean nor the Roman settlements have been the focus of hydrological investigations yet.

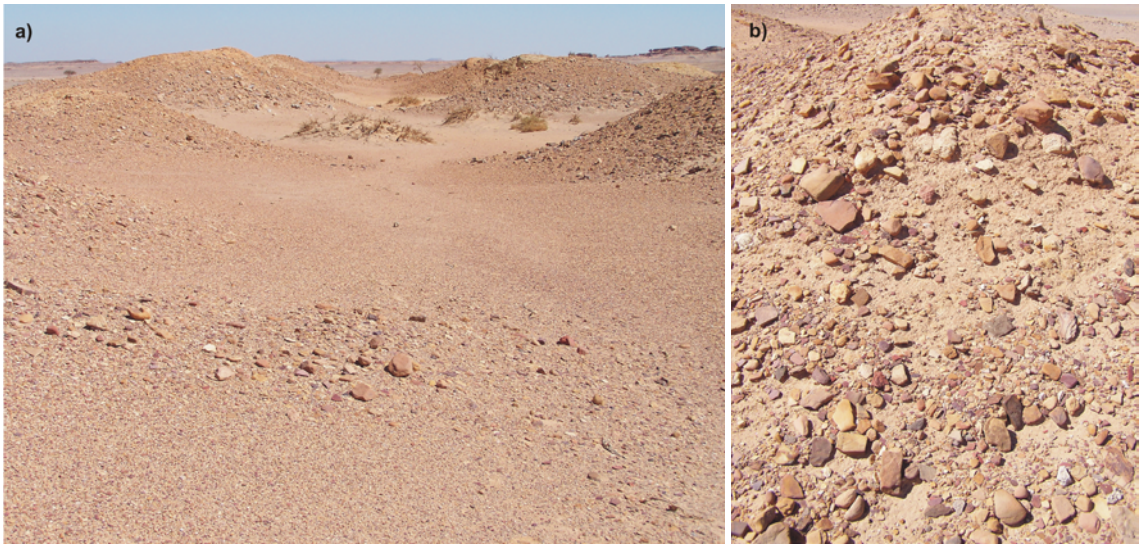


Fig. 28 *The presumed ditch. a) It has very irregular banks, which are unlikely for an artificial canal. Recognizable are several pits that overlap each other. b) The pits are surrounded by gravel with a bigger grain-size than the gravel found next to the presumed qanats. This kind of gravel is not typical for the normal Qurayyah surface.*

الشكل ٢٨الخندق المفترض. a) لديه حواف غير منتظمة بشكل كبير و التي من غير المرجح أن تعود لقناة اصطناعية. من الملاحظ وجود عدة حفر تتداخل بيعضها البعض. b) الحفر محاطة بحصى أكبر حجماً من الحصى التي اكتشفت بجانب الفلج المفترض و هذا النوع من الحصى ليس تقليدياً بالنسبة إلى سطح الأرض في قريّة.

5.5 Irrigation system of Fields A

Situated north of Qurayyah Rock are at least two larger agricultural areas, which needed a systematic irrigation network to be supplied with sufficient water (Fields A and B, location cf. Fig. 25). The whole agricultural area had a size of ca. 2 to 3 km². The investigations performed in 2008 focussed on the agricultural area located about 1 km north of the settlement (Fields A). Several circular structures (wells?), dams and canals were identified, although the relationship between the different structures is not clarified yet. In the centre of this agricultural field a cistern and buildings were identified. They probably date to the Roman era.

The agricultural area is divided by several dams into smaller units and supplied by canals with water. Three geoelectrical profiles were recorded looking for a local source of water. Profile QQ_2 (Fig. 31a) was located in the northwest and profile QQ_3 (Fig. 31b) in the east of this agri-cultural area, while profile QQ_4 (Fig. 31c) is located very close to Qurayyah Rock and the settlement (the locations of all profiles are shown in Fig. 25).

The tomogram of profile QQ_2 (Fig. 31a) shows a zone of low resistivity values at its southern edge, followed by medium resistivity towards its centre. It is suggested that at the profile centre partly fractured, (perhaps moist) clay-, silt- and fine sandstones compose the subsurface. The lower resistivity in the south might correlate with moist fissures and cracks, or a higher water content within the pore volume of the sedimentary rocks. Ground water close to the surface might have been available there in former times. This hypothesis has to be carefully tested by further investigations.

The two eastern profiles (Figs. 31b and 31c) up to 40 m below the surface yielded continuous high to very high resistivity values, indicating dry hard rock. At these locations today there are neither indications of ground water in the subsurface nor of fractured structures allowing the upwelling of ground water from deeper zones. Thus, rising water from deeper zones at these sections in antiquity seems unlikely. If these areas were used for agriculture, irrigation must have been carried out, preferably with surface water.

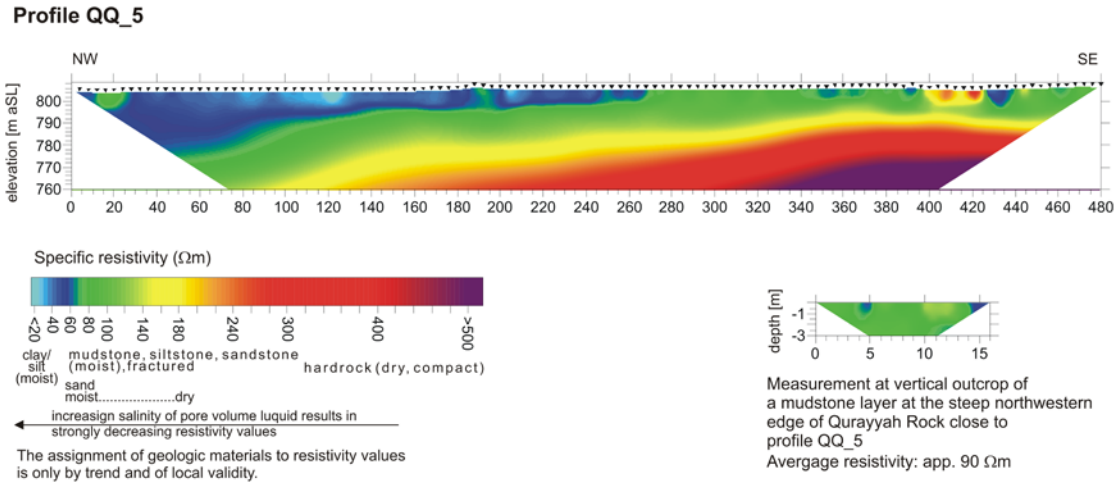


Fig. 29 *Tomogram QQ_5 shows predominantly medium to high resistivity values in the range of the investigated claystone layer and higher. Lower resistivity values at the northwestern edge of the tomogram could be interpreted in accordance with tomogram QQ_2 (Fig. 31a) as partly fractured clay- or siltstones with moist fissures and cracks. Shown in the lower right of the figure are the resistivity values of a vertical outcrop performed in mudstone at the northwestern base of Qurayyah Rock.*

الشكل ٢٩تظهر الصورة الطبقية QQ_5 قيم مقاومية متوسطة إلى عالية في الغالب و ذلك ضمن نطاق طبقات الحجر الغضاري قيد الدراسة و ما فوقها. يمكن تفسير قيم المقاومية الأخفض عند الحافة الشمالية الغربية للصورة الطبقية بالتوافق مع الصورة الطبقية QQ_2 (الشكل ٣١a) كحجارة غضارية و غرينية متفتتة جزئياً مع شقوق و تصدعات رطبة. تظهر في أسفل يمين الشكل قيم المقاومية العائدة لبروز عمودي من الحجر الطيني عند القاعدة الشمالية الغربية لصخرة قريّة.

Fig. 30 *a) Presumed canal on top of Wall C with two faces on each side (view towards the south). b) Wall D. There is no indication of any canal-like structure on top of this wall, which could provide transportation of water from the rock into the settlement (view towards the north).*

الشكل ٣٠ a) قناة مفترضة على قمة السور C مع وجهين من كل جانب (منظر باتجاه الجنوب). b) السور D. لا يوجد دليل على وجود أي بنية شبيهة بقناة على قمة هذا السور و التي يمكن أن توفّر نقل المياه من الصخرة إلى المستوطنة (منظر باتجاه الشمال).

In this context it should be pointed out that recently (and probably also in former times) a *wadi* crosses this agricultural area from south to north. Regarding the higher density of sherds in the vicinity of the settlement compared to agriculture areas further away, Ingraham *et al.* (1981, 73) suggested that these were transported by periodic flash-floods. Because sherds can be found even now in the higher lying fields, there must have been diversion dams to retain flash floods for irrigation purposes. However, no structural evidence (remains of diversion dams or similar relicts) supporting this thesis has been found yet. Due to the topographical situation irrigating the fields with periodic (annual) flash floods is conceivable. Because there is no evidence for a local, constant water source, irrigation by means of surface water is likely. To prove this thesis, further survey of the surface and exploration of the water distribution system (canals) is required.

5.6 Irrigation system of Fields B

During our reconaissance in 2009 a second large agricultural area about 3 km northeast of Qurayyah Rock was examined (Fields B in Fig. 25). In this area the irrigation canals and field boundaries are even better preserved than in the aforementioned Fields A (Fig. 32).

Although there is a large number of canals, the water source for these fields is unclear. Wall M, as suggested by Parr *et al*. (1970), could have been a diversion dam (cf. Fig. 33). Moreover, the topographic situation today seems to support this theory. Further investigations, in particular a survey of the surface and detailed exploration of the structures, are necessary.

5.7 Flood endangerment and flood protection

The main direction of surface runoff is, in accordance with topography, from south to north. Faced with the hazard of flash floods the Qurayyah settlement was protected by several walls and dams.

On the western part of the settlement Parr *et al.* (1970) suggested Wall A protected the residential area against a *wadi* running along this wall towards Field A. Because of the present (and probably former) topographic situation, this theory should be rejected. The main *wadi* a few hundred meters west of Qurayyah Rock seems to be much lower in elevation than this area, so there was no need for any protection in this context. Parr *et al.* also suggested that the 'ditch' was a kind of alignment of the *wadi* to concentrate the runoff water for irrigation. Because the 'ditch' apparently never was a canal (see above), this is another reason for rejecting this hypothesis. It is more likely that Walls A and C enclosed an agricultural area fed by runoff from Qurayyah Rock. Due to clayey and silty soil, agriculture by means of rain water harvesting methods could have been possible. Walls A and C were probably never intended for flood protection.

Further, Ingraham *et al.* (1981, 72) suggested that the settlement was protected by Wall F and, approx. 1 to 2 km farther south, by a dam bordering the banks of today's main *wadi*. But only one of the structures identified by them as a 'line of stones (remains of dam)' could actually be confirmed as the remains of a dam. This probable dam prevented the whole valley, including the settlement and the agricultural fields to the north of the settlement, from being flooded.

In the eastern part of the settlement surface runoff was primarily deflected by Wall F. Because this structure today is in very poor condition, interpretation of Wall F without further investigations is hazardous. Ingraham *et al.* (1981, 73) suggested that the water was forced to circle two small hills in the eastern area before a targeted lead-in, which occured with Wall G. Actual investigations contradict this hypothesis. The present topographic situation as well as some structural features suggest a lead-in of runoff water in the range of Wall E, southwest of the aforementioned small hills (location see Fig. 25). Furthermore, a second lead-in of water further north, transecting Wall G, as mentioned by Ingraham *et al.,* seems possible, although there is no concrete evidence of this.[41]

Today there is another *wadi* with a small catchment between Wall E and F and close to Qurayyah Rock. It transects Wall D south of the Nabataean settlement, circles the settlement and drains into the water canal suggested by Ingraham *et al.,* before passing Fields A in a northerly direction.

5.8 Qurayyah Rock in hydrologic perspective

During the 2009 season the survey and investigation of possible hydrological installations (dams, cisterns) on top of Qurayyah Rock were intensified. The top of the hill (approx. 860 m a.s.l.) looms about 60 m above the surrounding plain. The cliffs on either side are mainly vertical with different stages of broken-down banks.

The surface of Qurayyah Rock consists of nearly impermeable claystone. Precipitation is mainly drained by surface runoff. Little erosion pathways indicate how the water concentrates on the surface with steep slope (Fig. 34a). Most of it ends up in gaps or cracks at the edge of the rock (Fig. 34b). Here the water infiltrates into the rock and presumably emerges at the base of the rock as spring.

The volume of infiltrated water depends on precipitation rates, catchment area and runoff-infiltration-evaporation ratio for certain rainfall events. Therefore, the yield and the duration of

[41] Wall G is not represented in Fig. 25. For the location see Ingraham *et al.* 1981, Pl. 69.

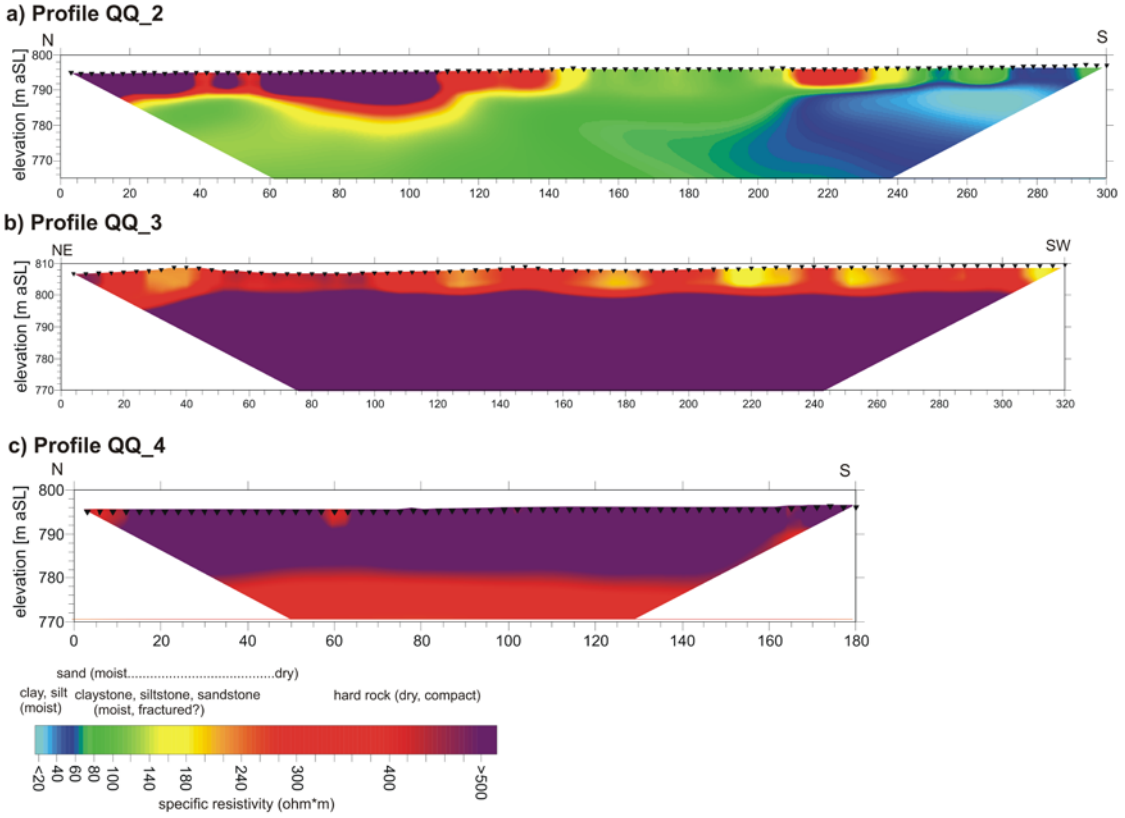


Fig. 31 *a) In the northern part of tomogram QQ_2 high resistivity values can be observed that are close to the surface, indicating dry, hard, rock material. In greater depth zones and also in the centre of the profile mostly medium resistivities (green colour) occur, indicating probable moist, fractured clay- and siltstones. In the most southern part of the profile occur low to very low resistivity values. b) Tomogram QQ_3 shows high resistivity values over nearly the entire section. Rising water from deeper zones in this area is rather unlikely. c) Tomogram QQ_4 shows high resistivity values over nearly the entire section, too. Again, rising water from deeper zones in this area is rather unlikely.*

الشكل ٣١ a) يمكن ملاحظة قيم مقاومية عالية قريبة من سطح الأرض في الجزء الشمالي من الصورة الطبقية QQ_2 و هي تدلّ على وجود مادة صخرية جافة و صلبة. تظهر قيم مقاوميات متوسطة في الغالب (اللون الأخضر) في المناطق الأعمق و كذلك في مركز المقطع مشيرةً إلى وجود محتمل لأحجار غضارية و غرينية مفتتة و رطبة. تظهر قيم مقاوميات منخفضة إلى منخفضة جداً في معظم القسم الجنوبي من المقطع. b) تظهر الصورة الطبقية QQ_3 قيم مقاومية عالية تشمل تقريباً كامل المقطع. من غير المرجح وجود ارتفاع للمياه من مناطق أعمق في هذا النطاق. c) تظهر الصورة الطبقية QQ_4 قيم مقاومية عالية تشمل تقريباً كامل المقطع، و هنا أيضاً لا يرجّح وجود ارتفاع للمياه من مناطق أعمق في هذا النطاق.

presumed sources at the base of Qurayyah Rock can hardly be estimated. Nevertheless, it seems likely that a spring at the base of Qurayyah Rock only supplied water for a limited period of time after a rainfall event.

Except for the well-known walls transecting the very top of the hill and some graves no further structures (e.g. cisterns) could be found. At the fringes of the hill runoff water concentrates in several small canyons. Although the storage of water in cisterns with the aid of small dams at these sites would have been possible, no remains indicating such structures were identified. Qurayyah Rock therefore seems to have played a secondary role in the water management system of ancient Qurayyah. Hence, any settlement on top of Qurayyah Rock seems unlikely. If such did exist, then only small communities would have settled on top of the hill, and the water required by the inhabitants would have had to have been carried up the steep banks.

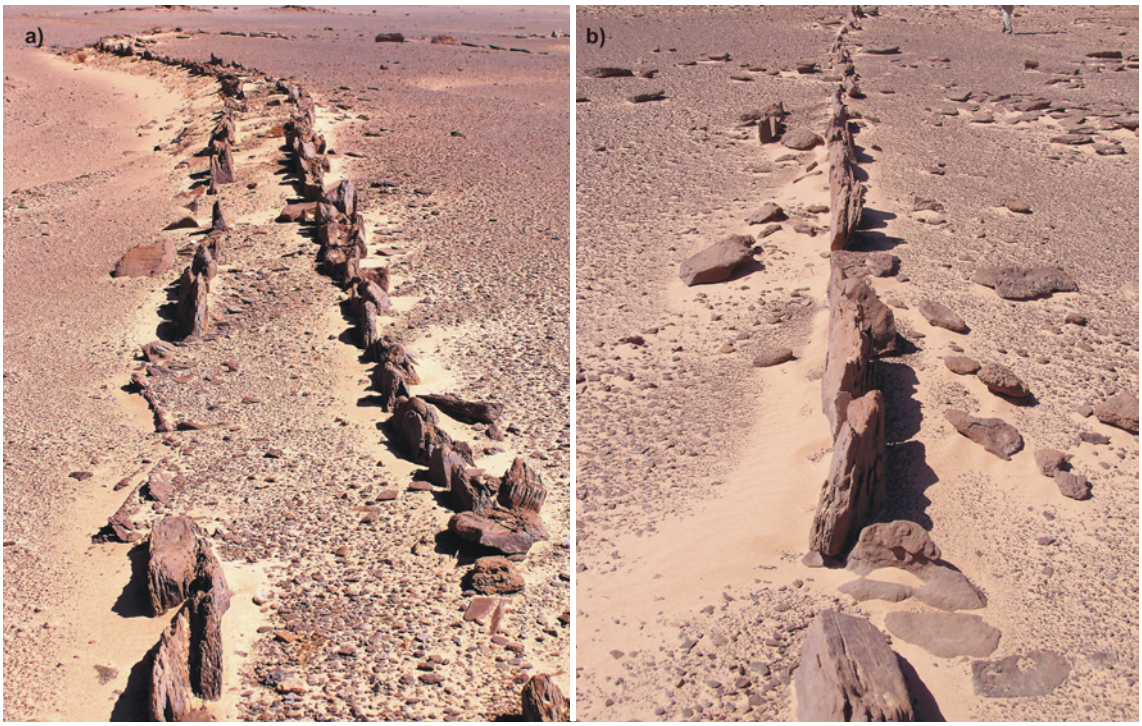


Fig. 32 *Components of the irrigation field network about 3 km northeast of the Qurayyah Rock (Fields B). a) Remains of the water distribution system with visible faces on each side of the canal. b) Field boundary of the agricultural area.*

الشكل ٣٢مكوّنات شبكة ريّ للحقول على بعد حوالي ٣ كم إلى الشمال الشرقي من صخرة قريّة (الحقول B). a) بقايا نظام توزيع للمياه مع وجوه واضحة على كل جانب من القناة. b) حدود الحقل التابع للمنطقة الزراعية.

Fig. 33 *Situated between two rock formations with a total length of about 80 m, Wall M is supposed to be the relict of a diversion dam, which retained water for irrigation purposes in agricultural area B.*

الشكل ٣٣السور M البالغ طوله حوالي ٨٠ م و الواقع بين تشكيلين صخريين، من المفترض أن يكون هذا السور من بقايا سد تحويلي كان يُستخدم لاحتجاز المياه لأغراض الريّ في المنطقة الزراعية B.

6 Conclusion

The oases of Taymāʾ, Dumat al-Jandal and Qurayyah have been investigated hydrologically. The main focus of the investigations was on Taymāʾ and its *sabkha*. Of particular interest was the environmental setting during the development of the very first oasis cultures and how these communities dealt with limited water resources.

Solving the water balance equation for the *sabkha* of Taymāʾ provided indications of a more humid climate, perhaps affected by monsoons, during the Holocene (approx. 8.4 to 5.4 ka BP), although the environment was also arid or at least semi-arid at that time. The result fits quite well with the presumed minor lake period identified in the an-Nafud desert by Schulz and Whitney (1986; cf. also Staubwasser – Weiss 2006). Due to supraregional climate shifts over the last ca. 6,000 years, not only annual precipitation rates but also reliable rainfall periods probably finally vanished. It is most likely that with less rainfall the yield as well as the number of ground water sources decreased.

According to Gebel and Mahasneh this change in the supraregional water balance probably led to the transition from pastoral well cultures to the beginnings of oasis cultures on the Arabian peninsula in the early 4th millennium BCE. Thus, this changeover should be linked to the so-called 5,200 cal BP drought event, proposed by Staubwasser and Weiss (2006; cf. Gebel – Mahasneh 2012).

At Taymāʾ the development of the *sabkha* is strongly connected to the growth of the settlement. Decreasing water levels in the salty lake during the mid- to late Holocene possibly promoted agriculture in the present-day palm garden. It is conceivable that agricultural development was triggered not only by the fertility of the area exposed by decreasing water levels, but also by the interaction of ground water and surface water at the margin of the *sabkha*. Parallels can obviously be drawn to the *sabkha* at Dumat al-Jandal, which probably had similar preconditions.

Today the investigated area is hyperarid with annual precipitation rates of less than 50 mm a-1. Consequently, the ground water-table has fallen and most wells are dessicated. In addition, this decline is exacerbated by motor driven pumps which convey more draw water than is naturally recharged.

Of course, the water source of a settlement ought to be reliable all-year-long. Natural water sources are aquifers, which can feed wells and springs, or surface runoff, which can be stored before usage. If these sources are not dependable or sufficient, greater reliability can be achieved by means of temporary or local transfer of water (Fahlbusch 2004a).

Since neither Taymāʾ nor Dumat al-Jandal exhibit systems for transfer (e.g. canals, aqueducts or cisterns) and because of rich aquifers at both oases, water provisioning seems to have relied mainly on ground water. Nevertheless, the utilization of surface runoff by means of check or diversion dams probably supplemented the available amount of water in times of rainfall. Like Taymāʾ and Dumat al-Jandal, the water supply of al-ʻUla (120 km southeast of Taymāʾ) probably also depended on both water sources. Ground water was obtained by means of *qanat*s and conveyed to the settlement as well as to the farmland (Nasif 1983). Additionally, the location of the agricultural area on both sides of a *wadi* suggests the use of surface runoff by means of simple diversion dams and gravity canals.

At Qurayyah no indication of such a ground water-based basis of water provision has been noted so far. Therefore, the supply of water there was probably based mainly on rain water harvesting methods and temporal transfer (for instance in cisterns). Furthermore, Qurayyah's dependency on reliable rainfall events is underlined by a large number of canals and diversion dams on both sides of today's main *wadi*. It seems rather unlikely that such a large area was irrigated only by means of ground water sources. Unlike Qurayyah, which depended only on reliable surface runoff, the communities of a late Chalcolithic to Early Bronze Age settlement at Tall Hujayrat al-Ghuzlan depended primarily on reliable ground water sources. As proposed by Heemeier *et al.* (2009, 271)

Fig. 34 *The surface of Qurayyah Rock is almost impermeable. Storm water is mainly drained by surface runoff. a) Small erosion paths (or small canyons?/gullies?) indicate how the water is concentrated on a surface with steep slope. b) Most of the runoff ends up in gaps or cracks at the edge of the rock.*

الشكل ٣٤إن سطح صخرة قريّة كتيم تقريباً لذلك يتم تصريف مياه الأمطار بشكل رئيسي عن طريق الجريان السطحي. a) مسارات تآكل صغيرة (أو أخاديد صغيرة؟) تدلّ على كيفية تركّز المياه على سطحٍ ذي انحدار حاد. b) تنتهي أغلب المجاري السطحية في فجوات أو شقوق على حافة الصخرة.

the abandonment of the settlement can perhaps be linked to an earthquake. Thus, the hydrogeological setting of Tall Hujayrat al-Ghuzlan, which is comparable to Taymāʾ, changed and the yield of the artesian ground water sources vanished. Consequently, the settlement had no reliable water source and ultimately was abandoned. Also the abandonment of Qulban Beni Murra, for which water provision by means of ground water is most likely, could be linked to a decreasing ground water level perhaps during the 5,200 cal BP drought event (see above).

With the weakening or even the absence of reliable rainfall events in an increasingly more arid environment, only the ground water-based oases were able to endure as long as these ground water sources sufficed. Perhaps this is a reason for the decline of Qurayyah, Qulban Beni Murra and the settlement at Tall Hujayrat al-Ghuzlan, whereas Taymāʾ, Dumat al-Jandal and al-ʻUla have stood the test of time until today.

Acknowledgments

The project was funded by the German Research Foundation (DFG). The continuous support of the Orient-Department of the German Archaeological Institute (DAI) Berlin for its continuous support, here especially R. Eichmann, A. Hausleiter, A. Intilia, S. Lora among others are to be mentioned. We are also grateful to the Taymāʾ Museum for Archaeology and Ethnography, in particular to M. al-Najam, for the logistical support during the excavation campaigns.

Kai Wellbrock
Laboratory of Urban Water and
Waste Management,
University of Applied Sciences Lübeck
Mönkhofer Weg 239
23562 Lübeck
wellbrock@fh-luebeck.de

Benjamin Heemeier
Landratsamt Esslingen
Amt für Wasserwirtschaft und Bodenschutz
Pulverwiesen 11
73728 Esslingen
wasserwirtschaft@lra-es.de

Arno Patzelt
Terrana Geophysik
Zeppelinstr.15
72116 Mössingen
terrana@terrana-geophysik.de

Peter Voß
Vogelweide 4,
24111 Preetz,
peter.vosz@kystenjung.de

Patrick Keilholz
DHI WASY GmbH
Büro München
Rosenheimer Straße 143
81671 München, Germany
pak@dhigroup.com

Matthias Grottker
Laboratory of Urban Water and
Waste Management,
University of Applied Sciences Lübeck
Mönkhofer Weg 239
23562 Lübeck
grottker@fh-luebeck.de

References

Abu Duruk, H. I.
1986 Introduction to the Archaeology of Tayma, Riyadh.

Bar-Matthews, M. – Ayalon, A.
2011 Mid-Holocene climate variations revealed by high-resolution speleothem records from Soreq Cave, Israel and their correlation with cultural changes, The Holocene 21, 163–171.

Bawden, G. – Edenc, C. – Miller, R.
1980 Preliminary archaeological investigations at Tayma, Atlal - The journal of Saudi Arabian Archaeology 4, 69–106.

Bellwald, U.
2008 The hydraulic infrastructure of Petra – A model for water strategies in arid land, in: C. Ohlig (Ed.), Cura Aquarum in Jordania – Proceedings of the 13th International Conference on the History of Water Management and Hydraulic Engineering in the Mediterranean Region 2007 in Petra/Amman, Schriften der Deutschen Wasserhistorischen Gesellschaft 12, Siegburg, 47–94.

Brunner, U.
2004 The Great Dam of Ma´rib as a Part of the Hydraulic Culture of Southern Arabia, in: H.-D. Bienert – J. Häser (Eds.), Men of Dikes and Canals – The Archaeology of Water in the Middle East, Orient Archäologie 13, Rahden/Westfalen, 405–413.

Burns, S. J. – Matter, A. – Mangini, A. – Mudelsee, M.
1998 The history of the monsoon in southern Arabia: results based on stable isotopes and U/Th dating of speleothems. Proceedings to the Goldschmidt Conference, Toulouse, 1998, Mineralogical Magazine 62A, 261–262.

Charloux, G. – Loreto, R.
2014 Dûma 1. 2010 Report of the Saudi-Italian-French Archaeological Project at Dûmat al-Jandal, Riyadh.
2016 Dûma 2. The 2011 Report of the Saudi-Italian-French Archaeological Project at Dûmat al-Jandal, Riyadh.

Claussen, M. – Kubatzki, C. – Brovkin, V. – Ganopolski, A. – Hoelzmann, P. – Pachur, H.-J.
1999 Simulation of an abrupt change in Saharan vegetation in the mid-Holocene, Geophysical Research Letters 26(14), 2037–2040.

Dinies, M. – Plessen, B. – Neef, R. – Kürschner, H.
2015 When the desert was green: Grassland expansion during the early Holocene in northwestern Arabia, Quaternary International 382, 293–302.

Edgell, H. J.
1987 Geological framework of Saudi Arabia. Groundwater resources, Journal of Earthsciences 3, 267–285.

Eichmann, R. – Schaudig, H. – Hausleiter, A.
2006a Archaeology and Epigraphy at Tayma (Saudi Arabia), Arabian Archaeology and Epigraphy 17, 163–176.

Eichmann, R. – Hausleiter, A. – M. al-Najam, M. – al-Said, S.
2006b Tayma – Spring 2004 Report on the Joint Saudi Arabian-German archaeological project, Atlal - The journal of Saudi Arabian Archaeology 19, 91–116.

Eichmann, R. – Hausleiter, A. – al-Najam, M. H. – al-Said, S. F.
2010 Tayma – Autumn 2004 and Spring 2005 – 2nd Report on the Joint Saudi-Arabian-German archaeological project. Atlal - The journal of Saudi Arabian Archaeology 20, 101–147.

Eichmann, R. – Hausleiter, A. – al-Najam, M. – al-Said, S. F.
2011 Tayma – Autumn 2005 and 2006 (Spring and Autumn) – 3rd Report on the Joint Saudi Arabian-German Archaeological Project, Atlal - The journal of Saudi Arabian Archaeology 21, 64–118.

Engel, M. – Brückner, H. – Bosch, J.
2011 Geoarchaeological research activities at Tayma, in: R. Eichmann – A. Hausleiter – M. H. al-Najem – S. F. al-Said (Eds.), Tayma - Autumn 2005 and 2006 (Spring and Autumn), 3rd Report on the Joint Saudi Arabian-German Archaeological Project, Atlal - The journal of Saudi Arabian Archaeology 21, 66–79.

Engel, M. – Brückner, H. – Pint, A. – Wellbrock, K.– Ginau, A. – Voss, P. – Grottker, M. – Klasen, N. – Frenzel, P.
2012 The early Holocene humid period in NW Saudi Arabia - evidence from sediments, micro-fossils and palaeo-hydrological modeling, Quaternary International 266, 131–141.

Engel, M. – Klasen, N. – Brückner, H. – Eichmann, R. – Hausleiter, A. – al-Najam, M. H. – al-Said, S. F. – Schneider, P. I.
2009 New age estimations for the western outer city wall of ancient Tayma (NW Saudi Arabia) based on OSL and radiocarbon data and geomorphologic evidence, Geophysical Research Abstracts 11, EGU2009-8313.

Enzel, Y. – Kushnir, Y. – Quade, J.
2015 The middle Holocene climatic records from Arabia: Reassessing lacustrine

environments, shift of ITCZ in Arabian Sea, and impacts of the southwest Indian and African monsoons, Global and Planetary Change 129, 69–91.

Engel, M. – Matter, A. – Parker, A. G. – Parton, A. – Petraglia, M. D. – Preston, G. W. – Preusser, F.
2017 Lakes or wetlands? A comment on 'The middle Holocene climatic records from Arabia: Reassessing lacustrine environments, shift of ITCZ in Arabian Sea, and impacts of the southwest Indian and African monsoons' by Enzel *et al.,* Global and Planetary Change, doi: 10.1016/j.gloplacha.2016.11.001

Enzel, Y. – Quade, J. – Kushnir, Y.
2017 Response to Engel *et al.* (in press): Lakes or wetlands? A comment on "The middle Holocene climatic records from Arabia: Reassessing lacustrine environments, shift of ITCZ in Arabian Sea, and impacts of the southwest Indian and African monsoons" by Enzel *et al.* (2015). In: Global and Planetary Change Vol. 148, 268–271, doi: 10.1016/j.gloplacha.2016.11.003 .

Fahlbusch, H.
2001 Ancient Dams in Saudi Arabia, in: H. Fahlbusch (Ed.), Historcial Dams, International Commission on Irrigation and Drainage (ICID), New Delhi, 243–272.
2004a Men of dikes and Canals, in: H.-D. Bienert – J. Häser (Eds.), Men of Dikes and Canals – The Archaeology of Water in the Middle East, Orient Archäologie 13, Rahden/Westfalen, 5–16.
2004b The Rehabilitation of the Al Hassa Oasis in Saudi Arabia, in: H.-D. Bienert – J. Häser (Eds.), Men of Dikes and Canals – The Archaeology of Water in the Middle East, Orient Archäologie 13, Rahden/Westfalen, 391–404.

Fahlbusch, H. (Ed.)
2001 Historical Dams, International Commission on Irrigation and Drainage, New Delhi.

FAO (Food and Agriculture Organization)
2000 Global map of monthly reference evapotranspiration - 30 arc minutes grid for the time period 1961–1990. Digital Map published 2000, provided at the FAO Geo Network server on Novemeber 21st 2009.
2004 Annual total precipitation data based on 0.167 degree resolution. Digital map published September 2004, provided at the FAO GeoNetwork server on Novemeber 21st 2009.

Fleitmann, D. – Burns, S. J. – Mudelsee, M. – Neff, U. – Kramers, J. – Mangini, A. – Matter, A.
2003 Holocene monsoon recorded in a stalagmite from southern Oman, Science 300, 1737–1739.

Fleitmann, D. – Matter, A. – Pint, J. J. – al-Shanti, M. A.
2004 The Speleothem record of climate change in Saudi Arabia. Saudi Geological Survey Open-file Report (SGS-OF-2004-08).

Fujii, S.
2007 Wadi Abu Tulaya and Wadi Ruweishid ash-Sharqi: An Investigation of PPNB Barrage Systems ind the Jafr Basin, Neo-Lithics 2/07, 6–17.

Garbrecht, G.
2004 Historische Wasserbauten in Ost-Anatolien – Königreich Urartu, 9.–7. Jh. v. Chr., in: C. Ohlig (Ed.), Wasserbauten im Königreich Urartu und weitere Beiträge zur Hydrotechnik in der Antike, Schriften der Deutschen Wasserhistorischen Gesellschaft 5, Siegburg, 1–103.

Gebel, H. G. K. – Mahasneh, H. M.
2012 Qulban Beni Murra - Unknown Mid-Holocene Sepulchral Green Desert Landscapes, Pastoral Well Cultures, and the Origins of Arabia's Oasis Economies, in: F. Klimscha – R. Eichmann – C. Schuler – H. Fahlbusch (Eds.), Wasserwirtschaftliche Innovationen im archäologischen Kontext - von den prähistorischen Anfängen bis zu den Metropolen der Antike, Forschungscluster 2. Innovationen technisch - sozial, Menschen - Kulturen - Traditionen, Forschungscluster des DAI 5, Rahden/Westfalen, 101–122.

Häser, J.
2004 Prehistoric Agricultural Water-Management on the Oman Pensinula, in: H.-D. Bienert – J. Häser (Eds.), Men of Dikes and Canals – The Archaeology of Water in the Middle East, Orient Archäologie 13, Rahden/Westfalen, 415–421.

Hausleiter, A.
2018 The outer wall of Taymāʾand its dating to the Bronze Age, in: in: L. Nehmé – A. al-Jallad (Eds.), To the Madbar and Back Again. Studies in the Languages, Archaeology, and Cultures of Arabia to Michael C. A. Macdonald, Studies in Semitic Languages and Linguistics 92, Leiden, 361–391.

Heemeier, B. – Rauen, A. – Waldhör, M. – Grottker, M.
2009 Water Management at Tall Hujayrāt al-Ghuzlān, in: L. Khalil – K. Schmidt (Eds.), Prehistoric ᶜAqaba I, Orient Archäologie 23, Rahden/Westfalen, 247–271.

Helms, S.
1981 Jawa: lost city of the Black Desert, Ithaca.

Ingraham, M. L. – Johnson, T. D. – Rihana, B. – Shatla, I.
1981 Saudi Arabian Comprehensive Program, Atlal - The journal of Saudi Arabian Archaeology 5, 59–84.

Keilholz, P.
2009 Hydraulik und Wasserwirtschaft – Schlüssel zum Verständnis der Entwicklung der antiken Dekapolisstadt Gadara?, Beitrag zum Wasserwirtschaftlichen Kolloquium der Universität der Bundeswehr München, Neubiberg, May 28, 2009.

Khalil, L. – Schmidt, K. (Eds.)
2009 Prehistoric ᶜAqaba I. Orient Archäologie 23, Rahden/Westfalen.

Klasen, N. – Engel, M. – Brückner, H.
2008 Report on optically stimulated luminescenece dating results from Tayma (Qrayyah – Square C1), NW Saudi-Arabia. Unpublished report on geoarchaeological research activities at Tayma embedded into a research project of the German Archaeological Institute, November 2008.

Knop, C. – Hausleiter, A.
2016 Tayma, Saudi-Arabien. Bauforschung am Qasr al-Radm, e-Forschungsberichte des Deutschen Archäologischen Instituts 2016-3, 155–160.

Livingstone, A. – Spaie, B. – Ibrahim, M. – Kamal, M. – Taimani, S.
1983 Taima. Recent Sounding and New Inscribed Material (1402/1982), Atlal - The journal of Saudi Arabian Archaeology 7, 102–116.

Luciani, M. – Alsaud, A. S.
2018 The new archaeological joint project on the site of Qurayyah, northwest Arabia: First results of two excavation seasons. Proceedings of the Seminar for Arabian Studies 48, 165–184.

McCorriston, J. – Oches, E.
2001 Two Early Holocene check dams from Southern Arabia, Antiquity 75, 675–676.

McLaren, S. – Al-Juadi, F. – Bateman, M. D. – Millington, A. C.
2009 First evidence for episodic flooding events in the arid interior of central Saudi Arabia over the last 60 ka, Journal of Quaternary Science 24(2), 198–207.

Ministry of Agriculture and Water (MAW)
1984 Water Atlas of Saudi Arabia. Riyadh.

Ministry of Water and Electricity (MWE), Kingdom of Saudi Arabia
2008 Investigations for updating the groundwater mathematical model(s) of the Saq and overlaying aquifers, Riyadh.

al-Najam, M. H.
2000 Irrigation system and ancient water resources in Tayma area, Atlal - The journal of Saudi Arabian Archaeology 15, 191–197.

Nasif, A. A.
1983 Al-Ula – An Historical and Archaeological Survey with special reference to its Irrigation System. PhD-thesis presented to the Victoria University of Manchester. King Saud University Press, 1408/1983.

Neubauer, W. – Löcker, K.
2006 Archäologisch-geophysikalische Prospektion in Tayma/Saudi-Arabien. Unpublished report to the German Archaeological Institute from June 2006.

Parr, P. J. – Hardings, G. L. – Dayton, J. E.
1970 Preliminary survey in northwestern Arabia, 1968, Institute of Archaeology, Bullentin 8/9, 193–242.

Philby, H. St. J.
1957 The land of Midian, London.

Schaloske, M.
1995 Antike Technologien – Die Sabäische Wasserwirtschaft von Marib – Teil 3: Untersuchungen der sabäischen Bewässerungsanlagen in Marib, Berlin.

Şen, Z.
2007 Hydrograph and unit hydrograph derivation in arid regions, Hydrological Processes 21, 1006–1014.

Schmidt, J.
1993 Die antike Wasserwirtschaft von Marib, Schriftenreihe der Frontinus-Gesellschaft, Heft 28, 55–76.

Schneider, P. I.
2010 Mauern in Tayma, in J. Lorenzen – F. Pirson – P. I. Schneider – U. Wulf-Rheidt (Hrsg.), Aktuelle Forschungen zur Konstruktion, Funktion und Semantik antiker Stadtbefestigungen, BYZAS: Veröffentlichungen des Deutschen Archäologischen Instituts Istanbul 10, Istanbul, 1–25.

Schulz, E. – Whitney, J. W.
1986 Upper Pleistocene and Holocene lakes in the An Nafud, Saudi Arabia, Hydrobiologia 143, 175–190.

Staubwasser, M. – Weiss, H.
2006 Holocene climate and cultural evolution in late prehistoric - early historic West Asia, Quaternary Research 66(3), 372–385.

Trabucco, A. – Zomer, R. J.
2009 Global Aridity Index (Global-Aridity) and Global Potential Evapo-Transpiration (Global-PET) Geospatial Database. CGIAR Consortium for Spatial Information. Published online, available from the CGIAR-CSI GeoPortal at: http://www.csi.cgiar.org/.

Vaslet, D. – Janjou, D. – Robelin, C. – al-Muallem, M. S. – Halawani, M. A. – Brosse, J.-M. – Breton, J.-P. – Courbouleix, S. – Roobol, J. M. – Dagin, J.
1994 Explanatory notes to the geologic map of the Tayma quadrangle, sheet 27C, Kingdom of Saudi Arabia. Ministery of Petroleum and Mineral Resources, Jeddah.

Vincent, P.
2008 Saudi Arabia – An Environmental Overview, London.

Vogt, B. – Brettschneider, W. – Brunner, U. – Heberg, W. – Röring, N.
2003 Der Große Damm von Marib, Republik Jemen – Neue Archäologische und bauhistorische Forschungen des Deutschen Archäologichen Instituts 2002, Allgemeine und Vergleichende Archäologie-Beiträge 23, Mainz, 49–74.

Voß, B.
1979 Ein Beitrag zur Hydrogeologie und Wasserwirtschaft der Oase Al Hassa in Saudi Arabien, Fortschritt-Berichte der VDI-Zeitschriften, Reihe 4, Nr. 48.

Wellbrock, K. – Voß, P. – Grottker, M.
2012 The evolution of water management methods in north-western Arabia and the southern Levant from the Neolithic Age through Antiquity, in: C. Ohlig (Ed.), Zehn Jahre wasserhistorische Forschungen und Berichte, Schriften der Deutschen Wasserhistorischen Gesellschaft 20-1, Siegburg, 29–48.

Weninger, B. – Clare, L. – Rohling, E. J. – Bar-Yosef, O. – Böhner, U. – Budja, M. – Bundschuh, M. – Feurdean, A. – Gebel, H. G. K. – Jöris, O. – Linstädter, J. – Mayewski, P. – Mühlenbruch, T. – Reingruber, A. – Rollefson, G. – Schyle, D. – Thissen, L. – Todorova, H. – Zielhofer, C.
2009 The Impact of Rapid Climate Change on Prehistoric Societies During the Holocene in the Eastern Mediterranean, Documenta Praehistorica 26, 1–53.

Wood, W. W. – Imes, J. L.
1995 How wet is wet? Precipitation constraints on late Quaternary climate in the southern Arabian Peninsula, Journal of Hydrology 164, 263–268.

Cultural Contacts

Sandsteinkubus aus Qasr al-Hamra, Seite A (Foto: DAI, Orient-Abteilung, G. Sperveslage).

مكعب من الحجر الرملي من قصر الحمراء، الجانب *A* (الصورة: معهد الآثار الألماني/ سبيرفسلاغه).

Ägypten und Arabien

Gunnar Sperveslage

***Abstract**: Contacts between Egypt and the Arabian Peninsula can be traced back over a long period of time. Although the sources of information are very sparse, they are all the more varied and cover a long time span. Archaeological excavations conducted in Taymāʾ in recent years have provided interesting finds, which throw new light on contacts with Egypt. Egypt's interest in Arabia was based foremost on trade in aromatics; ever since the Old Kingdom, Egypt imported incense and myrrh from abroad. Hence, trade relations between both regions were characterised basically by the transfer of goods, and not by political or military conflicts. Conversely, interest in Egyptian high culture existed on the part of the Arabian Peninsula.*
The following contribution discusses various aspects about reciprocal relations between both cultural spheres as evinced in epigraphic and archaeological material, and suggests trade routes and harbours on both sides of the Red Sea.
***Keywords**: Arabia, Egypt, Egyptian finds, trade, trade routes*

ملخّص: يمكن تتبع الاتصالات بين مصر وشبه الجزيرة العربية على مدى فترة طويلة. بالرغم من أن المصادر ضئيلة جداً إلا أنها تُظهر تبايناً أكبر و مدىً زمنياً أطول. قدّمت الحفريات الأثرية في تيماء في السنوات الماضية مكتشفات مثيرة للاهتمام تلقي ضوءاً جديداً على الاتصالات مع مصر. شكّلت تجارة العطريات المصلحة الأساسية لمصر في بلاد العرب حيث تم استيراد البخور و المرّ في مصر من الخارج منذ زمن الدولة القديمة. و هكذا فقد اتسمت علاقات المنطقتين بشكل أساسي بطابع تبادل البضائع و ليس بطابع النزاعات السياسية و العسكرية. تركّز الاهتمام أيضاً في شبه الجزيرة العربية على الحضارة المصرية المتقدّمة.
سوف تتم في هذه المقالة مناقشة جوانب مختلفة معينة تقدّمها المواد الكتابية و الأثرية المتعلقة بالعلاقات المتبادلة بين المنطقتين الحضاريتين بالإضافة إلى دراسة طرق التجارة و الموانئ على جانبي البحر الأحمر.
كلمات البحث: بلاد العرب، مصر، اللقى المصرية، التجارة، طرق التجارة.

1 Einleitung

Das ägyptische Reich unterhielt in allen Zeiten rege außenpolitische und wirtschaftliche Kontakte zu seinen Nachbarn, so dass auch Spuren des Kontaktes zwischen Ägypten und der arabischen Halbinsel zu erwarten sind. Anders als die Beziehungen nach Syro-Mesopotamien und der Levante oder nach Nubien, sind diese Kontakte jedoch nicht von reichhaltigen Schriftzeugnissen und Denkmälern begleitet. Es finden sich in den ägyptischen Quellen kaum Toponyme, Herrschernamen oder Ähnliches, die auf Arabien verweisen. Dies hängt zu einem gewissen Grad damit zusammen, dass die arabische Halbinsel weder eine kulturelle noch eine politische Einheit bildete. Die einzelnen Oasenkönigreiche stellen Machtverhältnisse dar, durch die Arabien, anders als beispielsweise das assyrische oder achämenidische Reich, dem ägyptischen Reich nicht 'auf Augenhöhe' gegenüber stand. Die Kontakte verliefen in kleinerem, inoffiziellerem Rahmen zwischen einzelnen Personen, meist im Handelsaustausch. So ist es der Transfer von Gütern, der die Beziehungen beider Regionen wesentlich prägte, nicht politische und militärische Auseinandersetzungen. Weder war die arabische Halbinsel zwischenzeitlich von Ägypten beherrscht, noch unterstand Ägypten vor der islamischen Eroberung einer arabischen Herrschaft. Die Art und Intensität der Beziehungen zwischen beiden Kulturbereichen manifestiert sich demnach weniger in offiziellen Texten und Denkmälern als vielmehr in den materiellen Hinterlassenschaften des täglichen Lebens sowie in der funerären Kultur. Dies betrifft Objekte der Kleinkunst, die in Siedlungs- und Grabkontexten gefunden wurden, aber auch die Übernahme und lokale Umsetzung ägyptischer Motive und Ikonographie (Sperveslage 2013). Über das

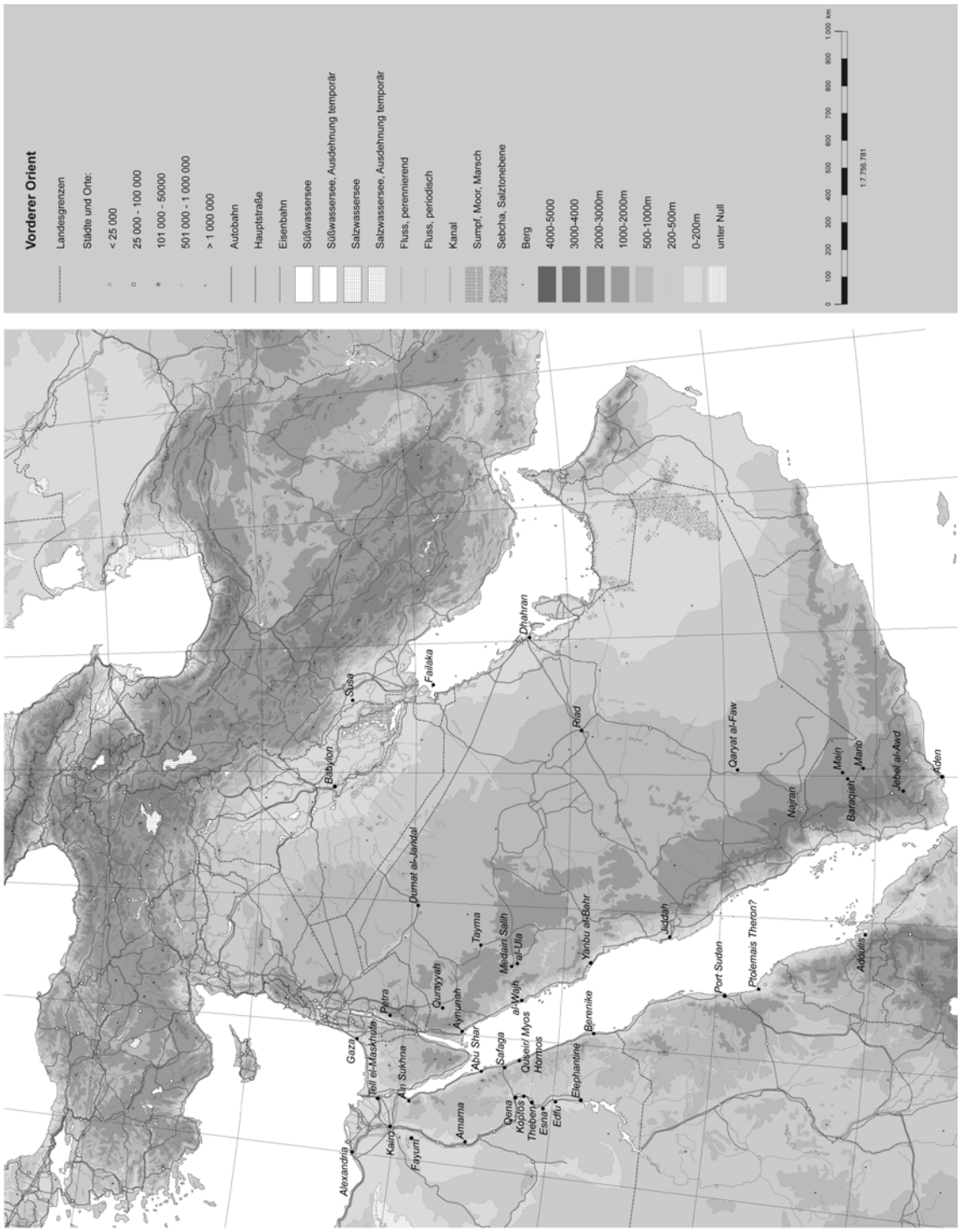


Abb. 1 *Karte mit den wichtigen Fundorten in Ägypten, Saudi Arabien und Mesopotamien (DAI, Orient-Abteilung).*

الشكل ١ خريطة تُظهر المواقع الأثرية المهمّة في مصر، المملكة العربية السعودية و بلاد الرافدين (معهد الآثار الألماني، قسم المشرق).

Interesse einzelner Personen an ägyptischen Motiven hinaus geht die Ausstattung von arabischen Sakralbauten mit ägyptischen Elementen. Hier hält Ägypten gewissermaßen Einzug in den lokalen Götterkult, indem sich dieser durch ägyptische Bilder ausdrückt. Die gegenseitigen Beziehungen lassen sich somit aus den archäologischen Funden und ihren Kontexten rekonstruieren und werden durch verschiedene epigraphische Quellen ergänzt.

Entsprechend der vereinzelten und punktuellen Einblicke, die uns das epigraphische und archäologische Material in die wechselseitigen Beziehungen beider Kulturbereiche liefert, sind die Kontakte Ägyptens zur arabischen Halbinsel in der Forschung bisher kaum zusammenhängend betrachtet worden. Dabei wurden bereits in der Frühzeit der Ägyptologie Zusammenhänge zwischen Arabien und Ägypten vermutet. Petrie war der Ansicht, der ägyptische Staat sei von außen durch Einwanderer über das Rote Meer und die ägyptische Ostwüste gegründet worden. Den Ursprung dieser Kulturbringer nahm er im Persischen Golf an, von wo auch Vorderasien kolonisiert wurde.[1] Diese Ansicht der Entstehung des ägyptischen Staates ist inzwischen obsolet und infolgedessen hat auch die arabische Halbinsel in Bezug auf die Erforschung des prädynastischen Ägypten keine Beachtung erfahren. Abgesehen von Beiträgen zu Einzelfunden bemühten sich allein Vittmann und al-Said um eine Synthese. Vittmann (2003, 180–193) erschloss insbesondere die Quellen für Araber in Ägypten für den Zeitraum des 1. Jahrtausends v. Chr., das Material der arabischen Halbinsel blieb, dem Konzept seines Buches entsprechend, weitgehend unberücksichtigt. Daneben lieferte al-Said (2003) eine umfassende Auswertung der epigraphischen Quellen, allerdings ohne sie in ausführlichen Bezug zu den archäologischen Funden zu setzen. Eine Zusammenfassung dieses Materials, vor allem unter Berücksichtigung der Objekte aus Saudi-Arabien, bietet jetzt Sperveslage 2014. Die Oase Taymāʾ war als Handelszentrum an der Weihrauchstraße ein Berührungspunkt verschiedener kultureller Einflüsse. Hier findet sich sowohl ein Nebeneinander lokaler und fremder Elemente als auch eine Vermischung, wie sie sich u. a. in der Ikonographie auf dem Kubus und der Stele aus Qasr al-Hamra zeigt (siehe unten 3.2). Somit war Taymāʾ gewissermaßen ein multikultureller Schmelztiegel, der auch in Bezug auf die Einflüsse aus Ägypten ein großes Potential bietet. Es wurden ägyptische Objekte als Grabbeigaben und innerhalb von Tempelarealen gefunden, daneben traten, insbesondere in religiösen Kontexten, Motivübernahmen aus Ägypten auf.[2] Aus Qaryat al-Faw in Zentralarabien stammt ebenfalls eine große Anzahl weiterer teils unpublizierter ägyptischer Funde, die zwar zeitlich später einzuordnen sind, sich aber dennoch mit den Funden aus Taymāʾ vergleichen lassen und mehr als nur ein Schlaglicht auf die Handelskontakte zwischen Ägypten und der arabischen Halbinsel werfen.

Das Interesse Ägyptens an Arabien bestand vornehmlich im Handel von Aromata. Weihrauch und Myrrhe wurden in Ägypten seit dem Alten Reich verwendet. Die Anwendungszwecke waren vielfältig und erklären den hohen Bedarf. Weihrauch und Myrrhe wurden als Räuchermittel im kultischen Bereich, als Heilmittel in der Medizin, in der Parfümherstellung sowie zur Balsamierung eingesetzt (Germer 1982; 1986; Müller 1978, 737–739).

2 Ägyptische Bezeichnungen für Arabien und Araber

Seit Beginn der dynastischen Zeit kannten die Ägypter eine Reihe von nomadisierenden Völkern, die an den Grenzen ihres Staatsgebietes lebten. Von Zeit zu Zeit verübten die Beduinen-

[1] Petrie 1939, 77. Diese Idee Petries hat Rice in modifizierter Form wieder aufgegriffen und meint, in den ägyptischen Jenseitsvorstellungen ferne Erinnerungen an ein verklärtes Inselreich Bahrain/Dilmun zu erkennen. Vgl. Rice 2003, insbesondere 226–243. Zu Diskussion und Ablehnung der Auffassung Petries siehe auch Endesfelder 2011, 10–12, Sperveslage 2014, Kap. 2.3.

[2] Zu den ägyptischen Funden aus Taymāʾ siehe auch den Beitrag des Verfassers ‘Ägyptische und ägyptisierende Funde der Kampagnen 2006–2010 aus Taymāʾ’ in Band IV der Taymāʾ Reihe.

stämme Überfälle und Raubzüge – insbesondere an der Ostgrenze – und wurden durch kleinere Feldzüge zurückgeschlagen. Von den Ägyptern wurden die Nomaden im Osten unspezifisch als 'Sandbewohner' (*ḫr.w-šʿ, nmj.w-šʿ)* bezeichnet, was weder über ihre geographische noch ethnische Herkunft etwas aussagt, sondern sich nur auf ihre Lebensweise bezieht. In der Bezeichnung drückt sich zugleich die abschätzende Wertung aus, die ihnen der sesshafte Ägypter entgegenbrachte.[3] Die 'Sandbewohner' waren Nomadengruppen, die sich auf dem Sinai, in Südpalästina und Nordwestarabien bewegten (vgl. Saleh 1978). Da sich ihr Territorialgebiet nicht auf den nordwestarabischen Raum beschränkte, wird man sie aber nicht zwangsweise als Araber bzw. als Bewohner der arabischen Halbinsel ansehen können. Die Nachbarn im Osten, bzw. Nordosten, mit denen über das Ostdelta Kontakt bestand, nannte der Ägypter schlicht 'Asiaten', ägyptisch *ʿꜣm.w*. In der Frühzeit der Ägyptologie wurde für diese Bezeichnung zwar eine Ableitung von semitisch *ʿrb* 'Araber' vorgeschlagen (Ember 1918), der Begriff wird dagegen jetzt von Schneider aus dem hebräischen *derôm* 'Süden', bzw. der entsprechenden Nisbe *dərômî* 'Südländer/Bewohner Südpalästinas' etymologisiert (Schneider 1997, 195–196).

Eine Gruppe von Beduinen, die im Neuen Reich verstärkt hervortritt, sind die Shasu-Beduinen.[4] Die Verbreitung des Stammesgebietes der Shasu wird von Parr bis hin nach Nordwestarabien gesehen und ist für ihn ein wesentlicher Faktor für ägyptischen Einfluss in Nordwestarabien in der Bronzezeit (Parr 1988, 84–85). Die Belege des frühen Neuen Reiches, insbesondere aus der Zeit Thutmosis III., zeigen, dass sich das territoriale Kerngebiet der Shasu in Nordpalästina bzw. Südsyrien befunden haben muss (Görg 1976; 1979; Giveon 1971, 235–239). Eine Ausweitung nach Süden fand zwar in der 19. Dynastie statt, in Nordwestarabien lässt sich die Präsenz von Shasu-Beduinen aus den ägyptischen Quellen jedoch nicht belegen. Weiterhin hat Parr eine Subsumierung der Midianiter unter die Shasu vertreten (Parr 1988, 85), was sich ebenfalls nicht halten lässt. Das Gebiet der Shasu wird in den jüngeren Ächtungstexten des Mittleren Reiches neben anderen Völkern genannt, u. a. den *kwšw*. Hinter *kwšw* verbirgt sich das alttestamentliche *kwšn*. Diese Bezeichnung wird synonym zu Midian gebraucht (Albright 1941, 34 Anm. 8; Görg 1976, 426–427 mit Anm. 21), womit Midianiter und Shasu als verschiedene Stämme zu betrachten sind.

Im Zusammenhang mit den Shasu und ihrer möglichen Präsenz auf der arabischen Halbinsel wurde die Frage nach dem Grad ihrer Urbanisierung aufgeworfen. Giveon hielt eine teilweise urbanisierte Lebensweise für möglich (Giveon 1971, 115), woraufhin Parr in Betracht zog, die Oasensiedlungen von Qurayyah und Taymāʾ als Shasu-Städte anzusehen. Diese seien unter ägyptischen Einfluss gegründet worden, um die Handelsrouten von ägyptischer Seite zu kontrollieren (Parr 1988, 84). Diese Interpretation hängt jedoch an einem einzigen Textzeugen, der Stele Ramses' II. aus Tell er-Rataba (Petrie 1906, Taf. XXVIII. XXXII). Eine Passage in der abschließenden Zeile wurde dahingehend gedeutet, dass die Shasu Städte bewohnt hätten, die nach einer Auseinandersetzung mit Ramses II. erneuert wurden. Der fragliche Abschnitt, in dem von Städten gesprochen wird, lässt sich jedoch nicht auf die Shasu beziehen und ist stattdessen so aufzufassen, dass Ramses II. im Ostdelta bzw. auf dem Sinai die Shasu zurückgedrängt und daraufhin neue Städte bzw. Festungen zur Grenzsicherung errichtet hat, um die ägyptische Position in der Region zu stärken und die Bedrohung durch die nomadisierende Bevölkerung einzudämmen.[5] Dass die Shasu auf dem Sinai bzw. an der Ostgrenze Ägyptens präsent waren, geht u. a. daraus hervor, dass Sethos I., der Vorgänger Ramses II., während seines Palästinafeldzuges in eine Auseinandersetzung mit den Shasu verwickelt war (vgl. Giveon 1971, 225–226). Der Wohnraum der Shasu wird in demselben Text als bergiges und wüstes Land charakterisiert und

[3] Zum Bild der Nomaden siehe Staubli 1991, 20–66; Beduinen gelten z. B. auch als Wegelagerer und Diebe (pAnastasi I 19.2).

[4] Vgl. zum Folgenden Sperveslage 2011; zu den Shasu Giveon 1971.

[5] Zu Lesung und Interpretation der Stele siehe ausführlich Sperveslage 2011.

als *ṯz.(w)t* ‘Gebirge; Hügel’ bezeichnet, worunter man sich sicherlich eher temporäre Zeltdörfer als befestigte Städte vorstellen kann.

Mit der Neuinterpretation der Stele aus Tell er-Rataba entfällt der einzige Beleg für Shasu-Städte. Eine Verbindung der Shasu mit der arabischen Halbinsel ist nach der bisherigen Beleglage nicht herzustellen. Eventuell kann ein Shasu-Beleg vom Chnum-Tempel in Esna als ein Synonym für Arabien interpretiert werden, doch bestehen auch hier andere Deutungsmöglichkeiten (vgl. Giveon 1971, 191). Zudem datiert der Beleg in die römische Kaiserzeit unter Trajan, so dass mit einer Umdeutung des Begriffs zu rechnen ist und selbst bei einer sicheren Identifizierung mit Arabien keinerlei Rückschlüsse auf das Territorialgebiet der Shasu während des Neuen Reiches gezogen werden können. Die Rolle, die Parr den Shasu in Bezug auf die Beziehungen zwischen Ägypten und Arabien zugerechnet hat, kann damit nicht aufrechterhalten werden (vgl. Sperveslage 2013, 237–238).

Toponyme und Ethnonyme, die sich auf die arabische Halbinsel und ihre Bewohner beziehen, treten erst sehr spät und hauptsächlich in demotischen Texten auf. In den meisten Fällen finden sich diese Erwähnungen in literarischen Texten, so dass sich kaum historische Informationen gewinnen lassen. Die Bezeichnung ‘Arabien’ tritt in einem literarischen Brief aus dem 1. Jh. v. Chr. auf, der als die Fabel *Die Schwalbe und das Meer* bekannt ist (Hoffmann – Quack 2007, 194–195. 355–356). Die Fabel ist in die Form eines Briefes gekleidet, den Auski, Fürst von Arabien (*ȝlbjn*), an Pharao Psammetich II. richtet, und erzählt von zwei ungleichen Gegnern. Der Inhalt ist eine politische Botschaft, die davor warnt, dass auch schwache Gegner sich zur Wehr setzen können (vgl. Quack 2005, 144–145). Einen historischen Zusammenhang, dass nämlich ein arabischer Fürst dem ägyptischen König eine Warnung ausspricht, einen militärischen Schlag gegen Arabien zu führen, vermag man nicht anzunehmen. Dagegen spricht die Literaturform der Fabel und die zeitliche Differenz zwischen dem Text (1. Jh. v. Chr.) und der Regierungszeit des Adressaten Psammetich II. (6. Jh. v. Chr.).

In der Erzählung vom *Kampf um den Panzer des Inaros* (Hoffmann – Quack 2007, 59–87. 334–336), überliefert aus dem 2. Jh. n. Chr., wird der Bezug auf Arabien ein wenig konkreter. Bevor der Held Paklul seine Kämpfer aufstellt, wird seine Ausrüstung beschrieben. Seine Lanze besteht zu zwei Dritteln aus Holz und einem Drittel aus Eisen. Das Holz, aus dem sie gefertigt war, stammt offenbar aus Arabien, demotisch *ȝljbj*.[6] Leider ist diese Passage sehr schlecht erhalten, so dass über die Holzart keine weiteren Angaben verfügbar sind. Es scheint jedoch, dass Arabien die Quelle eines Holzes war, das sich, zumindest in der Erzählung, bevorzugt für die Herstellung von Lanzen eignete. Ob diesem Holz eine besondere magische Wirkung zugesprochen wurde, kann nur spekuliert werden.

Auch im *Mythos vom Sonnenauge* (Hoffmann – Quack 2007, 195–229. 356–360) ist Arabien genannt. Die entsprechende Stelle ist sicher als *ʿrbj* zu lesen (Hoffmann – Quack 2007, 358). Es heißt im Text, die Speise des Sonnengottes befinde sich im Lande Arabien. In der vorangehenden Zeile heißt es, der Leben(saufgang) des Sonnengottes sei unter den Hagritern *(hgr)*, über die gleich noch zu sprechen ist. Arabien als Land im Osten und des Sonnenaufganges bezeichnet im Mythos also einen der Aspekte des Sonnengottes.

Die zitierten Stellen zeigen, dass es im Demotischen offenbar keine konventionelle Schreibung für ‘Arabien’ gab. In den drei Texten sind jeweils unterschiedliche Notationen *ȝlbjn*, *ȝljbj* sowie *ʿrbj* vorhanden. Der einzige Text, indem dieses Toponym mehrfach auftritt, ist die Fabel von der Schwalbe und dem Meer. Die Schreibweise ist in allen drei Fällen gleich und somit innerhalb des Textes einheitlich.

Für die achämenidische Zeit liefert die Monumentalstatue Dareios I. aus Susa zwei ägyptische Ethnonyme, die sich auf die arabische Halbinsel beziehen.[7] Die Statue ägyptischen Typs zeigt Da-

[6] pKrall 18.26; Hoffmann 1996, 338 mit Anm. 1969; siehe auch Hoffmann – Quack 2007, 80.

[7] Zur Statue siehe Roaf 1974.

reios I. in persischer Tracht, auf den beiden Seiten der Basis sind je 12 unterworfene Fremdländer in ägyptischem Stil dargestellt. Der Name des Landes bzw. Volkes ist in ägyptischer Schrift und Sprache in einem Stadtmauerring geschrieben, darüber befindet sich eine menschliche Figur in Adorationshaltung. Diese ist in der Tracht des jeweiligen Volkes gekleidet und mit entsprechender Physiognomie ausgestattet. Die beiden auf Arabien zu beziehenden Ethnonyme befinden sich auf der vom Betrachter gesehenen linken Seite. An siebenter Position steht *hgr*, an elfter *mg* (Abb. 2).

2.1 Hagriter

Aus einem Vergleich der Liste auf der Statue des Dareios mit persischen Listen derselben Epoche geht hervor, dass der Begriff *hgr* ‘Arabien’ bzw. ‘Araber’ bezeichnet. Auf der Statue befindet sich *hgr* zwischen den Bezeichnungen *ʒšwr* (Assyrien) und *km.t* (Ägypten). In den persischen Listen findet sich an dieser Position mit nur einer Ausnahme die Bezeichnung *arabāya* ‘Arabien’ (Retsö 2003, 237–240). Zudem findet sich für *hgr* im demotischen Papyrus pLille 59,4 im Verso die griechische Entsprechung ‘Arabs’.[8] Einen dritten Beleg für die Bedeutung ‘Arabien’ ist ein weiterer demotischer Papyrus, in dem ein Mann als *hgr* bezeichnet wird[9]. Der Name des Mannes *(Wjlw)* sowie der seines Vaters *(ʿwmʒjlw)* sind semitischen Ursprungs, wobei der erste Name vor allem in Nordwestarabien belegt ist und Entsprechungen im Safaitischen, Thamudischen und Liḥyanischen findet (Lüddeckens 1988, 56; Müller 1988, 84; siehe auch Honigman 2002, 50–51). Damit könnte eine geographische Zuweisung nach Nord- bzw. Nordwestarabien gegeben sein. Dies wird zudem durch die Position von *hgr* zwischen Assyrien und Ägypten auf der Dareios-Statue bestätigt sowie möglicherweise auch durch die geographische Spezifizierung des *hgr* in dem bereits genannten pLille 59,4 als *hgr jšwr* ‘syrischer Hagriter’.[10] Zu einer Lokalisierung des

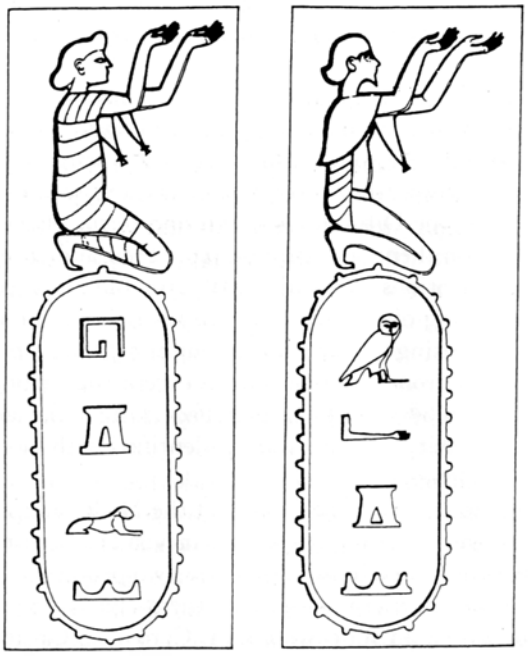


Abb. 2 *Arabische Ethnonyme auf der Statue Dareios I. aus Susa (nach: Roaf 1974, Nr. 134 u. 144).*

الشكل ٢ أسماء إثنية عربية على تمثال داريوس الأول من سوسة (المصدر: Roaf ١٩٧٤، Nr. 134 و 144).

[8] Vittmann 2004, 145; der demotische Text ist publiziert bei De Cenival 1973, Nr. 59,4.

[9] pLüddeckens II, A 1–2, B 2–3; publiziert bei Lüddeckens 1988; vgl. Vittmann 2004, 145.

[10] De Cenival 1973, Nr. 59,4, vgl. die Korrektur bei Thissen 1974, 168. Eine Gleichsetzung mit Hager in Ostarabien, dem heutigen al-Hufūf südlich von Dammām, wie Knauf (1990, 203) angenommen hat, scheint aufgrund des geographischen Zusammenhangs auf der Dareios-Statue ausgeschlossen. Vgl. Retsö 2003, 261, Anm. 122.

Stammesgebietes der Hagriter im Norden der Arabischen Halbinsel gelangte auch Robin insbesondere anhand der Überlieferung der klassischen Autoren, südarabischer, syrischer und arabischer Quellen. Er kommt zu dem Schluss, dass ihr Gebiet in der Region um Dumat al-Jandal zu suchen ist (Robin 1974, 102–111). Die ägyptischen Quellen hatte Robin in seiner Untersuchung nicht berücksichtigt. Neben dem Vorkommen auf dem Sockel der Dareios-Statue sind zwar keine weiteren hieroglyphischen Belege bekannt, in den demotischen Texten ist *hgr* dagegen mehrfach bezeugt.[11] Der Begriff tritt als geographische bzw. ethnographische Bezeichnung in Verbindung mit Wüste und Beduinen auf (Posener 1969) und kann mit den bei Plinius d. Ä. bezeugten Agraei (Plinius, Nat. hist, VI 32. 154. 159. 161) in Verbindung gebracht werden. Ob die Ägypter unter *hgr* jedoch konkret einen Angehörigen des nordarabischen Stammes verstanden oder die Bezeichnung vielmehr allgemein für Arabien, bzw. nomadisierende Stämme verwendeten, muss aufgrund der spärlichen Beleglage allerdings offen bleiben (vgl. auch Stadler 2004, 134). In den demotischen Texten werden die *hgr* meist als *hgr n p3 tw* spezifiziert (zum Beispiel im pLüddeckens II; siehe Lüddeckens 1988). Das demotische Wort *tw* geht auf das hieroglyphische *ḏw* ‘Berg’ zurück, weshalb *hgr n p3 tw* als ‘Hagriter des Berges’ wiedergegeben wird. Im Demotischen ist die Bedeutung von *tw* allerdings weitergefasst und kann auch für Nekropole oder allgemein für Wüste stehen. Der Ausdruck ließe sich daher vielleicht besser als ‘Araber aus der Wüste’ auffassen (vgl. auch Honigman 2002, 60).

Das Wort *hgr* kann nicht nur für Araber verwendet werden, sondern es ist auch als ägyptischer Personenname belegt. Eine eindeutige Identifizierung der *hgr* wird dadurch zusätzlich erschwert. Der bekannteste Träger dieses Namens ist König Achoris, ägyptisch *hgr* (auch *hkr* oder *hqr*), der dritte Herrscher der 29. Dynastie. Aus dem Namen abzuleiten, Achoris sei arabischer Herkunft und sein Name reflektiere seine ethnische Zugehörigkeit (so Retsö 2003, 252–253), ist fraglos verfrüht, da dieser Personenname bereits seit der 26. Dynastie belegt ist (so schon Posener 1969; vgl. auch Ranke 1935, 231.12; Lüddeckens *et al.* 1980–2000, 766). In der 29. Dynastie war *hgr* bereits ein eingebürgerter ägyptischer Name und nicht Ausdruck von Ethnizität. Posener vermutete eine Ableitung des Personennamens von der ethnischen Bezeichnung (Posener 1969). Dies ist jedoch fraglich, da ethnisch abgeleitete Personennamen üblicherweise mit einem Artikel gebildet wurden und der Name somit **p3-hgr* lauten müsste.[12] Ein direkter Zusammenhang zwischen dem Personennamen und dem Volksstamm muss daher offen bleiben.

2.2 Magan

Das zweite Ethnonym auf der Dareios-Statue bereitet weniger Schwierigkeiten. Das hieroglyphische *mg* entspricht dem persischen Maka- und ist mit dem bereits aus den sumerischen Texten bekannten Land Magan bzw. Makan zu identifizieren (vgl. Vittmann 2004, 161). Da die Liste auf der Statue dem persischen Formular folgt, liegt die Vermutung nahe, dass es sich bei *mg* weniger um eine ägyptische Bezeichnung für Magan handelt, sondern um eine Wiedergabe des persischen Maka- in hieroglyphischer Schrift. Daher ist zweifelhaft, ob im ägyptischen Bewusstsein eine Vorstellung vom Land Magan existierte.

In den mesopotamischen Quellen des 3. Jt. v. Chr. ist Magan vor allem für seine reichen Vorkommen an Kupfer bekannt, das entweder direkt oder im Zwischenhandel über Dilmun nach Mesopotamien gelangte. Anhand von Kupferanalysen konnte Magan in der Region des heutigen Oman lokalisiert werden (vgl. u. a. Heimpel 1988). Entsprechend der engen Verbindung mit Meluḫḫa in den sumerischen Texten wird Magan auch auf der Susa-Statue direkt vor Indien genannt.

---

[11] Zuletzt zusammenfassend Winnicki 2009, 340–348.

[12] Clarysse 1991, 238. Vgl. u. a. die Personennamen *p3-nḥs.j* ‘der Nubier’(Ranke 1935, 113.13) oder *t3-ḫr.t* ‘die Syrerin’(Ranke 1935, 367.3).

2.3 Liḥyān

In demotischen Texten findet auch das Königreich von Liḥyān Erwähnung. Dies ist im Zusammenhang mit der Archäologie der Oase Taymāʾ besonders interessant, da das Zentrum Liḥyān die Nachbaroase al-ʻUla ist und die Könige von Liḥyān zeitweise auch über Taymāʾ geherrscht haben. Der Papyrus Wien D 62 aus der ersten Hälfte des 2. Jh. n. Chr. enthält eine stark fragmentarische mythologische Erzählung[13]. Inhaltlich ist von mehreren Göttern die Rede, die sich zu verschiedenen Orten begeben, offenbar fliehen. Die den Göttern zugewiesenen Orte entsprechen teils ihren Kultorten, häufig ist ein Zusammenhang zwischen Gott und Ort jedoch unklar. Der Gott, der nach Liḥyān geht, ist Geb, das entsprechende Toponym lautet im demotischen *lhjnj*. Hoffmann (2004, 254 Anm. 39) vermutete zunächst eine demotische Schreibung für das Wadi Hammamat, ägyptisch *r'-hnw*. Dagegen ist mit Vittmann[14] eine Identifizierung mit Liḥyān anzunehmen. Dies bereitet lautlich weniger Probleme als die Ansetzung einer Schreibung für *r'-hnw* und auch die außerägyptische Lage stellt keine Schwierigkeit dar, denn schließlich heißt es daneben von Osiris, er gehe bzw. fliehe nach Ninive.

Weitere ägyptische Belege für das Königreich Liḥyān finden sich im demotischen Papyrus pCarlsberg 459. Der Papyrus stammt aus Tebtynis und enthält eine fragmentarische Erzählung, in der Liḥyān mehrfach genannt wird (Ryholt 2012).

3 Das archäologische Material

3.1 Ägyptische Objekte auf der arabischen Halbinsel

Im archäologischen Fundmaterial der arabischen Halbinsel sind in den letzten Jahrzehnten zahlreiche ägyptische Objekte zu Tage getreten. Dabei handelt es sich in erster Linie um Amulette und Objekte der ägyptischen Kleinkunst, gefunden wurden sie in nahezu jeder Grabungsstätte der Halbinsel. Auf Failaka vor Kuwait und auf Bahrain wurden ebenso Skarabäen gefunden, wie in den Tumuli von Dhahran.[15] Auch im Jemen wurden neben den von Fakhry angekauften Amuletten und Skarabäen[16] bei den Grabungen des DAI in Marib weitere Skarabäen entdeckt (Gerlach 2002, 55 Taf. 22), die auf einen Kontakt nach Ägypten verweisen. Während das Auftreten von Aegyptiaca im Osten und Süden der Arabischen Halbinsel eher sporadisch ist, bieten die Fundorte Taymāʾ im Nordwesten und Qaryat al-Faw in Zentralarabien in dieser Hinsicht eine relativ hohe Funddichte.

Die in Taymāʾ gefundenen Amulette und Skarabäen lassen sich aufgrund der ermittelten Vergleichstücke und des Materials bisher als ägyptische Importe ansprechen.[17] Es handelt sich weder um lokale Produktionen noch um Objekte, die in der Levante hergestellt wurden, sondern, nach Ausweis des Materials und der Vergleichsstücke aus dem ägyptischen Kernland, um indigene ägyptische Stücke. Unter den Amuletten sind verschiedene Typen vertreten, sowohl Objekt- wie auch figürliche Amulette, neben Skarabäen sind auch Skaraboide im Fundmaterial repräsentiert. Diese Fundgruppe verteilt sich im Wesentlichen auf zwei Grabungskontexte. Zum einen stammen

[13] Hoffmann 2004; vgl. auch die Übersicht bei Quack 2005, 24, sowie die Übersetzung von Vittmann im Thesaurus Linguae Aegyptiae (TLA <http://aaew.bbaw.de/tla/index.html>, Version Oktober 2014).

[14] Vittmann im Thesaurus Linguae Aegyptiae (TLA <http://aaew.bbaw.de/tla/index.html>, Version Oktober 2014).

[15] Einen kurzen Überblick über einige ägyptisierende Objekte aus den Golfstaaten bietet Shaheen 2000.

[16] Fakhry 1952, 136–139. Insgesamt vier Amulette und zwei Skarabäen, die in die Spätzeit datieren. Auch der Skarabäus mit dem Namen Amenophis III. ist entgegen der Einordnung Fakhrys in der Spätzeit anzusetzen.

[17] Zu den ägyptischen Funden aus Taymāʾ der Beitrag des Verfassers ‘Ägyptische und ägyptisierende Funde der Kampagnen 2006–2010 aus Taymāʾ’ in Band IV der Taymāʾ Reihe sowie Sperveslage 2014.

die Objekte aus Areal O und sind einem wahrscheinlich sakral zu interpretierenden Gebäudekomplex zuzuordnen, der in den Zeitraum des 12. bis 9. Jhs. v. Chr. datiert wird (Hausleiter 2010, 230–231; Hausleiter 2011, 111. 113; Intilia 2011; 2012; 2017). Die von dort stammenden ägyptischen Objekte können eventuell als Votivgaben angesehen werden (Sperveslage – Eichmann 2012, 374). Zum anderen wurden ägyptische Artefakte im Gräberfeld von Sana'iye gefunden, das die Ausgräber in das 7. bis 6. Jh. v. Chr. setzen (Abu Duruk 1989, 15 Taf. 9). Hier dienten sie als Grabbeigaben und sollten die Verstorbenen ins Jenseits begleiten.

Zu den ägyptischen Amuletten aus Taymāʾ gesellen sich lokale Umsetzungen ägyptischer Motive. Im Bereich des Zentralgebäudes E-b1 wurde eine Monumentalplastik in Gestalt einer Sphinx, sowie ein weiteres Fragment einer ähnlichen Skulptur freigelegt. Ein Gegenstück konnte im Magazin des Museums von Taymāʾ identifiziert werden.[18] Ob das Fragment Teil einer der beiden Sphingen ist oder als Teil einer dritten Figur angesehen werde muss, ist gegenwärtig nicht gesichert. Gefertigt sind die Skulpturen aus lokalem roten Sandstein, ihr Stil ist deutlich ägyptisierend. Ausgehend von der Fundposition der ersten Plastik kann vermutet werden, dass die Sphingen den Eingang zu dem als Tempel interpretierten Gebäude E-b1 flankierten.

In der antiken Siedlung von Qaryat al-Faw wurden ebenfalls zahlreiche ägyptische Objekte gefunden, die die Handelsverbindungen und den Warenverkehr auf den arabischen Karawanenrouten beleuchten.[19] Die in Qaryat al-Faw ergrabenen Strukturen datieren in die letzten Jahrhunderte des 1. Jts. v. Chr. und die erste Hälfte des 1. Jts. n. Chr. Die ägyptischen Objekte entstammen unterschiedlichen Kontexten (Gräber, Siedlung, Heiligtum) und bieten eine große typologische Vielfalt. Es handelt sich einerseits um diverse Amulette und mehr als 30 Skarabäen zum Schutz der Lebenden wie auch der Toten, Glasobjekte, die teilweise mit ägyptisierenden Darstellungen und Pseudoinschriften verziert sind, sowie um zwei hellenistische bzw. römische Bronzen des ägyptischen Gottes Harpokrates.[20]

Es dürfte kein Zufall sein, dass sie an einem Ort gefunden wurden, der eine zentrale Station auf der antiken Karawanenroute ist, die von Südarabien zum Arabischen Golf und weiter nach Mesopotamien führte. Insbesondere bei den Glasfunden handelt es sich um Luxusgüter, die auf der Karawanenroute verhandelt wurden und die den Wohlstand der Oasenstadt widerspiegeln. Herkunft der Gläser war vermutlich Alexandria, die Hauptstadt des ptolemäischen und römischen Ägypten. Wenn auch archäologische Nachweise fehlen, so bezeugen doch die klassischen Autoren, dass in Alexandria Glasmacher tätig waren und Luxusglas herstellten, welches sie u. a. nach Rom exportierten (Strabo 16.2.25; Cicero, Rab. Post. 14.40; Aurelian 45.1). Vergleichbare Glasfunde wurden auch auf Bahrain gemacht und zeigen den hohen Stellenwert dieser Produkte (Andersen 2007). Unabhängig von ihrem Produktionsort, sind die Gläser vermutlich auf dem Seeweg nach al-Faw gelangt. In den Häfen von Quseir al-Qadim und Berenike in Mittel- bzw. Südägypten traten entsprechende Funde aus römischer Zeit auf.[21]

Die Funktion der beiden Harpokrates-Bronzen, die zusammen mit weiteren hellenistischen Bronzen gefunden wurden, ist nicht eindeutig zu klären. Denkbar wäre, dass sie aufgrund ihres Materialwertes verhandelt wurden. Wahrscheinlicher ist dagegen, dass sie wegen ihrer religiösen Funktion nach al-Faw gelangten. Sie könnten nach der erfolgreichen und gesunden Heimkehr von einer Handelsexpedition als Votivgabe an die lokalen Gottheiten geweiht worden sein. Ähnlich verhält es sich mit den Funden hellenistischer Bronzen vom Jebel al-Awd im Jemen, unter denen

---

[18] Hierzu ausführlich der Beitrag des Verfassers 'Ägyptische und ägyptisierende Funde der Kampagnen 2006–2010 aus Taymāʾ' in Band IV der Taymāʾ Reihe.

[19] Mein herzlicher Dank gilt Said F. al-Said, King Saud University Riad, der mir im Frühjahr 2009 gestattete, diese Funde im Universitätsmuseum in Riad zu studieren.

[20] Die Objekte sind teilweise publiziert: Cotty 2010; Demange 2010; al-Ansary 2011a; siehe auch Sperveslage 2014.

[21] Zu Quseir al-Qadim siehe Meyer 1992; Peacock – Blue 2011; zu Berenike siehe Sidebotham 2011.

sich eine kleine ptolemäische Bronzesphinx mit einer sekundären Weihung an die Lokalgottheit Ragabum befand (Jändl 2009; Fleischer – Schulz 2012).

Die Amulette und Skarabäen sind weniger als Handelsobjekte anzusprechen, sondern stellen aufgrund ihrer geringen Größe und ihrer generellen Verbreitung in der antiken Welt Mitbringsel Handelsreisender und persönliche Schutzamulette dar. Sie bezeugen das Interesse der Menschen an ägyptischen Objekten. Diese können einerseits als Prestigeobjekte verstanden werden (hierzu Seidlmayer 2009), andererseits besaßen sie Wirkungsmächtigkeit im magisch-religiösen Bereich. Die magische Funktion der Amulette, die auf der arabischen Halbinsel gefunden wurden, bezieht sich aus ägyptischer Sicht entweder auf den Schutz vor bösen Mächten, Krankheiten und Gefahren oder auf den Themenbereich Regeneration, Fruchtbarkeit und Lebenskraft. Es sind daher primär Amulette, die zu Lebzeiten getragen wurden.[22] Erst in sekundärer Funktion gewannen sie als Grabbeigabe auch funeräre Aspekte. Ob mit den Amuletten auch ihre Funktionen übernommen wurden, entzieht sich unserer Kenntnis. Es kann jedoch festgehalten werden, dass die ägyptischen Amulette auf der arabischen Halbinsel, soweit erkennbar, ausschließlich in funerären und sakralen Kontexten gefunden wurden, Funde aus Siedlungskontexten fehlen bisher (hierzu Sperveslage 2013; 2014). Für den Gebäudekomplex in Areal O, dessen Funktion bisher nicht abschließend geklärt ist, deutet dieser Befund auf einen sakralen Charakter. Ebenso fehlen Amulette, deren Funktion in Ägypten primär im Schutz des Verstorbenen besteht, wie z. B. Herz-Amulette oder Amulette in Gestalt der Horussöhne.[23]

3.2 Ägyptische Ikonographie im Götterkult von Taymāʾ

Bei den 1979 durchgeführten Grabungen wurde im nördlichen Bereich von Qasr al-Hamra ein Raum freigelegt, der eine Reihe von Objekten enthielt, welche Rückschlüsse auf die kultischen und religiösen Praktiken Taymāʾs zulassen (Bawden *et al.* 1980, 82–86; Abu Duruk 1986, 56–70; Hausleiter 2012). In der Südwestecke befand sich ein Sandsteinkubus von ca. 37 cm Kantenlänge *in situ*, der an den beiden in den Raum weisenden Schauseiten mit Stierdarstellungen in ägyptischer Ikonographie dekoriert ist (Abb. 3 und 4). Dazu wurde in demselben Raum, unweit des Kubus, eine Stele freigelegt (Abb. 5), die ebenfalls mit ägyptischen Elementen versehen ist, sich allerdings nicht mehr an ihrem ursprünglichen Aufstellungsort befand. Beide Objekte sind unter den Bezeichnungen ‘Hamra-Kubus’ und ‘Hamra-Stele’ in die Literatur eingegangen. Sie befinden sich heute im Nationalmuseum von Riad[24] und datieren in das 5.–4. Jh. v. Chr.

Der Hamra-Kubus zeigt auf der einen Seite einen Stierkopf in Frontalansicht auf einem dreistufigen Podest (Abb. 3). Von den Ohren des Stieres hängen Schmuckbänder herab, zwischen den Hörnern befindet sich eine (Sonnen-)scheibe. Rechts des Bukraniums steht ein hoher Weihrauchbrenner, links ein Priester, der Opfergaben darbringt. Zwischen dem Priester und dem Bukranium befindet sich ein zweiter, kleinerer Weihrauchbrenner. Oberhalb der Szene befinden sich die vorderasiatischen Göttersymbole Flügelsonne, Mond und Stern. Gerahmt wird das Bildfeld von einer mit Kreisen versehenen Bordüre. Diese könnte als Holzarchitektur interpretiert werden und andeuten, dass sich das Kultbild der Stiergottheit in einem Holzschrein befindet.

Auf der zweiten, rechts angrenzenden Schauseite ist ein stehender Stier in Seitenansicht dargestellt (Abb. 4). Er trägt ebenfalls eine (Sonnen-)scheibe zwischen den Hörnern. Vor ihm

[22] Ein Skarabäus aus den Tumuli von Dhahran zeigt beispielsweise deutliche Abnutzungsspuren; Zarins *et al.* 1984, Taf. 52k; siehe auch Rice 2003, 145.

[23] Vgl. hierzu auch Hölbl 1979, I 229–239; speziell zum Fehlen von Amuletten mit funerärem Charakter Hölbl 1979, I 234–235.

[24] Inventarnummern 1020 (Stele) und 1021 (Kubus); Hausleiter – Intilia 2010a; Hausleiter – Intilia 2010b.

steht in verkleinertem Maßstab ein Priester, der wiederum Opfergaben darreicht. Über dem Stier befindet sich eine große Flügelsonne in assyrischem Stil. In der rechten oberen Ecke ist ein achtstrahliger Stern, in der linken ein Skorpion zu sehen. Auch dieses Bildfeld ist von einer Bordüre gerahmt, die Seiten sind jedoch undekoriert, der obere Abschluss ist mit einem Fries aus abwechselnd geöffneten und geschlossenen Lotosblüten versehen.

Die Göttersymbole Flügelsonne, Mond und Stern sind ebenfalls auf der Hamra-Stele abgebildet (Abb. 5). Sie sind in demselben Stil gehalten wie auf dem Kubus, so dass von einer zeitgleichen Aufstellung der beiden Objekte ausgegangen werden kann (Bawden *et al.* 1980, 84; Abu Duruk 1986, 61). Zusätzlich zeigt die Stele links neben der Flügelsonne ein weiteres Element. In sehr flachem Relief ist ein Udjat-Auge eingeritzt. Da es nicht wie die anderen Symbole in erhabenem Relief ausgearbeitet ist, handelt es sich wohl um eine spätere Ergänzung. Der Bereich oberhalb des Udjat-Auges ist beschädigt, der Platz wäre ausreichend für ein weiteres Dekorationselement. Ebenfalls stark beschädigt ist der Bereich zwischen den Symbolen und dem zehnzeiligen aramäischen Text. Links des Mondsymbols ist ein Kreis zu erkennen, der beidseitig zu etwa zwei Dritteln eingefasst ist. Dies lässt sich in Analogie zum Hamra-Kubus als eine von Stierhörnern gerahmte (Sonnen-)scheibe deuten. Bis zum Beginn der ersten Textzeile ist ausreichend Platz vorhanden, um einen stehenden Stier zu rekonstruieren. Die Rekonstruktion eines stehenden Stieres konnte anhand einer Untersuchung des Originals im Nationalmuseum von Riad bestätigt werden. Der Verlauf von Brust, Vorderbein und Rücken sowie die Reste eines Weihrauchbrenners vor dem Stier sind dort noch zu erkennen.

Das ikonographische Element der Scheibe zwischen den Hörnern gehört in den ägyptischen Kulturkreis. Stier- bzw. Kuhgottheiten werden in dieser Form repräsentiert. Das ägyptische Pantheon kennt eine Reihe heiliger Stiere, deren Verehrung auf die Bedeutung und den Nutzen des Rindes in der Landwirtschaft zurückgeht und das daher als Träger von Fruchtbarkeit galt. Als die bedeutendsten Stiergötter sind Apis, Buchis und Mnevis zu nennen, deren Kulte bis in die römische Zeit gut belegt sind.[25] Während die Darstellung des schreitenden bzw. stehenden Tieres den männlichen Rindern, d. h. den Stiergottheiten, vorbehalten ist, ist die Repräsentationsform des Bukraniums in Frontalansicht typisch für die Göttin Hathor. Es ist nicht davon auszugehen, dass auf den beiden Seiten des Hamra-Kubus verschiedene Gottheiten abgebildet sind. Offenbar sind hier zwei verschiedene ägyptische Darstellungsweisen miteinander verbunden worden bzw. es wurden die bereits bestehenden Darstellungskonventionen um die (Sonnen-)scheibe ergänzt.

In dem auf dem Kubus und der Stele dargestellten Stier kann eine Repräsentation des Gottes Ṣalm vermutet werden (Hausleiter 2012; anders Dalley 1985; 1986). Verschiedene Formen des Gottes Ṣalm sind aus zahlreichen Quellen Nordwestarabiens bekannt, wobei die Frage, ob es sich um eine Mond- oder Sonnengottheit handelt, bisher unbeantwortet ist (vgl. hierzu u. a. Maraqten 1996, 19–22). In Zusammenhang mit der ägyptischen Ikonographie ist der Text der Taymāʾ-Stele aus dem Louvre (AO 1505) interessant, der in dieselbe Zeit wie beide Monumente aus Qasr al-Hamra zu datieren ist.[26] Dieser berichtet von der Einführung eines Kultes für Ṣalm von *hgm* durch Salmshezeb, den Sohn des Petosiris (*pṭsry*). Dem gräzisierten Namen Petosiris entspricht die ägyptische Form *pȝ-dj-Wsr*(*.w*) ‘der, den (der Gott) Osiris gegeben hat’, eine Namensform, die von der Spätzeit bis in die römische Kaiserzeit häufig bezeugt ist.[27] Auch in der aramäischen Nebenüberlieferung ist der Name Petosiris mehrfach vertreten. Allein in

[25] Zu ägyptischen Stierkulten allgemein Otto 1938; Winter 1983.

[26] Zur Taymāʾ-Stele zuletzt Briquel-Chatonnet – Robin 1997, 261–262 (Nr. 200). Eine Neubearbeitung der Stele durch Peter Stein ist in Vorbereitung. Zur chronologischen Abfolge der Taymāʾ-Stele und der etwas späteren Stele aus Qasr al-Hamra siehe den Beitrag von Stein in Band II der Taymāʾ Reihe.

[27] Ranke 1935, 123.1; Lüddeckens *et al.* 1980–2000, I 298–299; zu den Varianten in der griechischen Form siehe ebenfalls Lüddeckens *et al.* 1980–2000, I 298–299.

Abb. 3 *Sandsteinkubus aus Qasr al-Hamra, Seite A (Foto: DAI, Orient-Abteilung, G. Sperveslage).*

الشكل ٣ مكعب من الحجر الرملي من قصر الحمراء، الجانب A (الصورة: معهد الآثار الألماني/ سبيرفسلاغه).

Abb. 4 *Sandsteinkubus aus Qasr al-Hamra, Seite B (Foto: DAI, Orient-Abteilung, G. Sperveslage).*

الشكل ٤ مكعب من الحجر الرملي من قصر الحمراء، الجانب B (الصورة: معهد الآثار الألماني/ سبيرفسلاغه).

Abb. 5 *Stele aus Qasr al-Hamra (Foto: DAI, G. Sperveslage).*

الشكل ٥ شاهدة من قصر الحمراء (الصورة: معهد الآثار الألماني/ سبيرفسلاغه).

den aramäischen Dokumenten aus Ägypten finden sich 16 Bezeugungen für diesen Namen in vier verschiedenen Varianten (Porten – Lund 2002, 396). Dieselbe Schreibweise, die auf der Taymāʾ-Stele vorliegt, findet sich in zwei Texten aus Elephantine.[28]

Aufgrund des Namens kann zwar nicht auf eine ägyptische Herkunft geschlossen werden, da ägyptische theophore Namen auch für Nichtägypter häufig belegt sind.[29] Dennoch belegt der Name, dass Petosiris Kontakte nach Ägypten besaß. Ob eine Verbindung zwischen dem ägyptischen Namen auf der Taymāʾ-Stele und der ägyptischen Ikonographie der Gottheit besteht und ob Petosiris die Darstellungsweise vielleicht aus Ägypten mitbrachte, kann nur vermutet werden. Auffällig ist, dass die Repräsentation des Stierkopfes auf der Seite der Taymāʾ-Stele auf eine Sonnenscheibe verzichtet. Möglicherweise handelt es sich um zwei verschiedene Formen des Gottes Ṣalm, wobei der mit Qasr al-Hamra assoziierte Salm von *db* (bzw. *rb*) mit Sonnenscheibe dargestellt wird, während Salm von *hgm* ohne dieses ikonographische Merkmal wiedergegeben wird (hierzu ausführlich Hausleiter 2012).

---

[28] Porten – Lund 2002, 396 (Peṭosiri #2.001, #7.002).

[29] Vgl. in anderem Zusammenhang auch Maraqten 1996, 21.

3.3 Arabische Heiligtümer im Nildelta

Anders als die Adaption ägyptischer Ikonographie für den Gott Ṣalm stellt sich die Situation mehrerer arabischer Heiligtümer im östlichen Nildelta und auf dem Sinai dar. Aus dem Nildelta sind zwar nur indirekte Spuren in Form von epigraphischen Zeugnissen erhalten, doch die überlieferten Funde legen nahe, dass es Bauten gab, die in der Architektur und Ausstattung den Traditionen ihrer Erbauer entsprachen. Eines dieser Heiligtümer bestand um 400 v. Chr. in Tell el-Maskhuta, dem ägyptischen Per-Atum. Zwei weitere Heiligtümer errichteten die Nabatäer im 1. Jh. v. Chr. im Ostdelta. Ein drittes nabatäisches Heiligtum befindet sich in Qasrawet auf dem Sinai. Der Bautyp selbst ist nabatäisch, weist aber ägytisierende Architekturelemente auf, wodurch sich eine gewisse kulturelle Angleichung zeigt.

Von dem Heiligtum in Tell el-Maskhuta zeugen vier silberne Votivschalen, die sich heute im Brooklyn Museum befinden.[30] Alle vier tragen eine aramäische Inschrift mit Weihung an die Göttin Han'ilat, drei der Schalen nennen zudem die Namen der Stifter mit Filiation. Diese Namen sind insofern interessant, als sie eine stufenweise Akkulturation bezeugen. Während auf der ersten Schale der Name der weihenden Person wie die seines Vaters in nordarabischer Tradition steht, weist die zweite den Stifter als Träger eines ägyptischen Namens aus, während der Vater einen arabischen Namen trägt. Auf der dritten Schale sind schließlich beide Namen ägyptischen Ursprungs (vgl. Vittmann 2003, 182). Das legt nahe, dass wir es nicht mit einem Heiligtum für reisende Händler zu tun haben, sondern dass es eine ansässige arabische Gemeinschaft im Ostdelta gegeben hat, die sich über mehrere Generationen der ägyptischen Kultur so weit geöffnet hat, dass sie ägyptische Namen annahmen. Dabei handelt es sich offenbar nicht um einen zusätzlichen ägyptischen Namen, der parallel zum semitischen verwendet wurde. Diese Gepflogenschaft ist u. a. von den karischen Denkmälern aus Ägypten bekannt – hier werden Personen mit einem ägyptischen Namen, der in Hieroglyphen geschrieben ist, und einem davon verschiedenen karischen Namen in karischer Schrift ausgewiesen (Kammerzell 1993, 185). Im Falle der Votivschalen aus Per-Atum ist dagegen der ägyptische Name in aramäischer Schrift und zudem auf einem Objekt außerägyptischen Kontextes überliefert, womit anzunehmen ist, dass es sich um den einzigen, oder zumindest um den wichtigsten Namen des Stifters handelt.

Die Stammeszugehörigkeit der Stifter offenbart die erste Schale. Ihr Stifter ist 'Qainu, Sohn des Gashmu, König von Qedar'. Die Anwesenheit von Qedaritern im östlichen Nildelta erklärt möglicherweise die Überlieferung Herodots. Als die Perser unter Kambyses 525 v. Chr. Ägypten eroberten und zur persischen Satrapie erklärten, waren sie auf Unterstützung durch die arabischen Stämme angewiesen. Nicht näher bezeichnete 'Araber' gewährten den Persern freien Durchzug und versorgten Kambyses während des Feldzuges mit Wasser (Herodot III 7–9. 88; vgl. hierzu auch Honigman 2002, 52–54). Da das Stammesgebiet der Qedariter im Südosten des heutigen Jordanien und Norden Saudi-Arabiens mit dem Zentrum in der Oase Dumat al-Jandal lag, ist denkbar, dass es sich bei diesen Arabern um Qedariter handelte. Im Gegenzug für den freien Durchzug erhielten die Araber von den Persern offenbar Land und Steuerfreiheit zugesprochen (Herodot III 91). Eine vergleichbare Konstellation hatte bereits 671 v. Chr. die assyrische Eroberung Ägyptens durch Asarhaddon begünstigt (Retsö 2003, 158–161). Spätestens im ausgehenden 6. Jh. v. Chr. könnte so die qedaritische Gemeinde im Ostdelta entstanden sein, deren Präsenz dazu führte, dass diese Region, der 20. unterägyptische Gau, seit ptolemäischer Zeit als Gau Arabia bekannt ist (Helck 1974, 198). Herodot bezeichnete Per-Atum bereits als 'arabische Stadt' (Herodot II 158). Die Anwesenheit der Araber in der Region um Tell el-Maskhuta war demnach mehr als nur eine kurze Episode. Da in Per-Atum erst um 600 v. Chr.

[30] Zu den Schalen siehe insbesondere Dumbrell 1971; vgl. auch Winnicki 2009, 348–352.

unter Necho II. (26. Dynastie) Siedlungsspuren greifbar sind,[31] scheint die arabische Präsenz insgesamt sehr prägend für den Ort gewesen zu sein.

In Tell esh-Shuqafiya, einem Ort am Wadi Tumilat, wurde eine nabatäische Inschrift gefunden. Sie zeugt von der Errichtung eines Tempels für die nabatäische Göttin Al-Kutba' im vierten Jahr des Königs Ptolemaios (Strugnell 1959, 31–34). Um welchen der Ptolemäer es sich handelt, ist umstritten, es wurden Datierungen in das Jahr 44 oder 77 v. Chr. vorgeschlagen (Strugnell 1959, 35). Ein weiterer Tempel für Al-Kutba' befand sich im Nordwesten des Sinai beim heutigen Qasrawet (Netzer 2003, 95–99). Die Basis eines Altars mit einer entsprechenden Weihinschrift hat sich erhalten (Strugnell 1959, 34–35).

Eine zweite nabatäische Inschrift auf einer Stele aus Tell esh-Shuqafiya befindet sich heute im Museum von Hariyyat Raznah (Abb. 6 und 7).[32] Die kleine Stele ist mit den Maßen 21,5 x 23,5 cm nahezu quadratisch. Die Rückseite ist undekoriert und grob bearbeitet, die Vorderseite trägt eine siebenzeilige Inschrift. Der Inhalt ist die Widmung eines Schreines an den Hauptgott der Nabatäer, 'Dushares, der in Daphnae ist' (Jones *et al.* 1988). Dieses Heiligtum befand sich offenbar in Daphnae im östlichen Nildelta. Die Stele ist durch eine Dreifachdatierung durch das Jahr 14 Kleopatra VII., das Jahr 26 Malichus' I. und das Jahr 2 des Dushares-Priesters Atlah (vgl. Jones *et al.* 1988, 55) in das Jahr 37/36 v. Chr. datiert.

Die oben genannten Orte befinden sich entlang der Handelsrouten zwischen Ägypten und dem Nabatäerreich. Es ist somit nicht verwunderlich, dass an diesen vor allem in der Ptolemäerzeit stark frequentierten Verkehrswegen nabatäische Heiligtümer entstanden (Strugnell 1959, 35; Jones *et al.* 1988, 53–54; vgl. auch Winnicki 2009, 357–358). Die große Zahl nabatäischer Graffiti auf den Felswänden in den *wadi*s auf dem Sinai, zumeist aus dem 2. und 3. Jh. v. Chr., steht als Beleg für die Präsenz der Nabatäer auf dem Sinai (vgl. Vittmann 2003, 189–190; Jones *et al.* 1988, 52).

4 Handelswege und Handelswaren

4.1 Handelswege

Für den Warenverkehr zwischen Ägypten und Arabien standen der Land- und der Seeweg zur Verfügung. Beide Verkehrswege wurden zu verschiedenen Zeiten mit unterschiedlicher Intensität genutzt. Der Landweg war die Route der Weihrauchstraße, die im Westen der arabischen Halbinsel von Südarabien nach Norden führte, über Najran und Taymāʾ nach Petra und Gaza, von dort über den Sinai ins Ostdelta. Das Tor zu Ägypten war Per-Atum, das heutige Tell el-Maskhuta, im 20. unterägyptischen Gau. Die Route führte durch das Wadi Tumilat in die ägyptischen Zentren. Entlang des *wadi*s wurden bei Tell el-Jahudiya zwei thamudische Inschriften auf zwei Grabstelen aus spätantiker Zeit gefunden. Die Inschriften nennen die Namen zweier Brüder und bezeugen die Anwesenheit von Arabern in dieser Region, wo sie möglicherweise im römischen Militär dienten (Kensdale 1952).

Weitere Handels- und Verkehrswege führten über das Rote Meer und liefen verschiedene Häfen entlang der ägyptischen Küste an. Ausgehend von diesen Häfen verliefen Wüstenstraßen ins Niltal.[33] Von Norden nach Süden vorgehend, ist von den wichtigsten Routen zuerst die Via

---

[31] MacDonald 1980, 57. In der Zweiten Zwischenzeit gab es eine mittelbronzezeitliche Vorgängersiedlung, in der Zeit des Neuen Reiches bis zur 26. Dynastie war der Ort jedoch nicht besiedelt. Vgl. Paice *et al.* 1996.

[32] Inventar-Nr. 699. Mein herzlicher Dank gilt Helmut Brandl, Projekt M.i.N. Museen im Nildelta, für die Publikationerlaubnis der Abbildungen.

[33] Übersicht über die Verkehrswege u.a bei Winnicki 2000, 166–169; Sidebotham 1997; Sidebotham 2011, 125–174.

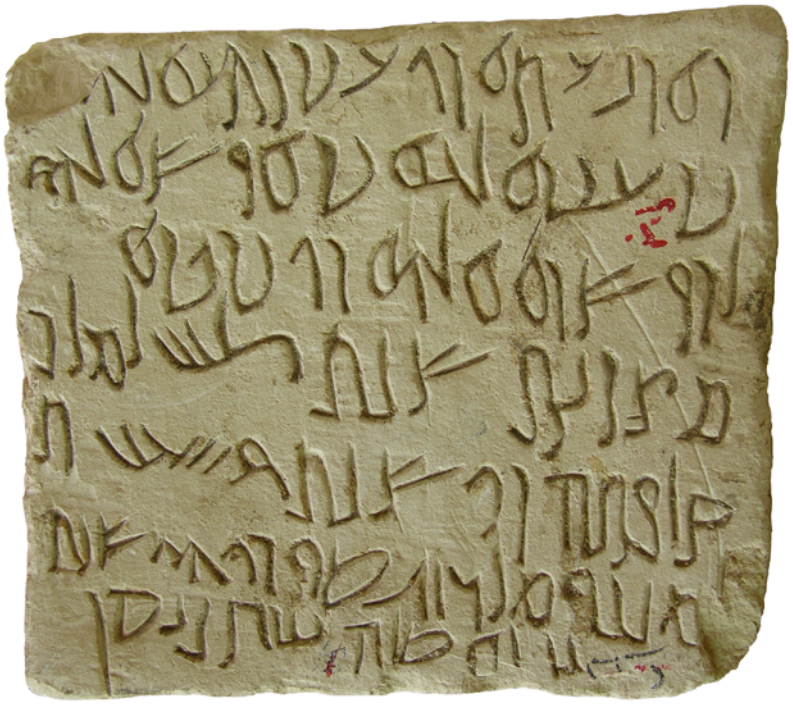


Abb. 6 *Nabatäische Stele aus Tell esh-Shuqafiya, Vorderseite (Foto: © Project M.i.N.).*

الشكل ٦ شاهدة نبطية من تل الشقافية، الوجه الأمامي (الصورة: *© Project M.i.N.*).

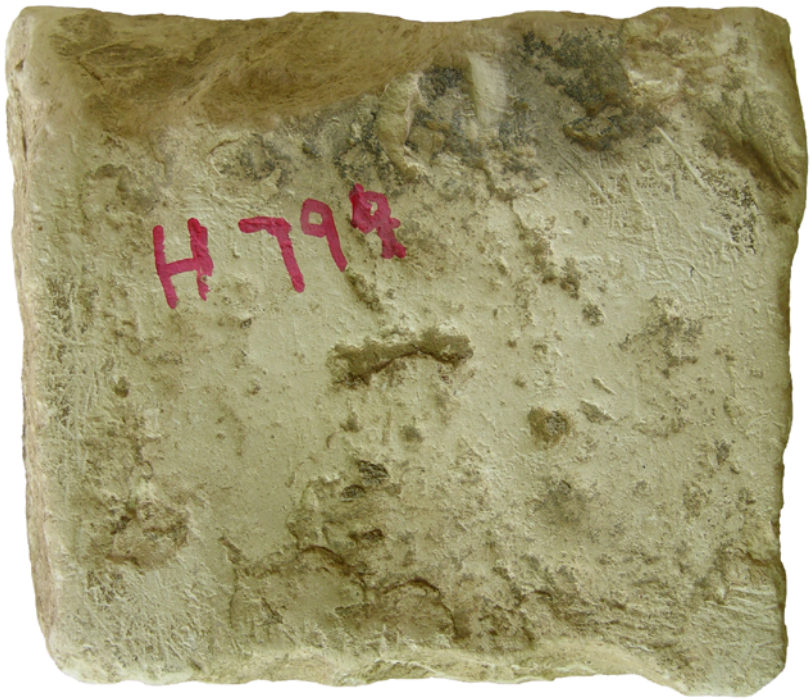


Abb. 7 *Nabatäische Stele aus Tell esh-Shuqafiya, Rückseite (Foto: © Project M.i.N.).*

الشكل ٧ شاهدة نبطية من تل الشقافية، الوجه الخلفي (الصورة: *© Project M.i.N.*).

Hadriana zu nennen, die von Antinoopolis zum Roten Meer führte und dann die Küste entlang bis Berenike im Süden verlief. Surveys entlang der Straße ergaben Nutzungsspuren aus dem 4. und 3. Jt. v. Chr. und dann erst wieder in der römischen Epoche ab der Zeit Hadrians. Eine zweite Route verlief von Qena an den römischen Steinbrüchen am Mons Claudianus und Mons Porphyrites vorbei nach Abu Sha'r, nördlich des heutigen Hurghada. Durch das Wadi Hammamat führte von Koptos nach Quseir eine dritte Route. Dieser Weg wurde bereits seit dem 3. Jt. v. Chr. genutzt, wie durch Felsinschriften bezeugt ist. Eine vierte Hauptroute schließlich führte von Berenike im Süden Ägyptens durch die Ostwüste nach Norden. Sie gabelte sich bei ad-Dweig; von hier führte eine Route westlich nach Edfu, die andere nach Norden, traf dort auf das Wadi Hammamat und folgte diesem bis nach Koptos (hierzu Sidebotham 1997). Im Wadi Hammamat sowie im Wadi Manih befinden sich einige wenige thamudische und altsüdarabische Felsinschriften, die die Durchreise von Arabern dokumentieren (Robin 1994, 296–297; Bülow-Jacobsen *et al.* 1995, 112–115; Tokunga 2003). Es handelt sich um kurze ein- bis zweizeilige Graffiti, die nicht mehr als die Namen der Durchreisenden nennen. Über ihre Funktion und den Grund ihres Aufenthaltes in der ägyptischen Ostwüste sagen sie allerdings nichts aus.

Der ägyptische Rotmeerhandel war wahrscheinlich bereits in vordynastischer Zeit etabliert. Die Provenienzbestimmung ägyptischer Obsidianfunde verweist in den südlichen Bereich des Roten Meeres (Zarins 1989; 1990). Ob der Obsidian von der arabischen Halbinsel importiert wurde, war lange fraglich, da die Zusammensetzung der Vorkommen in Arabien und Äthiopien/Eritrea sehr ähnlich ist. Die bisherigen Analysen ägyptischer Funde schienen eher nach Eritrea als in den Jemen zu verweisen (Aston *et al.* 2000, 46; Bavay *et al.* 2000, 13–17). Eine aktuelle systematische Untersuchung der einzelnen Obsidianvorkommen beidseits des südlichen Roten Meeres konnte dies bestätigen (Giménez *et al.* 2015). Somit ist die arabische Halbinsel als Provenienz des in Ägypten verwendeten Obsidians zwar auszuschließen, es ist jedoch möglich, dass er auf dem Schiffsweg über das Rote Meer nach Ägypten gelangt ist (Zarins 1989, 368; vgl. auch Bavay *et al.* 2000, 17–19). Zahlreiche Darstellungen auf prädynastischen Keramikgefäßen sowie Felsbilder in der Ostwüste zeigen Schiffe und belegen die nautische Aktivität in dieser Zeit. Umstritten ist, ob die abgebildeten Schiffe und Boote auf dem Roten Meer eingesetzt wurden oder ob sie allein der Nilschifffahrt dienten. Da sich die Felsbilder im westlichen Teil der Ostwüste befinden, scheint keine Verbindung zwischen den Darstellungen und dem Roten Meer zu bestehen, weshalb Rotmeerschifffahrt allgemein abgelehnt wird (Diskussion bei Hartung 2001, 332–335). Die Konzentration von Schiffsdarstellungen in der Ostwüste bei nur vereinzelten Belegen auf der Westseite des Nils scheint eine Verbindung zum Roten Meer jedoch nicht völlig auszuschließen.

Kontakte in den südlichen Bereich des Roten Meeres belegen zudem Muschelfunde aus der Siedlung von Maadi südlich von Kairo und dem zugehörigen Friedhof am Wadi Digla aus der ersten Hälfte des 4. Jts. v. Chr. Dort wurde eine große Zahl von Muscheln der Art *Ancilla acuminata* gefunden, die nur im südlichen Roten Meer und im Golf von Aden vorkommt (Boessneck *et al.* 1989, 119). Diese Muscheln dienten als Schmuckgegenstände. Der Apex war jeweils abgeschnitten, so dass die Muscheln als Kettenglieder aufgereiht werden konnten. Der Fund von 12 bis 18 dieser exotischen Muscheln in jeweils einem einzigen Grab zeigt, dass sie nicht als einzelne Kettenglieder, sondern als vollständige Kette getragen wurden. Dafür spricht auch, dass ausschließlich verhältnismäßig kleine Exemplare verwendet wurden (Boessneck *et al.* 1989, 119). Auch in den Gräbern von Badari (zweite Hälfte 5. Jt. v. Chr.) wurden Muscheln gefunden, die aus dem Roten Meer und dem Indischen Ozean stammen (Krzyżaniak 1977, 76–77). Hier wurden die Muscheln ebenfalls als Kettenglieder verwendet. In großer Zahl sind Muscheln und Schnecken vom Roten Meer auch in den Gräbern der unteren Bevölkerungsschichten in der Qau-Region belegt, wo sie aufgrund der fernen Herkunft als Prestigeobjekte der Breitenkultur angesehen werden können (Seidlmayer 2009).

Insgesamt lässt sich feststellen, dass in vordynastischer Zeit die Verbindung oberägyptischer Fundorte, neben den intensiven Kontakten nach Vorderasien, nach Osten und Süden, insbeson-

dere zum Roten Meer sehr ausgeprägt war.[34] Bei den Muschelfunden überwiegen die Arten aus dem Roten Meer gegenüber denen aus dem Mittelmeer (Boessneck 1988, 146; Krzyżaniak 1977, 76), Obsidian aus dem mediterranen und anatolischen Raum tritt dagegen weder im Delta noch in Oberägypten auf (Zarins 1989, 340–342). Mit den Unternehmungen der Ägypter bis zum südlichen Roten Meer war somit die Möglichkeit eines Kontaktes zur arabischen Halbinsel gegeben. Der Nachweis einer Überquerung des Roten Meeres fehlt allerdings für die vordynastische Zeit. Erst für das Mittlere Reich sind direkte Kontakte über das Rote Meer durch Funde von Keramik aus Südarabien an der ägyptischen Küste bei Mersa Gawasis bezeugt (Fattovich 2005, 19–20; Bard *et al.* 2007, 147; Manzo – Perlingieri 2007, 130–131; Manzo 2012).

4.2 Häfen an der ägyptischen Rotmeerküste

Über die Häfen an der ägyptischen Küste des Roten Meeres sind wir am besten aus den Quellen der ptolemäischen und römischen Epoche unterrichtet. Aus dieser Zeit stammen nicht nur Küstenbeschreibungen, namentlich der *Periplus Maris Erythraei,*[35] sondern auch Berichte klassischer Autoren über die wirtschaftlichen und militärischen Expansionen. Nach Strabo (XVI, 4–5) und Plinius (VI, 168) stammen die Häfen an der ägyptischen Küste des Roten Meeres aus ptolemäischer Zeit, ihre Gründung wird Ptolemaios II. zugeschrieben. Dabei handelt es sich aber in den meisten Fällen nicht um eine Neugründung, sondern lediglich um einen Ausbau, um die Vorherrschaft über die Handelswege über das Rote Meer bis hin nach Indien zu erlangen (Hölbl 2004, 54–57). Die ägyptische Präsenz am Roten Meer reicht dagegen weit in die pharaonische Zeit zurück.

Dies konnte in jüngerer Zeit durch Grabungen an zwei Stätten nachgewiesen werden. Ain Sukhna, südlich von Tell el-Maskhuta am Golf von Suez, sowie Mersa Gawasis, rund 20 km südlich von Safaga, lassen sich bis ins Alte bzw. Mittlere Reich zurück datieren. Die Funde aus beiden Stätten belegen bereits für diese Zeit Hafenfunktionen. In Ain Sukhna fanden sich Nachweise für Kupferminen und eine Verhüttungsindustrie. Nach Interpretation der Ausgräber waren die Minen bereits im Alten Reich ausgebeutet, da man aber die groß angelegte Infrastruktur zur Metallverarbeitung nicht aufgeben wollte, verschiffte man Rohmetalle aus den Kupferminen des Sinai über den Golf von Suez hierher zur Weiterverarbeitung (Abd el-Raziq *et al.* 2006). Die epigraphischen Funde aus Ain Sukhna weisen daher zum Sinai. Eine Inschrift aus der späten 11. Dynastie berichtet von einer Expedition, die von Ain Sukhna aus aufgebrochen ist, um Türkis und Kupfer zu holen (Abd el-Raziq *et al.* 2006). Ziel dieser Expedition kann nur der Sinai gewesen sein. Mehrere Inschriften nennen zudem Personen, die auch aus dem epigraphischen Material vom Sinai bekannt sind. Eine Felsinschrift aus der Zeit Amenemhets III. (um 1.800 v. Chr.) stammt beispielsweise von Iti, Sohn der Isis. Dieselbe Person ist zweimal in den Inschriften aus dem Wadi Maghara vertreten (Abd el-Raziq *et al.* 2002, 44–47. 108). Es sind also dieselben Personen beidseits des Golfes von Suez tätig. Als Verbindungsweg zwischen Ain Sukhna und dem Wadi Maghara ist nicht der Landweg, sondern der direkte Seeweg anzunehmen, wie sowohl die epigraphischen Belege zeigen, als auch die Funde von Schiffsplanken und Steinankern (Abd el-Raziq *et al.* 2002, 110–112; Abd el-Raziq *et al.* 2006).

Eine ähnliche Befundsituation bietet sich für Mersa Gawasis. Auch hier wurden zahlreiche Schiffsteile gefunden, die auf ausgedehnte nautische Aktivitäten schließen lassen. Zu den Funden gehören u. a. Planken, Steuerruder und Seile (Fattovich 2005; Bard *et al.* 2007; Ward – Zazzaro 2007). Die epigraphische Seite beleuchtet eine Stele aus der Zeit Amenemhets III. Sie gehört den beiden Brüdern Amenhotep und Nebsu, die im Auftrag des Königs eine Fahrt zum Weihrauchland Punt geleitet haben (Mahfouz *et al.* 2007, 219–221). Mersa Gawasis wurde demnach bereits seit

[34] Zu den prädynastischen Kontakten nach Vorderasien siehe Hartung 2001.

[35] Hier verwendete Edition: Casson 1989; vgl. auch Huntingford 1980.

dem Mittleren Reich, mindestens ab 1800 v. Chr., als Hafen für Fahrten auf dem Roten Meer genutzt.

Die Funde von Ain Suknha und Mersa Gawasis zeigen, dass die Westküste des Roten Meeres nicht erst in ptolemäischer und römischer Zeit eine wichtige Rolle in der Wirtschaft und Außenpolitik Ägyptens spielte. Es gab hier bereits im Mittleren Reich Häfen, von denen Expeditionen zum Sinai und ins Weihrauchland Punt ausgingen. Zu dieser Zeit bestanden ebenfalls bereits Kontakte zur arabischen Halbinsel. Unter den Funden aus Mersa Gawasis befanden sich mehrere Keramikfragmente, die von der südarabischen Küste aus der Region um Aden stammen (Fattovich 2005, 19–20; Bard *et al.* 2007, 147; Manzo – Perlingieri 2007, 130–131; Manzo 2012). Chronologisch reichen die Keramikfunde vom ausgehenden 3. Jt. v. Chr. bis ins frühe 1. Jt. v. Chr., so dass nicht ein vereinzelter Kontakt, sondern vielmehr über einen langen Zeitraum kontinuierlicher Austausch stattgefunden hat. Die Ausgräber vermuten, dass Personen aus der Region von Aden an den ägyptischen Rotmeer-Expeditionen teilnahmen und so die jemenitische Keramik nach Mersa Gawasis brachten (Bard – Fattovich 2007, 251). Denkbar ist jedoch auch, dass die Gefäße von ägyptischen Expeditionen aus Südarabien mitgebracht wurden.

In ptolemäischer und römischer Zeit bestand das wirtschaftliche Interesse an einer Umgehung der Weihrauchstraße, was dazu führte, dass die direkten Kontakte ausgebaut und intensiviert wurden. Von den Häfen an der Rotmeerküste verliefen die Schifffahrtswege direkt nach Arabien und bis nach Indien. Die bedeutendsten Häfen in dieser Zeit waren Quseir am Ausgang des Wadi Hammamat, das mit dem antiken Myos Hormos identifiziert werden muss (s. u.), sowie Berenike. Beide Stätten sind durch archäologische Untersuchungen gut bekannt;[36] im Fundmaterial befand sich ebenfalls südarabische Keramik. Gefunden wurden Vorratsgefäße und Kochgeschirr, teils waren die Gefäße mit südarabischen Graffiti versehen (Tomber 2004; Tomber 2008; Sidebotham 2011).

4.3 Häfen an der arabischen Küste

Die Präsenz von Arabern in Mersa Gawasis wirft die Frage nach Häfen an der arabischen Küste des Roten Meeres auf, von denen aus direkter Kontakt nach Ägypten bestand. Ein in den 1980er Jahren durchgeführter Survey entlang der Westküste Saudi-Arabiens hat keine eindeutigen Hinweise auf einen derartigen Hafen liefern können (Ingraham *et al.* 1981). Aus dem *Periplus Maris Erythraei* ist hingegen bekannt, dass es in römischer Zeit eine wichtige Anlaufstelle gegeben hat. Bevor die Häfen Südarabiens erreicht werden, wird als einziger Hafen Leuke Kome auf der Ostseite des Roten Meeres genannt. Hierbei handelt es sich vielleicht um denselben Ort, den Plinius als Ampelone kennt (Plinius Nat. Hist. IV 159; vgl. Tarn 1929, 21–23; Sidebotham 1986, 3; 2011, 175–177).

Die Lokalisierung von Leuke Kome bereitet allerdings einige Schwierigkeiten, obwohl seine Position in Bezug auf Myos Hormos und Berenike, beide auf der ägyptischen Seite des Roten Meeres, im Periplus beschrieben ist. Der Verfasser des Periplus gibt an, dass sich Leuke Kome nördlich von Berenike befindet und zwei bis drei Tagesreisen *(dromoi)* östlich von Myos Hormos liegt.[37] Der Hafen befand sich demnach annähernd auf derselben geographischen Breite wie Myos Hormos, womit die von Huntingford vorgenommene Ansetzung gegenüber von Berenike bei Yanbu al-Bahr ausgeschlossen ist (Huntingford 1980, 100).

---

[36] Zu Quseir und dem Indienhandel Meyer 1992; Peacock – Blue 2006; Peacock – Blue 2011; zu Berenike Sidebotham 2011.

[37] Periplus Kap. 19; Casson 1989, 61. Die Position von Leuke Kome ist als „links von Berenike“ angegeben, was in Hinblick auf das vorhergehende Kap. 18 („rechts von Berenike“) aus der Orientierung einer Person zu sehen ist, die vom Hafen von Berenike auf das Meer blickt. „Links“ meint somit „nördlich“. Mein herzlicher Dank gilt Frank Feder für die Diskussion des Periplus.

Ein Problem stellte lange die Lokalisierung von Myos Hormos dar. Dieser Hafen wurde traditionell mit dem heutigen Abu Sha'r, nördlich von Hurghada, identifiziert. Infolge dessen wurde Leuke Kome auf der gegenüberliegenden Seite am Eingang des Golfes von 'Aqaba bei Aynunah gesehen (Kirwan 1984; Sidebotham 1986, 124; vgl. auch Ingraham *et al.* 1981, 77–78). Inzwischen ist aufgrund neuer epigraphischer Funde klar, dass Myos Hormos nicht mit Abu Sha'r, sondern mit dem etwa 80 km weiter südlich liegenden Quseir al-Qadim zu verbinden ist (Bülow-Jacobsen *et al.* 1994; Whitcomb 1996; Peacock – Blue 2006; 2011). Entlang des Wadi Hammamat wurden in römischer Zeit zahlreiche Polizeistationen errichtet, an denen Reisende und Händler Abgaben und Zölle zu leisten hatten. Mit al-Zarqa wurde eine dieser Stationen ca. 65 km von Quseir al Qadim entfernt ergraben. Es wurden zahlreiche auf Ostraka erhaltene Briefe aus dem 2. Jh. n. Chr. gefunden, in acht der Briefe erfolgt eine Nennung von Myos Hormos. Aus dem Kontext geht hervor, dass es sich nur um einen Ort am Ausgang des Wadi Hammamat handeln kann, womit der Hafen bei Quseir al-Qadim mit dem antiken Myos Hormos zu identifizieren ist.[38] Diese Ansetzung entspricht zudem exakt den im Periplus angegebenen Entfernungen. Die Strecke von Myos Hormos bis Berenike wird mit 1.800 Stadien angegeben (Kap. 1), nach 4.000 Stadien folgt Ptolemais Theron (Kap. 3) und nach weiteren 3.000 Stadien Adoulis (Kap. 4). Während Ptolemais Theron nicht lokalisiert ist,[39] sind Berenike und Adoulis bekannt. Die Entfernung zwischen Berenike und Adoulis beträgt nach dem Periplus 7.000 Stadien und steht damit im Verhältnis von 39:10 zur Entfernung zwischen Myos Hormos und Berenike. Die Distanz zwischen Berenike und Adoulis beträgt etwa 1.100 km, die Strecke von Myos Hormos müsste nach dem Entfernungsverhältnis im Periplus ca. 280 km betragen. Dies entspricht exakt der Distanz zwischen Quseir al-Qadim und Berenike, während Abu Sha'r 80 km zu weit nördlich und damit in einer Entfernung von rund 2.300 Stadien zu Berenike liegt.[40]

Aufgrund dessen muss eine Lokalisierung von Leuke Kome bei Aynunah ausgeschlossen werden. Nach den Angaben des Periplus liegt Leuke Kome zwei bis drei Tagesreisen östlich von Myos Hormos, also in etwa auf derselben geographischen Breite. Gegenüber von Myos Hormos/ Quseir al-Qadim befindet sich das heutige al-Wadjh. Diese Position scheint der wahrscheinlichste Ort für eine Lokalisierung Leuke Komes zu sein (vgl. Nappo 2010). Al-'Ula, das antike Dedan, befand sich seit dem 1. Jh. v. Chr. unter nabatäischer Herrschaft, so dass wahrscheinlich auch al-Wadjh von den Nabatäern kontrolliert wurde. Insofern besteht kein zwingender Grund, aus der Angabe im Periplus, dass von Leuke Kome ein Landweg in die Nabatäerhauptstadt Petra führt, eine Lokalisierung am Golf von Aqaba anzunehmen. Von al-Wadjh führte die Route nach al-'Ula und schließlich von dort über die Weihrauchstraße nach Petra. Ein Oberflächensurvey in der Gegend von al-Wadjh konnte zwar weder römische noch nabatäische Keramik bezeugen (Ingraham *et al.* 1981, 78), doch ist keineswegs auszuschließen, dass eine intensivere Begehung bzw. eine Grabung die entsprechenden Nachweise liefert. Der negative Befund eines Surveys kann nicht ausreichend sein, um einen antiken Hafen in dieser Region auszuschließen.

---

[38] Bülow-Jacobsen *et al.* 1994; Whitcomb 1996; die von Bongrani Fanfoni 1997 vertretene Lokalisierung von Myos Hormos bei Port Safaga lässt die Ostraka aus al-Zarqa außer Acht. Bongrani Fanfonis Hinweis auf die heutige Bedeutung von Port Safaga kann nicht überzeugen; das Argument, der Hafen von Quseir sei eine moderne künstliche Anlage und daher als antiker Hafen auszuschließen, widerspricht den dortigen Grabungsergebnissen. Der antike Hafen Quseir al-Qadim war in römischer Zeit ein wichtiger Umschlagplatz für den Indienhandel, vgl. hierzu z.B. Peacock – Blue 2006; Peacock – Blue 2011; Tomber 2008.

[39] Ptolemais Theron wird entsprechend der Entfernungsangaben im Periplus südlich von Port Sudan zwischen Suakin und Aqiq angenommen, vgl. Casson 1989, 100–101.

[40] Vgl. Whitcomb 1996. Auf diese Diskrepanz von 500 Stadien hat bereits Casson in seiner Edition des Periplus hingewiesen (Casson 1989, 97).

4.4 Handelswaren

Betrachtet man nun die Handelswaren, die zwischen Ägypten und Arabien ausgetauscht wurden, wird man zuerst von Weihrauch und Myrrhe sprechen müssen. Beides wurde seit dem Alten Reich bei religiösen Praktiken in den ägyptischen Tempeln verwendet. Ab wann Weihrauch aus Arabien importiert wurde ist ungewiss. Die Ägypter bezogen ihren Weihrauch zunächst aus Punt, die erste Expedition dorthin ist unter Sahure in der 5. Dynastie belegt (um 2450 v. Chr.). Auch spätere Quellen aus dem Mittleren und Neuen Reich liefern Berichte über Fahrten nach Punt und den Import von Weihrauch, edlen Ölen, Edelsteinen und anderen kostbaren Dingen.

Die Frage nach Kontakten zwischen Ägypten und der arabischen Halbinsel, insbesondere nach Handelskontakten und der Einfuhr von Weihrauch, ist eng mit der Lokalisierung von Punt verbunden, da dieses wiederholt mit Südarabien identifiziert wurde (Meeks 2003). Bereits in den Quellen des Alten Reiches ist Punt (ägyptisch *pwn.t*) als wichtigstes Importland für Weihrauch und Myrrhe belegt. Die Darstellung einer Expedition nach Punt auf den Wänden des Hatschepsut-Tempels in Deir al-Bahari aus dem Neuen Reich ist die detailreichste Informationsquelle zu den Handelsfahrten in diese Region. Weihrauch liefernde Gewächse der Art *Boswellia* kommen am nördlichen Horn von Afrika sowie im Südosten der arabischen Halbinsel vor. Somit kann Punt nur in einer der beiden Regionen lokalisiert werden und entsprechend wurden in der Forschung beide Ansätze vertreten. Das Punt-Problem und die unterschiedlichen Forschungsmeinungen an dieser Stelle darzustellen, verbietet der zur Verfügung stehende Raum, generell besteht jedoch in der Ägyptologie ein weitgehender Konsens, Punt auf der afrikanischen Seite des Roten Meeres zu lokalisieren.[41] Dies wurde zuletzt von Breyer auch linguistisch untermauert. Eine altägyptische Bezeichnung der Einwohner von Punt lautet *ḫbst.jw* ‘die Bärtigen’ und ist mit dem modernen Toponym Abessinien etymologisch verwandt (Breyer 2016, 530–535). Dieser sprachliche Nachweis macht eine Lokalisierung in der Grenzregion zwischen Nubien und Abessinien wahrscheinlich. Dieser Ansatz wird auch hier favorisiert, weshalb die Punt-Expeditionen nicht als Handelskontakte zur arabischen Halbinsel angesehen werden.

Der erste sichere Beleg für die Einfuhr von Aromata aus Arabien scheint die Inschrift auf dem Sarkophag des Zayd’il aus ptolemäischer Zeit zu sein (Abb. 8). Der Sarkophag aus Sykomorenholz befindet sich im Museum von Kairo und weist eine dreizeilige minäische Inschrift auf (Kairo SS 27/B 4; Sayed 1984; Robin 1994, 291–296; Vittmann 1998, 1241–1244; 2003, 183–186). Die Inschrift berichtet, dass der Minäer Zayd’il, Sohn des Zayd, von der Sippe Zayran, die ägyptischen Tempel mit Myrrhe und Kalmus versorgte und im Tempelbezirk des Osiris-Apis nach ägyptischen Ritus bestattet wurde. Interessant ist die Tatsache, dass ein Minäer ein Begräbnis in einem ägyptischen Heiligtum erhält. Dies kann nur mit einer fortgeschrittenen Akkulturation erklärt werden, für die sich auch weitere Anzeichen in der Inschrift finden. So enthält der minäische Text zwei ägyptische Lehnwörter, zum einen den Begriff *b’*, entsprechend dem ägyptischen *bꜣ* ‘Seele’, zum anderen das Wort *tmḫ*, das auf das ägyptische *tꜣ mnḫ.t* ‘Geschenk; Gewand; Opfergabe’ zurückgeht (Robin 1994, 295–296; Vittmann 2003, 186). Ein weiteres ägyptisches Lehnwort wurde im einleitenden Formular der Inschrift gesehen. Der Ausdruck *ḏwb* wurde als ‘der Wab-Priester’ gelesen und der Text dahingehend gedeutet, dass Zayd’il ein Priesteramt in einem ägyptischen Tempel innehatte (Vittmann 1998, 1241–1243; vgl. auch Robin 1994, 294). Der lautliche Zusammenhang zwischen dem minäischen *ḏwb* und dem ägyptischen *wꜥb*, insbesondere der Ausfall des Ajin, ist von Vittmann plausibel begründet worden (Vittmann 1998, 1242), das Formular der minäischen Inschriften verlangt an dieser Stelle hinter der Nennung des Hauptclans Zayran jedoch einen zweiten spezifizierenden Clan-Namen, die Angabe des Amtes wäre ungewöhnlich.[42]

---

[41] Eine Übersicht über Forschungsstand und Forschungsgeschichte mit ausführlichen bibliographischen Hinweisen findet sich bei Breyer 2016.

[42] Persönliche Mitteilung von Norbert Nebes. Vgl. dazu auch Robin 1994, 294.

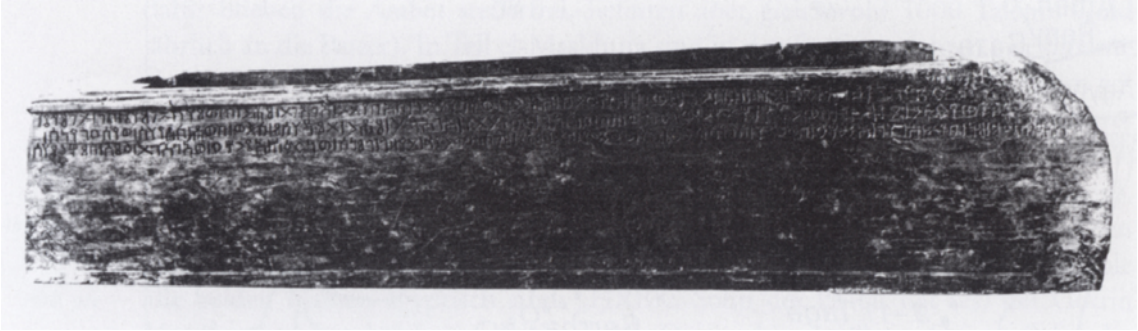


Abb. 8 *Sarkophag des Zayd'il (aus: Robin 1994, Fig. 8).*

الشكل ٨ تابوت زيد إل (المصدر: Robin ١٩٩٤، Fig. 8).

Die Tatsache, dass ein Clan-Name *Wb* in den minäischen Dokumenten im Gegensatz zu Zayran bisher nicht bezeugt ist, kann als Argument nicht überzeugen, da auch für mehrere andere Clan-Namen nur singuläre Belege vorliegen (vgl. Beeston 1984, 100 gegenüber Sayed 1984, 94). In Bezug auf die Beziehungen zwischen Ägypten und Arabien ist der Nachweis, dass ein Minäer in einem ägyptischen Tempel dient, jedoch keineswegs notwendig, denn die kulturelle Vermischung und enge Verbundenheit Zayd'ils mit Ägypten zeigt sich bereits in den Lehnwörtern *b'* und *tmḫ* sowie im Ort seiner Bestattung.

Einen weiteren Beleg hat ein Händler aus Aden in Koptos hinterlassen (Wagner 1976). Im Bereich des Tempels von Koptos fand sich ein griechischer Inschriftenblock mit einer Widmung an Isis und Hera. Gestiftet wurde der Stein in der Regierungszeit Vespasians von „Hermeros, Sohn des Athenion, aus Aden". Anders als im Fall des Zayd'il trägt hier der Stifter keinen semitischen, sondern einen griechischen Namen. Ob es ein Zweitname ist, den er im Rahmen seiner Handelsbeziehungen mit dem hellenisierten Ägypten verwendete, entzieht sich unserer Kenntnis. Dieselbe Person ist bereits von einem Ostrakon aus Koptos bekannt. Hier erfährt man, dass Hermeros ein Weinhändler war (Wagner 1976, 279–280).

Neben dem Import von Aromata und der oben bereits besprochenen Einfuhr von Obsidian und Muscheln, sind wir über Importwaren aus Arabien fast ausschließlich durch griechische und lateinische Papyri unterrichtet. Die Quellen fallen in ptolemäische bis byzantinische Zeit. Hier werden arabische Schafe und arabische Wolle sowie Kamele genannt. Bei den Kamelen ist auffällig, dass häufig der Zusatz „mit arabischen Brandzeichen" vermerkt ist (Harrauer 1983, 60–61). Dies kann als ein Gütezeichen verstanden werden und belegt die Wertschätzung der arabischen Herkunft. Weiterhin fällt auf, dass das überlieferte Material keine Importe von Werk- und Industriestoffen, Lebensmitteln oder Luxusgegenständen verzeichnet. Dies ist insofern bemerkenswert, da zu derselben Zeit aus anderen Regionen Dinge wie Weine, Öle, Heilpflanzen, Gewänder, Schmuck und auch Sklaven in großer Zahl eingeführt wurden (vgl. die Aufstellungen bei Harrauer 1983). Das Interesse Ägyptens an arabischen Waren scheint sich in ptolemäischer und römischer Zeit neben Räucherwerk auf Schafe und Kamele zu beschränken. Rückschlüsse auf die pharaonische Zeit lassen sich aus den späten Quellen jedoch nur bedingt ziehen.

Im Gegenzug stellt sich die Frage, welche Güter Ägypten nach Arabien exportierte. Mit dieser Frage stößt man sogleich auf ein großes Hindernis. Aus der pharaonischen Zeit existiert zwar eine große Zahl an Berichten über Handelsexpeditionen und die importierten Waren, in vielen Gräbern sind Personen ausländischer Herkunft abgebildet, wie sie ihre landestypischen Waren und Güter dem Pharao darbringen. Der Wareneingang wird in der Regel als Tribut verzeichnet und als eine untertänige Abgabe des fremdländischen Herrschers angegeben (vgl. Bleiberg 1996; Hallmann 2006). Auf den Preis der Waren und die Art der Bezahlung wird dabei nicht hingewiesen. Hier ist zwischen dem Austausch von Waren, bei denen mit einer dem materiellen Wert entsprechenden Gegenleistung zu rechnen ist, und dem Geschenkaustausch zwischen Herr-

scherhäusern zu unterscheiden. Bei letzterem wurde zwar ebenfalls ein Gegengeschenk erwartet, neben dem materiellen Wert war jedoch der symbolische Wert entscheidend (vgl. hierzu Faist 2001, 9–32).

Solche Waren, die von den Königen untereinander als Geschenke ausgetauscht werden, sind in den Amarnabriefen genannt. Darunter befinden sich u. a. Möbel, Edelmetalle und Edelsteine. Hieraus lassen sich jedoch keine allgemeinen Aussagen über Handelswaren gewinnen, die genannten Geschenke zeigen lediglich, welche ägyptischen Prestigegüter im Ausland geschätzt wurden (vgl. Helck 1975, 263–264). Einen Sonderfall stellt auch der 'Antikenhandel' in der Hyksoszeit dar. In der Zeit der Fremdherrschaft wurden insbesondere Statuen und Steingefäße aus der Zeit des Alten und Mittleren Reiches nach Vorderasien und in die Ägäis verhandelt (Helck 1975, 179).

Nur wenige Quellen geben direkte Auskunft über Warenexporte im Sinne des Warenaustausches. Im Bericht über eine Puntexpedition unter Ramses III. (19. Dynastie) heißt es, die Schiffe seien bei ihrem Aufbruch nach Punt „beladen mit den Produkten Ägyptens" (pHarris I 77,8–78,1; Text bei Breasted 1906, IV 203–204). Präziser sind die Angaben zur Puntexpedition unter Hatschepsut in der 18. Dynastie. Hier werden die Produkte im Einzelnen genannt: Die ägyptische Delegation überbrachte „Brot, Bier, Wein, Fleisch, Früchte sowie alle Dinge, die es in Ägypten gibt" (Text bei Breasted 1906, II 108). Die neuägyptische Erzählung der Reise des Wenamun aus der 21. Dynastie nennt ebenfalls Zahlungsmittel. Der Papyrus berichtet von der Mission des Wenamun, in Byblos Holz zum Bau einer Götterbarke zu kaufen. Die Bezahlung sollte in Gold und Silber erfolgen. Als dem Helden der Geschichte die Zahlungsmittel gestohlen wurden, musste er sich Ersatz aus Ägypten nachsenden lassen. Ein Bote brachte ihm mehrere Gold- und Silbergefäße, Leinen und Stoffe, Seile, Linsen sowie Fisch (Text bei Breasted 1906, IV 274–287; vgl. auch Helck 1975, 264–265).

Es ist demnach in erster Linie mit Exporten zu rechnen, die sich nicht oder nur bei außerordentlichem Erhaltungszustand im archäologischen Material niederschlagen, also Lebensmittel, Kleider, Stoffe, Flechtwerk oder auch Kosmetika.[43] Unter den exportierten Lebensmitteln ist auch Salz anzunehmen, das im Binnenhandel und in Lebensmittelzuweisungen große Bedeutung hatte. Der Salzhandel wurde in ptolemäischer Zeit vom Staat kontrolliert, Exporte sind bisher nur für diese Epoche belegt (Helck 1965, 847; Fuchs 1984, 371–372). In ptolemäischer und römischer Zeit wurde auch Papyrus für den Export in den Mittelmeerraum, insbesondere nach Rom hergestellt (Aufrère 2005).

Wie die Ägypter ihre Importe aus Arabien bezahlt haben, kann nur anhand dieser Aufstellung vermutet werden. Abgesehen vom römischen Glas, das in Qaryat al-Faw und auf Bahrain gefunden wurde, sind keine Prestige- und Luxusgüter ägyptischer Herkunft von der arabischen Halbinsel bekannt. Sowohl archäologische Nachweise wie epigraphische Quellen fehlen bisher. Die in Arabien und speziell in Taymāʾ gefundenen ägyptischen Objekte, kleine Amulette und Skarabäen, können nicht als Entgelt für Waren angesehen werden. Ob sie in diesem Zusammenhang als Prestigegüter anzusprechen sind, muss offen bleiben, da es sich bei diesen Objekten um Massenware handelt, die mit geringem Kosten- und Materialaufwand hergestellt wurden. In Qantir wurden bisher ca. 10.000 Modeln zur Amulett-Herstellung gefunden, in Amarna ca. 5.000. Diese Zahlen verdeutlichen recht eindrucksvoll die Produktionsmengen der dortigen Fayence-Werkstätten. Diese Objekte stellen Nebenprodukte des Handels dar, die zwar den Handelskontakt belegen, aber nicht die Handelsware sind. Als Handelsware müssen beim aktuellen Kenntnisstand vergängliche Güter, sowie Metalle und Edelsteine angenommen werden. Darüber hinaus besteht die Möglichkeit eines Durchgangshandels. So können Straußeneier und Elfenbein aus Afrika über Ägypten auf die arabische Halbinsel verbracht worden sein. Ein Indiz für diesen Handelsweg

[43] Vgl. hierzu die Aufstellung bei Helck 1971, 370–427. Die Situation ist in Assyrien vergleichbar, hier gehören Textilien zu den Hauptexportwaren, siehe Faist 2001, 73–75.

können die Elfenbeinfunde aus Areal O sowie die Straußeneiperlen aus den Arealen O, H und C in Taymāʾ sein. Die Kenntnisse über die Art der Handelskontakte kann zukünftig eventuell durch weitere naturwissenschaftliche Untersuchungen verbessert werden.

Ob die Amulette und Skarabäen direkt aus Ägypten nach Taymāʾ gelangten, oder ob sie über Zwischenhändler ihr Ziel fanden, lässt sich nicht sagen. Das Vorkommen von figürlichen Amuletten in den Gräbern bezeugt jedoch ein exotisches Interesse an ägyptischen Motiven und Symbolen. Dass es sich dabei um Objekte mit magischer Wirkung handelt, nämlich Schutzamulette, ist nicht überraschend, da die ägyptische Religion schon früh ihre Wirkung über das Niltal hinaus ausgestrahlt hat. Inwieweit allerdings mit den Motiven auch Funktionen aus dem ägyptischen Kulturkreis übernommen wurden oder ob sie einer völligen Neuinterpretation unterlagen, lässt sich anhand der wenigen Funde derzeit nicht beantworten.[44]

Auch die Quellen zur Richtung der Handelswege sind spärlich. Durch die Inschrift des Zayd'il ist bekannt, dass Minäer ihre Waren nach Ägypten brachten und dort verkauften. Weitere Texte aus Südarabien berichten von Minäern, die von erfolgreichen Handelsreisen zurückgekehrt sind. Aus Maʿin und Baraqish sind insgesamt vier Texte aus der zweiten Hälfte des 1. Jts. v. Chr. bekannt, in denen Ägypten genannt ist (Robin 1994, 286–290). Über die Details der Handelexpedition und die ausgetauschten Waren schweigen die Inschriften allerdings.

Belege für eine ägyptische Handelsexpedition nach Arabien fehlen, abgesehen von einer Felsinschrift Ramses' III. nördlich von Taymāʾ, die jedoch nur die Namen des Königs und keine Angaben über die Hintergründe ihrer Anbringung enthält (Sperveslage – Eichmann 2012; Sperveslage 2016, 308–310; Somaglino – Tallet 2011; Somaglino – Tallet 2013). Aufgrund der dünnen Überlieferungslage ist eine von den Ägyptern entsandte Expedition nicht auszuschließen. Da der Weihrauchhandel aber von südarabischen Herrschern kontrolliert wurde und hier das Handelsmonopol lag, ist eher mit einer alleinigen Distribution des Weihrauches durch südarabische Handelskarawanen zu rechnen.

5 Ägyptische Aussenpolitik

Die arabische Halbinsel ist nie von Ägypten unterworfen worden, auch einzelne Feldzüge sind nicht belegt. Anders als die Assyrer und Babylonier strebten die Ägypter keine Kontrolle des Weihrauchhandels durch die Einnahme strategisch wichtiger Oasen an. In der Spätzeit war zudem die Möglichkeit einer militärischen Expansion aufgrund der innenpolitischen Situation nicht gegeben. Im frühen Neuen Reich, als Ägypten unter Thutmosis III. seine größte Ausdehnung erfuhr und in Vorderasien bis zum Orontes vorstieß, war die Machtposition der Oasensiedlungen offenbar noch nicht ausgeprägt genug, dass eine Eroberung für Ägypten interessant gewesen wäre. Dennoch hat sich aus der Zeit Ramses III. eine offizielle Inschrift in der Umgebung von Taymāʾ gefunden.[45] Es handelt sich um eine Felsinschrift, die in zwei senkrechten Kolumnen und einer waagerechten Zeile Titulatur und Namen Ramses III. (20. Dynastie) nennt. Die Inschrift bezeugt die Präsenz einer ägyptischen Expedition in bzw. bei Taymāʾ, liefert allerdings keine Angaben, ob es sich um eine Handelsexpedition oder eine militärische Aktivität handelt. Auch die Anwesenheit des ägyptischen Königs selbst lässt sich nicht ableiten.

In späterer Zeit gab es Auseinandersetzungen zwischen den Ptolemäern und den Nabatäern um die Kontrolle der Handelswege (Tarn 1929, 15–16; Hölbl 2004, 56). Die Ptolemäer versuchten den Landweg zu umgehen und die Aromata Südarabiens auf dem Seeweg zu importieren, um so Abgaben und Zölle zu vermeiden. Der Versuch einer militärischen Eroberung wurde erst in

[44] Zu dieser Problematik generell Hölbl 1979, I 229–239.

[45] Al-Ansary 2011b; Somaglino – Tallet 2011; Somaglino – Tallet 2013; Sperveslage – Eichmann 2012; Sperveslage 2016.

römischer Zeit unternommen. Der gescheiterte Feldzug des Aelius Gallus ist in Hinblick auf die Beziehungen zwischen Ägypten und Arabien aber nur in sofern interessant, da er von Ägypten aus begonnen wurde. Aelius Gallus war Präfekt von Ägypten, Nachfolger des Gaius Cornelius Gallus, dem nach der Eingliederung Ägyptens ins Römische Reich die erste Statthalterschaft über Ägypten übertragen worden war. Durch die Eroberung Arabiens sollte ein indirekter Schlag gegen das parthische Großreich geführt werden (Marek 1993), wodurch zugleich die Handelsrouten unter römische Herrschaft gebracht und der Indienhandel erschlossen werden konnte. Nach der erfolglosen Belagerung Maribs musste der Feldzug jedoch abgebrochen werden, Aelius Gallus verlor zudem das Präfektenamt.[46]

5.1 Eine ägyptische Eroberung Arabiens? Der Sesostris-Roman

Aus späten demotischen und griechischen Quellen erfahren wir von einem Feldzug, den ein König mit Namen Sesostris nach Arabien unternommen habe, doch ist die Historizität dieses Ereignisses keineswegs gesichert, da es durch keine zeitgenössischen Belege gestützt wird. Sowohl Herodot als auch Diodor schildern Sesostris als einen kriegerischen König, der zahlreiche militärische Operationen durchführte. Diodor überliefert, Sesostris sei von seinem Vater mit einer Armee nach Arabien entsendet worden und hätte das gesamte Volk der Araber unterworfen. Als er nach dem Tod seines Vaters die Regentschaft erhielt, habe er seine Eroberungszüge ausgeweitet (Diodor I 53). Auch bei Herodot unternimmt ein König namens Sesostris einen Feldzug in nordöstlicher Richtung. Arabien ist zwar nicht ausdrücklich als Ziel genannt, doch in Hinblick auf die Überlieferung Diodors anzunehmen. Zunächst, so Herodot, sei Sesostris mit seiner Kriegsflotte bis in den Indischen Ozean vorgedrungen und habe alle von ihm angetroffenen Völker unterworfen. Dann sei er aufgrund von Unwegsamkeiten zurückgekehrt und habe den Eroberungszug auf dem Landweg vollendet (Herodot II 102; vgl. auch die Schilderung bei Strabo XVI 4.4). Den Darstellungen der griechischen Historiker fehlt zweifelsohne die historische Schärfe, denn sie vermischen in der Figur des Königs Sesostris[47] die Könige dieses Namens aus der 12. Dynastie mit den Überlieferungen späterer Könige, insbesondere Ramses II. (19. Dynastie), Scheschonk I. (22. Dynastie) und Psammetich I. (26. Dynastie). Aufgrund des Charakters einer Volkserzählung wundert es nicht, dass Fragmente eines griechischen Romans überliefert sind, welche eine nahezu identische Geschichte erzählen (Stephens – Winkler 1995, 246–266). Der König, der nach seiner militärischen Ausbildung auf Anweisung seines Vaters zu einem Feldzug nach Arabien aufbricht, heißt hier Sesonchosis und meint fraglos ebenso Sesostris. Der arabische Fürst, gegen den die Aktion gerichtet ist, trägt den Namen Webelis;[48] er kann fliehen, während seine Truppen vernichtend geschlagen werden. Überliefert ist der Roman in zwei Handschriften auf Papyrusfragmenten aus Oxyrhynchos, die Ende 3. bis Anfang 4. Jh. n. Chr. datiert werden.[49] In Hinblick auf die Überlieferung bei Herodot und Diodor weist die Erzählung demnach eine lange Tradition auf. Der Ursprung des Romans wurde zunächst aufgrund des Namens des Protagonisten in Ägypten vermutet, doch ein Vergleich mit anderen griechischen Romanen zeigt z.B. starke Ähnlichkeiten in der Erzählstruktur zwischen dem Sesonchosis-Roman und dem Ninos-Roman (Text bei Stephens – Winkler 1995, 23–71), so dass Stephens und Winkler auf eine griechische Herkunft schlossen (Stephens – Winkler 1995, 248–249). Inzwischen belegen jedoch zwei bisher

[46] Zum Feldzug des Aelius Gallus siehe von Wissmann 1976; Marek 1993 sowie zuletzt Kaumanns – Sperveslage 2015.

[47] Sesostris bei Herodot, Sesoosis bei Diodor.

[48] Webelis reflektiert möglicherweise den südarabischen Herrschernamen Wahbil; vgl. López Martínez 1998/1999, 224.

[49] P. Oxy. 1826, 2466 und 3319; zur Datierung Stephens – Winkler 1995, 251, 255.

unpublizierte demotische Papyri aus Tebtynis (pCarlsberg 411 und 412; Widmer 2002) sowie ein Ostrakon in Leipzig (Ostrakon Leipzig UB 2217; Ryholt 2010) den ägyptischen Ursprung. Alle drei Texte stellen Fragmente einer größeren Erzählung dar, bei der es sich ebenfalls um einen Prinzen namens Sesostris und dessen Militärkampagnen handelt. Ein Großteil der Handlung findet in Nubien und Äthiopien statt, doch auch ein Zug nach Syrien sowie gegen das „Land von Arabien" (*p3 t3 n 3lbj*) sind bezeugt (Widmer 2002, 390). Die Existenz drei verschiedener Handschriften desselben Textes belegt deutlich, was Diodor zu berichten wusste: die Erzählung um Sesostris war im ganzen Land verbreitet, bei den Ägyptern, deren Priester und Dichter sein Loblied sangen (Diodor I, 53).

In der ägyptischen Tradition war eine Volkserzählung um den Heldenkönig Sesostris entstanden, basierend auf historischen Ereignissen und Figuren, aber auch geschmückt mit späteren Gegebenheiten. Dass es sich dabei um eine literarische Verarbeitung und nicht um Geschichtsschreibung handelt, muss nicht betont werden. Diese Erzählung war so populär, dass Herodot und Diodor daraus schöpften und aus ihnen historische Ereignisse formten – dies mag in der Wahrnehmung der Ägypter tatsächlich Geschichte gewesen sein. Die Verbreitung im griechischen Kulturraum führte zum Sesonchosis-Roman als einer freien Nachdichtung der demotischen Überlieferung.[50]

Im Zusammenhang mit den Beziehungen zwischen Ägypten und Arabien zeigt die Erzählung um Sesostris, dass es in der Wahrnehmung der Ägypter einen Zeitpunkt gegeben hat, in der Arabien ihnen unterworfen war. Diese Erinnerung hängt mit dem historischen Wissen zusammen, dass insbesondere unter Sesostris I. und Sesostris III. das ägyptische Reich nach dem Zerfall des Alten Reiches und der Ersten Zwischenzeit konsolidiert wurde und die Südgrenze weit in den nubischen Raum verschoben wurde. Dazu kommt wahrscheinlich die Erinnerung an die Feldzüge Thutmosis III. nach Vorderasien, mit denen er Ägypten zu seiner größten Ausdehnung führte. Der Ägypter der Spätzeit kannte dagegen ein Reich, das weitgehend auf das Niltal beschränkt war und zudem von Fremdherrschern regiert wurde. In einer verklärenden Wahrnehmung war ihm – in früheren Zeiten heroischer Pharaonen – die gesamte bekannte Welt unterworfen, einschließlich Arabiens.

Die Suche nach einem historischen Kern der Sesostris-Überlieferung ist jedoch nicht ganz so aussichtslos, wie es zunächst scheinen mag. Die demotische Fassung der Erzählung nennt den Vater des Prinzen mit dem Namen Amenemhet. Durch die Generationenfolge können nur Amenemhet I. und Sesostris I. gemeint sein.[51] Sesostris I. sicherte in mehreren Feldzügen Unternubien bis zum 2. Nilkatarakt, wobei sein Hauptaugenmerk jedoch der inneren Ordnung des Reiches galt. Zu Beginn seiner Regentschaft ist allerdings ein Feldzug gegen Beduinen im Norden belegt. Dieser fand unter der Leitung des Generals Nesmonth im 24. Regierungsjahr des Königs Amenemhet I. statt und fällt damit in die Zeit der zehnjährigen Koregenz von Amenemhet I. und Sesostris I.[52] Das historische Dokument ist die Stele des Nesmonth, die hinter den für Grabstelen konventionellen Texten und Darstellungen eine kurze historische Notiz folgen lässt.[53] Nesmonth berichtet hier, dass er einen militärischen Schlag gegen Beduinenvölker an der Nordostgrenze Ägyptens geleitet und diese bezwungen habe. Dabei wird es sich aber kaum um Araber gehandelt haben, sondern

---

[50] Für einen ägyptischen Ursprung des Sesonchosis-Romans spricht auch die Verwendung ägyptischer Personennamen, zudem widerspricht der Roman nicht der demotischen Erzähltradition, vgl. Quack 2005, 28. Zur Übersetzung ägyptischer, d. h. demotischer Texte ins Griechische am Beispiel des *Mythos vom Sonnenauge* vgl. auch Hoffmann 2000, 215–216.

[51] Zwar käme auch Sesostris II. als Sohn Amenemhets II. in Frage, doch ist dieser König in seiner kurzen Regierungszeit historisch kaum in Erscheinung getreten und im Gegensatz zu Sesostris I. und Sesostris III. sind keine Feldzüge und militärischen Aktivitäten bezeugt. Vgl. Schneider 2002, 266–267.

[52] Die Annahme einer Koregenz ist nicht unumstritten, entschiedener Gegner ist Obsomer 1993; vgl. aber Schneider 2006, 170–172.

[53] Stele Louvre C1; siehe hierzu Breasted 1906, I 227; Müller 1900, 46–49; Obsomer 1993.

um nomadisierende Stämme auf dem Sinai. Die verwendete Bezeichnung für die Beduinen lautet *ḫr.w-šˁ* 'Sandbewohner', eine unspezifizierte Bezeichnung für Beduinenstämme östlich des Nildeltas, die bereits in den Grabinschriften des Alten Reiches belegt ist.[54] Möglicherweise war dieser Feldzug Sesostris' I., bzw. eine verklärte Erinnerung daran, die historische Vorlage für den Sesostris-Roman.

5.2 Nabonid und Ägypten

Die Person des babylonischen Königs Nabonid ist eng mit der Geschichte Taymāʾs verbunden, so eng, dass sie auch in Bezug auf Ägypten nicht unberücksichtigt bleiben kann. Die Verlegung seiner Residenz in die Oase ist aus keilschriftlichen Quellen gut bekannt, heute belegen zudem archäologische Funde von Keilschrifttexten sowie Felsinschriften seine Präsenz in Taymāʾ.[55] In ägyptischen Quellen ist Nabonid vor der ptolemäischen Epoche bisher nicht bezeugt, aus der Überlieferung bei Herodot erfahren wir jedoch von einem Bündnis gegen das von Kyros II. geführte Perserreich, das der Lykerkönig Kroisos mit Sparta, Nabonid sowie Amasis eingegangen sei (Herodot I, 77). Der Zeitpunkt dieses Bündnisses ist unbekannt, als Eckdaten für eine Datierung können die Regierungszeiten von Amasis (570–526) und Nabonid (556–539) gelten.[56] Damit könnte dieses Abkommen, bei aller gebotenen Vorsicht in Bezug auf die Glaubwürdigkeit Herodots, innerhalb des zehnjährigen Aufenthaltes Nabonids in Taymāʾ anzusetzen sein – und es wäre denkbar, dass eine Gesandtschaft des Amasis zur Besiegelung dieses Abkommens nach Taymāʾ reiste.

Ein Nachweis für eine ägyptische Gesandtschaft in Taymāʾ wurde wiederholt in den Harran-Stelen gesehen.[57] Der babylonische Text berichtet jedoch nicht von einem konkreten Ereignis. Vielmehr wird die optative Aufforderung im Namen der Götter Sîn und Ištar ausgesprochen, dass „die Könige vom Lande Ägypten, vom [Land der Med]er, vom Land der Ar[aber und] die Gesamtheit der fei[nd]lichen Könige z[u] Friedens[schluß und guten Beziehungen (Boten)]" (Text nach Schaudig 2001, 497) zu Nabonid senden mögen. Eine Verbindung zwischen dem Stelentext und der Überlieferung bei Herodot kann nicht hergestellt werden, da die Meder, d.h. die Perser, im Text der Harran-Stelen zum Friedensschluss eingeladen sind, sich das Bündnis bei Herodot aber ausdrücklich gegen die Perser richtet.

Prinzipiell steht einem Friedensvertrag zwischen Amasis und Nabonid nichts entgegen, da die Auseinandersetzungen zwischen Ägypten und Babylon unter Nebukadnezar zu enden scheinen. Zu Beginn seiner Regierung war Apries noch gegen Nebukadnezar in Palästina ins Feld gezogen, musste jedoch zurückweichen. Nachdem er dann aufgrund seines gescheiterten Militärzuges gegen Kyrene als König abgesetzt wurde, bestieg Amasis den Thron. Apries floh nach Babylon und gewann Nebukadnezar zu einem Eroberungszug nach Ägypten, um auf diese Weise den verlorenen Thron zurück zu gewinnen. Die babylonischen Truppen wurden jedoch von Amasis geschlagen, Apries selbst fand den Tod. Von weiteren Auseinandersetzungen zwischen Ägypten und Babylonien ist nichts bekannt. Bisher gibt es auch keine Zeugnisse dafür, ob es noch unter Nabonid ägyptische Exulanten an der babylonischen Residenz gab. Doch da nicht nur ein ägyptischer

---

[54] Grabinschrift des Pepinacht, Urk. I 134.16 (= Sethe 1933, 134).

[55] Keilschrifttexte: Eichmann *et al.* 2006, 169–174; Schaudig 2010; Hausleiter – Schaudig 2010a; Hausleiter – Schaudig 2010b. Felsinschriften: Müller – al-Said 2002; al-Said 2009; Schaudig im Druck.

[56] Vermutlich fällt die Eroberung Lydiens durch Kyros II. in den Zeitraum zwischen 550 und 540 v. Chr. (vgl. Schaudig 2001, 24), die traditionelle Datierung in das Jahr 547 v. Chr. (vgl. u. a. Beaulieu 1989, 80–81) beruht auf einer falschen Lesung in der Nabonid-Chronik. Siehe hierzu Schaudig 2001, 25, Anm. 108; Rollinger 2008, 56. Ich danke Hanspeter Schaudig für diesen Hinweis.

[57] Al-Said 2000, 39–42. Auf die Harran-Stelen beziehen sich offenbar auch al-Ansary – Abu al Hassan 2005, 24.

König wie Apries, sondern auch Privatleute am babylonischen Hof Zuflucht gesucht haben,[58] wäre die Anwesenheit von Exilanten in Taymāʾ am Hof des Nabonid keine Überraschung.

6 Bevölkerung

6.1 Arabische Bevölkerung in Ägypten

Bereits im Neuen Reich könnte es Araber in Ägypten gegeben haben. Die Belege hierfür finden sich in den in ägyptischen Quellen vorliegenden ausländischen Personennamen. Eine Herleitung aus einer bestimmten semitischen Quelle ist nicht immer eindeutig zu ermitteln, für manche Namen lässt sich jedoch eine Ableitung aus dem Frühnordarabischen wahrscheinlich machen.[59] Inwieweit hinter jedem arabischen Personennamen auch tatsächlich ein Araber steckt, lässt sich nicht feststellen. Wäre dies der Fall, so hätten sie zum Teil auch höhere Positionen inne gehabt oder wären als Elternteil eines Beamten oder Würdenträgers belegt.

Ansässige arabische Bevölkerung gab es ab der Spätzeit im Ostdelta, im Fayum und in Mittelägypten, über die insbesondere aus ptolemäischer Zeit Zeugnisse vorliegen. Daneben durchzogen nomadisierende Gruppen arabischer Herkunft die Ostwüste (Winnicki 2000). Möglicherweise suchten sie die Nähe zum Nil wegen der Versorgung mit Wasser und Lebensmitteln.

Araber stellten in ptolemäischer Zeit neben Griechen, Persern und Juden einen größeren Teil der ausländischen Bevölkerung Ägyptens.[60] Anhand der überlieferten Steuerlisten aus dem Fayum lässt sich ihre Zahl beziffern. Mitte des 3. Jhs. v. Chr. betrug ihr Anteil im Arsinoitischen Gau 1,7 %, gemessen an einer Gesamtbevölkerung von 46.990 Einzelpersonen. In der Stadt Athenas Kome lag der Wert mit 7 % noch um einiges höher.[61] Für das Ostdelta, speziell den arabischen Gau, liegen keine Angaben vor. Aufgrund der für Daphnae und Tell el-Maskhuta belegten arabischen Heiligtümer sollte auch hier von einer arabischen Bevölkerung ausgegangen werden, deren Anteil an der Gesamtbevölkerung vielleicht noch höher einzuschätzen ist als im Fayum.

Im ptolemäischen Ägypten besaßen Araber eine privilegierte Stellung, da sie, ebenso wie Griechen und Perser, von der Obolos-Steuer befreit waren (Clarysse – Thompson 2006, 159–160). Die Obolos-Steuer war eine jährlich zu entrichtende Steuer in Höhe eines Obolos, was dem Lohn von ein bis zwei Arbeitstagen entsprach (Clarysse – Thompson 2006, 71–72). Unter der Berücksichtigung, dass insbesondere im landwirtschaftlichen Bereich Arbeit als Tagelöhner üblich und somit weder eine fortlaufende Beschäftigung noch ein regelmäßiges Einkommen gewährleistet war, stellte der Erlass der Obolos-Steuer eine starke Entlastung für die befreite Bevölkerungsschicht dar. Dass Araber zu dieser Zeit vor allem in der Landwirtschaft beschäftigt waren, geht u. a. aus den Papyri des Zenonarchives hervor (Boswinkel 1983). Hier sind Araber hauptsächlich als Hirten von Kleinviehherden genannt, seltener als Aufseher oder Boten. Landwirtschaftliche Tätigkeit ist ebenfalls in einem aus Mittelägypten stammenden demotischen Papyrus des späten 4. Jhs. v. Chr. für Araber bezeugt (Spiegelberg 1931, Nr. 13. 10). Auch die Beschäftigung des *Wjlw*, Sohn des *ʿwm3jlw*, aus dem Jahr 69 v. Chr. ist im ländlichen Bereich zu suchen. Dieser trägt den Titel ‘Diener des Horus’, doch ist hierin keine Stellung im Tempelkult zu sehen, sondern vielmehr ein Statustitel niedriger Tempelangestellter, die als Hirten, Bauern, Händler o. ä. im Dienste des Tempels agieren (Lüddeckens 1988; Vittmann 1998, 1248). Auch in der von Liesker

[58] Zu Ägyptern in Sippar in neubabylonischer Zeit siehe Zadok 1992 sowie Bongenaar – Haaring 1994. Vor Apries war bereits Psammetich I. ins Exil an den assyrischen Hof geflohen.

[59] Belege bei Schneider 1992, 358–359.

[60] Eine Zusammenstellung lieferte zuletzt Winnicki 2009, 306–339.

[61] Die Perser stellten vergleichsweise 0,3 % der Bevölkerung im Fayum, die Griechen 16 %, hierzu Clarysse – Thompson 2006, 159–160.

und Tromp zusammengetragenen Liste von Arabern in ptolemäischen Papyri fallen 13 von 17 Tätigkeiten in den landwirtschaftlichen Bereich, darunter auch ein Tennenwächter.[62] Dazu treten Beschäftigungen als Gymnasiarch, Soldat und Barbier, sowie die bereits angesprochenen Boten aus dem Zenonarchiv. Letztere fungieren als Überbringer von Nachrichten und Geld. Zu den Wächter- und Aufseherfunktionen, die die Araber im Fayum innehatten, gehörte offenbar auch die Aufstellung einer Polizeitruppe. Ihr fiel die Aufgabe zu, den Eingang zum Fayum zu kontrollieren und gegen Schmuggler und andere Verbrecher vorzugehen.[63] Die arabische Bevölkerung im ptolemäischen Ägypten gehörte somit im Wesentlichen zwei sozialen Schichten an. Araber waren zum einen in der Landwirtschaft, meist in der Schaf- und Ziegenhaltung, tätig. Diese Beschäftigungen konnten im Wirtschaftsbereich eines Tempels liegen. Zum anderen verdienten sie ihren Lohn als Aufseher und Wächter.

Wie die Quellen zeigen, scheinen die Araber ihre tribalen Strukturen beibehalten zu haben. Ihre soziale Gemeinschaft war durch Dekardarchen und Älteste organisiert, die auch als Sprecher für sie eintreten und Löhne einfordern (Clarysse – Thompson 2006, 160–161; Honigman 2002, 61). In einem Brief aus der Mitte des 3. Jhs. v. Chr. werden zwei Araber als Dekardarchen ausgewiesen. In ihnen sind sicherlich nicht im griechischen Wortsinne die Anführer einer Dekurie zu sehen, sondern die Vorsteher einer Gruppe von Arabern unbestimmter Größe, vielleicht einer Familie oder einer Sippe.

Ein Graffito aus dem Grab Ramses IV. im Tal der Könige bezeugt, dass Araber nicht nur als Arbeitskräfte und Sicherheitspersonal in Ägypten tätig waren. Hier hinterließ ein Mann, der sich als Olympichos Arabs bezeichnete, eine kurze Namensinschrift – er scheint das Grab als Tourist besucht zu haben (Baillet 1926, 108, Nr. 485, Taf. 19; Liesker – Tromp 1986, 87, Nr. 16).

Auffällig ist, dass nur wenige der namentlich bekannten Araber einen semitischen Namen tragen,[64] während die meisten einen griechischen oder ägyptischen Namen besitzen. E. Boswinkel (1983, 35) führt diesen Umstand darauf zurück, dass Aussprache und Schreibweise der arabischen Namen den Behörden und Arbeitgebern des ptolemäischen Ägypten Schwierigkeiten bereiteten, die dann durch einen geläufigen griechischen bzw. ägyptischen Namen umgangen worden seien. Das vereinzelte Auftreten von semitischen Namen, wie die des *Wjlw*, Sohn des *ʿwmɜjlw*, im spätptolemäischen Papyrus Lüddeckens II (Lüddeckens 1988, 56; Müller 1988; Honigman 2002, 50–51) oder des Zayd'il, Sohn des Zayd, auf dem minäischen Sarkophag in Kairo zeigen, dass dies keine gängige Praxis gewesen ist. Eher ist von einer Akkulturation der Araber auszugehen, die sich in der Annahme griechischer und ägyptischer Personennamen manifestiert.[65] Die in den Papyri genannten Personen sind möglicherweise bereits seit mehreren Generationen in Ägypten ansässig.

Der Sarkophag des Zayd'il im Museum von Kairo ist gleichzeitig die einzige bekannte Bestattung eines Arabers in Ägypten. Die Herkunft des Sarkophages ist allerdings nicht gesichert. Der Fayum wurde als Provenienz angegeben, der Inhalt der minäischen Inschrift lässt jedoch vermuten, dass sein Inhaber im Bereich des Serapeums von Sakkara bestattet war (Sayed 1984, 96; Vittmann 2003, 184).

---

[62] Liesker – Tromp 1986, 87–88; diese Liste schließt die Nennungen im Zenonarchiv ein.

[63] Clarysse – Thompson 2006, 175–176; zur militärischen Funktion siehe auch Hennig 2003, 165–168; Honigman 2002, 62–69.

[64] Nur drei der 41 bei Liesker – Tromp 1986, 87–88 gelisteten Personen haben einen semitischen Namen (Nr. 7, 13, 38), dabei handelt es sich zudem um drei Brüder; vgl. auch Vittmann 2003, 187; Winnicki 2009, 314.

[65] Man denke u. a. an die ägyptischen Namen der karischen Bevölkerung (Kammerzell 1993, 182–189) oder die z. T. semitischen Namen der ägyptischen Frauen in den 'Hierodulenlisten' von Maʿīn (hierzu unten sowie insbesondere Müller – Vittmann 1993).

6.2 Ägypter in Arabien

Die Spuren, die die Ägypter in Arabien hinterlassen haben, sind, zumindest in Bezug auf die Präsenz von Einzelpersonen, sehr spärlich. Es ist fraglich, ob es sich bei dem auf der Taymāʾ-Stele genannten Petosiris tatsächlich um einen Ägypter handelt. Der Personenname drückt keine ethnische Zugehörigkeit aus, sondern allenfalls eine kulturelle Hinwendung. Man wird daher sicherlich annehmen können, dass Petosiris über direkte oder indirekte Kontakte nach Ägypten verfügte, alles weitere führt jedoch in den Bereich der Spekulation.

Dasselbe gilt für weitere Personennamen mit theophorem Element, die u. a. in Graffiti aus Taymāʾ, al-ʿUla und Qaryat al-Faw bezeugt sind (Macdonald 1991; Müller – Vittmann 1993, 9; Sima 1999, 58–59; 2001, 162–166; Müller 2002, 267). Die Namen lassen sich als ‘Dienerin der Isis’, ‘Diener der Isis’ sowie ‘Diener des Osiris’ auffassen. Das Namenselement für ‘Dienerin’bzw. ‘Diener’ ist jeweils semitisch gebildet (*ʾmt* bzw. *ʿbd*), der Göttername ist aus dem Ägyptischen abgeleitet. Der Göttername Isis spiegelt dabei nicht die griechische Form wider, sondern geht entweder direkt auf die ägyptische Namensform oder auf eine aramäische Zwischenform zurück (Sima 2001, 166). Daraus lässt sich schließen, dass diese Namen bereits in vorhellenistischer Zeit auf der arabischen Halbinsel Verbreitung fanden. Aus dem südarabischen Raum sind derartige Personennamen allerdings nicht bekannt (vgl. Sima 2001, 166). In den ‘Hierodulenlisten’ von Maʿin tritt zwar ein solcher Name auf, doch der Cotext der Inschrift offenbart für eine Frau namens *ʾmtʾṯ* ‘Dienerin der Isis’ eine Herkunft aus Gaza.[66] Der Name besagt also auch hier nichts über die ethnische Abstammung. Das Vorkommen der mit Isis und Osiris gebildeten Personennamen auf der arabischen Halbinsel belegt vielmehr die Beliebtheit ägyptischer Götter in den arabischen Kulturen, wie sie auch durch die ägyptische Ikonographie im Götterkult von Taymāʾ bezeugt ist (s. o.).

Eine ägyptische Herkunft kann also nur bei Personen gelten, die durch den entsprechenden Cotext der Inschrift als Ägypter ausgewiesen sind. Belege, die diesen Anforderungen entsprechen, sind nur in geringer Zahl bekannt. So findet sich unter den zahlreichen Felsinschriften und Graffiti in der Umgebung von Taymāʾ am Jebel Ghuneim, einer Landmarke ca. 10 km südwestlich der Oase, eine kurze Inschrift in thamudischer Schrift, in der von einer Ägypterin die Rede ist. Das Graffito wird allerdings unterschiedlich gelesen. Winnett und Reed sahen den Beginn der Inschrift als Verbalform an und gaben den Text mit „lay with an Egyptian woman“ wider.[67] Dagegen sieht al-Said hier einen Personennamen und liest „Bi, die Ägypterin“ unter Verweis auf den in Ägypten belegten weiblichen Namen *bj* (Al-Said 2003, 59–60). Dieser Name ist jedoch nur ein einziges Mal auf einer Holzstatuette des Mittleren Reiches bezeugt (Ranke 1935, 93.7). Weitere ähnliche ägyptische Namen sind ebenfalls nur im Mittleren Reich und im Neuen Reich belegt, Zeugnisse für die Spätzeit fehlen.[68] Aufgrund dieser zeitlichen Differenz erscheint die Ansetzung des ägyptischen Personennamens unwahrscheinlich, jedoch aufgrund der Tatsache, dass die Mehrzahl der ägyptischen Personennamen nur ein einziges Mal bezeugt ist, nicht ausgeschlossen.

Eine weitere wichtige Quelle für Ägypter in Arabien sind die ‘Hierodulenlisten’ (Mlaker 1943; Bron 1998, 102–121). Hierbei handelt es sich um Inschriften auf Stelen, die bis Ende des 19. Jhs. im Tempelhof der Minäerhauptstadt Maʿin, dem antiken Qarnawu, standen. Auf ihnen erscheinen in formularartiger Liste die Namen ausschließlich fremdländischer Frauen unter Angabe ihres Herkunftsortes. Ursprünglich wurde der Inhalt der Stelen dahingehend interpretiert, dass diese Frauen als Hierodulen für den Tempelkult geweiht wurden. Aufgrund neuerer linguistischer Erkenntnisse gelten sie inzwischen als Dokument für die Heirat zwischen Minäern und ausländischen Frauen (Müller – Vittmann 1993, 1). Insgesamt werden 24 verschiedene Länder bzw.

---

[66] Zur Lesung als *ʾmtʾṯ* anstelle von *ʾmzʾṯ* siehe Müller – Vittmann 1993, 9–10; vgl. auch Sima 2001, 165.

[67] Winnett – Reed 1970, 106, Nr. 37. Dieser Lesung hat sich Vittmann 2003, 190, 278 Anm. 49 angeschlossen.

[68] Vgl. Ranke 1935, 93.8–12. Das Demotische Namenbuch (Lüddeckens *et al.* 1980–2000) verzeichnet keine Einträge, die als Entsprechung in Frage kämen.

Städte als Herkunft der Frauen genannt, die alle entlang der Weihrauchstraße liegen und somit im wirtschaftlichen Handelsimperium der Minäer von Bedeutung sind. Man wird daher vermuten dürfen, dass es sich um politische Heiraten in Verbindung mit den Handelsbeziehungen handelte. Robin (1994, 301) hat betont, dass die Stelen aufgrund ihrer Größe und Qualität als sehr teuer anzusehen sind und somit nur von der obersten Gesellschaftsschicht verfasst worden sein können. In den Listen sind mehr als 70 Frauen genannt, von denen acht aus Ägypten stammen *(bn Mṣr)*. Für diese acht Frauen sind sechs verschiedene Namen bezeugt (Müller – Vittmann 1993; Robin 1994, 297–301). Bemerkenswert ist, dass nur zwei der sechs Namen ägyptischen Ursprungs sind,[69] die übrigen Frauen haben offenbar nach ihrer Heirat und ihrer Eingliederung in die minäische Gesellschaft semitische Namen angenommen. Zwei der Namen sind im Altsüdarabischen gut belegt, weisen jedoch Parallelformen im Ägyptischen auf. Sie lassen so die Interpretation einer Lehnübersetzung zu.[70]

7 Zusammenfassung

Die Beziehungen zwischen Ägypten und der arabischen Halbinsel lassen sich über einen langen Zeitraum verfolgen. Zwar sind die Quellen nur sehr spärlich, zeigen dafür jedoch eine große Varianz und eine lange zeitliche Erstreckung. Gerade die archäologischen Grabungen in Taymāʾ haben in den vergangenen Jahren interessantes Fundmaterial geliefert, das neues Licht auf die Kontakte nach Ägypten wirft. Nicht nur ägyptische Objekte in Form von Amuletten und Skarabäen sind in funerären und sakralen Kontexten gefunden worden – sofern Areal O als sakral anzusprechen ist –, sondern auch Motivadaptionen im religiösen Bereich. Der ägyptische Einfluss auf die Oase wird so in vielerlei Hinsicht greifbar. In Zusammenhang mit den ägyptischen Funden von anderen Stätten auf der arabischen Halbinsel bietet sich ein umfangreiches Bild. Von besonderem Interesse sind die reichen Funde aus Qaryat al-Faw, die, auch wenn sie zeitlich später als die Objekte aus Taymāʾ einzuordnen sind, durchaus vergleichbar sind. Die Funde aus Qaryat al-Faw stellen ebenfalls ein bemerkenswertes Corpus in Bezug auf die Handelsbeziehungen zwischen Ägypten und Arabien dar. Hier sind dieselben Amulettformen und -typen belegt, die zeigen, dass in Taymāʾ und Qaryat al-Faw ein vergleichbares Interesse an ägyptischen religiösen Objekten bestand.

Der Austausch von materiellen Handelsgütern und religiösen oder ideellen Vorstellungen, wie sie durch das vorgestellte Material belegt sind, sind zwei der wesentlichen Punkte, an denen sich Kulturkontakt manifestiert und im archäologischen Fundmaterial greifbar wird. Diplomatische Beziehungen sind meist nur dann zu fassen, wenn sie durch schriftliche Zeugnisse dokumentiert sind. In den ägyptischen Textquellen liegen jedoch nur vereinzelte Hinweise auf Arabien vor. Diese finden sich fast ausschließlich in den späten demotischen Texten, dazu sind sie in mythologische Erzählungen eingebettet. Diese Texte zeugen von dem Wissen um die Nachbarkulturen auf der arabischen Halbinsel, erkennen sie aber nicht als eine politische Größe an. Zweifellos wird es Korrespondenz mit den regionalen arabischen Königreichen gegeben haben, sie ist jedoch nicht überliefert. Die Kontakte nach Arabien haben so erst spät auf die Monumentalkunst ausgestrahlt und es ist sicherlich kein Zufall, dass die einzige bekannte hieroglyphische Erwähnung Arabiens in einer Fremdvölkerliste unter Dareios I. auftritt und dazu dem persischen Formular folgt.

Die Oase Taymāʾ befand sich im Nordwesten Arabiens an einem Schlüsselpunkt an der Weihrauchstraße. Hier trafen die Interessen der verschiedenen Regionen und Großmächte aufeinander. In Taymāʾ überwog der politische Einfluss Vorderasiens durch die babylonische Eroberung, während sich die ägyptische Kultur – im Sinne eines ‘Versailles-Effektes’ (Wiener 1984) – in Tei-

[69] Müller – Vittmann 1993; vgl. auch Robin 1994, 297–301, der nur einen Namen als ägyptisch ansieht.

[70] Es handelt sich um die Namen *tḫyw* und *ʾmt šms* mit den möglichen ägyptischen Entsprechungen *ꜥnḫ=s* „Sie lebe“ bzw. *t3-b3k.t-n-Rꜥ* „Dienerin des (Sonnengottes) Re“; vgl. Müller – Vittmann 1993, 4–5.

len des religiösen und sakralen Bereiches manifestierte. Die Möglichkeiten, die die ägyptischen Funde aus Taymāʾ im Besonderen und von der arabischen Halbinsel im Allgemeinen zur Frage nach den Beziehungen zwischen den beiden Kulturkreisen bieten, können keinesfalls unterschätzt werden.

Danksagung

Das Manuskript des vorliegenden Beitrages wurde 2010 abgeschlossen. Später erschienene Literatur konnte nur noch in Einzelfällen berücksichtigt und eingearbeitet werden. Der Beitrag steht in Zusammenhang mit der Dissertation des Verfassers zu demselben Thema, die großzügig von der Gerda Henkel Stiftung gefördert und 2014 an der Freien Universität Berlin abgeschlossen wurde. Mein herzlicher Dank gilt zuallererst den Betreuern meines Dissertationsvorhabens, Stephan J. Seidlmayer und Ricardo Eichmann. Darüber hinaus habe ich zahlreichen Personen für Diskussionen, Anregungen und Hinweise zu danken. Hervorheben möchte ich Iris Gerlach, Arnulf Hausleiter, Andrea Intilia, Ludwig D. Morenz, Norbert Nebes, Joachim F. Quack, Hanspeter Schaudig, Peter Stein, Said F. al-Said, Heinz-Josef Thissen (†), Günter Vittmann, Robert Wenning sowie alle Mitarbeiter des Taymāʾ-Projektes und die aktuellen und damaligen Mitarbeiter des "Altägyptischen Wörterbuches".

Gunnar Sperveslage
Institut für Afrikanistik und Ägyptologie
- Abteilung Ägyptologie -
Universität zu Köln
Albertus-Magnus-Platz
50923 Köln
gunnar.sperveslage@uni-koeln.de

Literaturverzeichnis

Abd el-Raziq, M. – Castel, G. – Tallet, P.
2006 Ayn Soukhna et la mer rouge, Egypte Afrique et Orient 41, 3–6.

Abd el-Raziq, M. – Castel, G. – Tallet, P. – Ghica, V.
2002 Les inscriptions d'Ayn Soukhna, Mémoires de l'Institut Français d'Archéologie Orientale 122, Kairo.

Abu Duruk, H. I.
1986 Introduction to the Archaeology of Tayma, Riyadh.
1989 A Preliminary Report on the Industrial Site Excavation at Tayma, First Season 1408 H/ 1987 A.D., Atlal - The journal of Saudi Arabian Archaeology 12, 9–19.

Albright, W. F.
1941 The Land of Damascus between 1850 and 1750 B.C., Bulletin of the American Schools of Oriental Research 83, 30–36.

Andersen, S. F.
2007 The Tylos Period Burials in Bahrain. Vol I. The Glass and Pottery Vessels, Aarhus.

al-Ansary, A. R.
2011a Qaryat al-Faw, in: U. Franke – J. Gierlichs (Eds.), Roads of Arabia. Archäologische Schätze aus Saudi-Arabien, Tübingen, 150–167.
2011b Editorial, Adumatu 23, 4–6.

al-Ansary, A. R. – Abu al Hassan, H.
2005 Tayma - Crossroads of Civilizations. Prominent Cities on the Frankincense Route Series 2, Riyadh.

Aston, B. G. – Harrel, J. A. – Shaw, I.
2000 Stone, in: P. T. Nicholson – I. Shaw (Eds.), Ancient Egyptian Materials and Technology, Cambridge, 5–77.

Aufrère, S. H.
2005 La fabrication du papyrus égyptien et son exportation, in: S. H. Aufrère (Ed.), Encyclopédie religieuse de l'univers végétal. Croyances phytoreligieuse de l'Égypte ancienne, Vol. III, Orientalia Monspeliensia 15, Montpellier, 103–117.

Baillet, M. J.
1926 Inscriptions grecques et latines des tombeaux des rois ou syringes à Thèbes, Mémoires publiés par les Membres de l'Institut Français d'Archéologie Orientale du Caire 42, Kairo.

Bard, K. A. – Fattovich, R.
2007 Synthesis, in: K. A. Bard – R. Fattovich (Eds.), Harbor of the Pharaohs to the Land of Punt. Archaeological Investigations at Mersa/Wadi Gawasis, Egypt, 2001–2005, Neapel, 239–253.

Bard, K. A. – Fattovich, R. – Ward, C.
2007 Sea Port to Punt: New Evidence from Mersā Gawāsīs, Red Sea (Egypt), in: J. Starkey – P. Starkey – T. Wilkinson (Eds.), Natural Recources and Cultural Connections of the Red Sea, British Archaeological Reports International Series 1661, Society for Arabian Studies Monographs 5, Oxford, 143–148.

Bavay, L. – De Putter, T. – Adams, B. – Navez, J. – André, L.
2000 The Origin of Obsidian in Predynastic and Early Dynastic Upper Egypt, Mitteilungen des Deutschen Archäologischen Instituts, Abteilung Kairo 56, Berlin, 5–20.

Bawden, G. – Edens, C. – Miller, R.
1980 Preliminary Archaeological Investigations at Tayma, Atlal - The journal of Saudi Arabian Archaeology 4, 69–106.

Beaulieu, P.-A.
1989 The reign of Nabonidus, King of Babylon 556–539 BC, Yale Near Eastern Researches 10, New Haven.

Beeston, A. F. L.
1984 Further Remarks on the Zayd-'il Sarcophagus Text, Proceedings of the Seminar for Arabian Studies 14, 100–102.

Bleiberg, E.
1996 The Official Gift in Ancient Egypt, London.

Boessneck, J.
1988 Die Tierwelt des Alten Ägypten untersucht anhand kulturgeschichtlicher und zoologischer Quellen, München.

Boessneck, J. – von den Driesch, A. – Ziegler, R.
1989 Die Tierreste von Maadi und Wadi Digla, in: I. Rizkana – J. Seeher (Eds.), Maadi III. The Non-lithic Small Finds and the Structural Remains of the Predynastic Settlement. Archäologische Veröffentlichungen. Deutsches Archäologisches Institut, Abteilung Kairo 80, Berlin, 87–128.

Bongenaar, A. C. V. M. – Haring, B. J. J.
1994 Egyptians in Neo-Babylonian Sippar, Journal of Cuneiform Studies 46, 59–72.

Bongrani Fanfoni, L.
1997 Myos Hormos nel “Periplus Maris Erythraei”, Aegyptus. Rivista Italiana di Egittologia e di Papirologia 77, 53–59.

Boswinkel, E.
1983 Die Araber im Zenonarchiv, in: Araber in Ägypten. Freundesgabe für Helene Loebenstein zum 65. Geburtstag, Wien, 27–37.

Breasted, J. H.
1906 Ancient Records of Egypt. Historical Documents from the Earliest Times to the Persian Conquest, Collected, Edited and Translated with Commentary, Chicago.

Breyer, F.
2016 Punt. Die Suche nach dem "Gottesland", Culture and History of the Ancient Near East 80, Leiden.

Briquel-Chatonnet, F. – Robin, C.
1997 Objets d’Arabie du Nord-ouest, in: Y. Calvet – C. Robin (Eds.), Arabie heureuse – Arabie deserte. Les antiquités arabiques du Musée du Louvre, avec la collaboration de F. Briquel-Chatonnet et M. Pic, Paris, 260–269.

Bron, F.
1998 Inventaire des inscriptions sudarabiques 3: Maʿīn, Paris.

Bülow-Jacobsen, A. – Cuvigny, H. – Fournet, J.-L.
1994 The Identification of Myos Hormos. New Papyrological Evidence, Bulletin de l'Institut français d'archéologie orientale 94, 27–42.

Bülow-Jacobsen, A. – Cuvigny, H. – Fournet, J.-L. – Gabolde, M. – Robin, C.
1995 Les inscriptions d’Al-Muwayḥ, Bulletin de l'Institut français d'archéologie orientale 95, 103–124.

Casson, L.
1989 The Periplus Maris Erythraei. Text with Introduction, Translation, and Commentary, Princeton.

Clarysse, W.
1991 Hakoris. An Egyptian Nobleman and his Family, Ancient Society 22, 235–243.

Clarysse, W. – Thompson, D. J.
2006 Counting the People in Hellenistic Egypt. Vol. II: Historical Studies, Cambridge.

Cotty, M.
2010 Katalogeinträge 154, 156, 184–185, in: A. I. Al-Ghabban – B. André-Salvini – F. Demange – C. Juvin – M. Cotty (Eds.), Routes d‘Arabie. Archéologie et histoire du Royaume d’Arabie Saoudite, Paris, 334–335. 350.

Dalley, S.
1985 Stelae from Teima and the God Ṣlm (Ṣalmu), Proceedings of the Seminar for Arabian Studies 15, 27–33.
1986 The God Ṣalmu and the Winged Disk, Iraq 48, 85–101.

de Cenival, F.
1973 Cautionnements démotiques du début de l'époque ptolémaïque (P dém. Lille 34 à 96), Société d'histoire du droit, Collection d'histoire institutionnelle et sociale 5, Paris.

Demange, F.
2010 Katalogeinträge 189–198, in: A. I. Al-Ghabban – B. André-Salvini – F. Demange – C. Juvin – M. Cotty (Eds.), Routes d'Arabie. Archéologie et histoire du Royaume d'Arabie Saoudite, Paris, 352–355.

Dumbrell, W. J.
1971 The Tell el-Maskhuta Bowls and the "Kingdom" of Qedar in the Persian Period, Bulletin of the American Schools of Oriental Research 203, 33–44.

Eichmann, R. – Schaudig, H. – Hausleiter, A.
2006 Archaeology and Epigraphy at Tayma (Saudi Arabia), Arabian Archaeology and Epigraphy 17, 163–176.

Ember, A.
1918 Egyptian *ʿ3m* "Semite" = Semitic 'Arab "Arab, Bedouin", Johns Hopkins University Circular 306, 5.

Endesfelder, E.
2011 Beobachtungen zur Entstehung des altägyptischen Staates, Internetbeiträge zur Ägyptologie und Sudanarchäologie 14 (http://www2.rz.hu-berlin.de/nilus/net-publications/ibaes14/index.html).

Faist, B. I.
2001 Der Fernhandel des assyrischen Reiches zwischen dem 14. und 11. Jh. v. Chr., Alter Orient und Altes Testament. Veröffentlichungen zur Kultur und Geschichte des Alten Orients und des Alten Testaments 265, Münster.

Fakhry, A.
1952 An Archaeological Journey to Yemen (March–May, 1947), Part I, Kairo.

Fattovich, R.
2005 Marsā Gawāsīs: A Pharaonic Coastal Settlement by the Red Sea in Egypt, in: J. C. M. Starkey (Ed.), People of the Red Sea. Proceedings of the Red Sea Project II. Held in the British Museum October 2004, British Archaeological Reports, International Series 1395, Society for Arabian Studies Monographs 3, Oxford, 15–22.

Fleischer, R. – Schulz, R.
2012 Figurale Bronzen ägyptischer und griechisch-römischer Art vom Jabal al-'Awd, Jemen, Archäologische Berichte aus dem Yemen 13, 1–90.

Fuchs, R.
1984 *s.v.* Salz, Lexikon der Ägyptologie V, Wiesbaden, 371–374.

Gerlach, I.
2002 Der Friedhof des Awām-Tempels in Marib. Bericht der Ausgrabungen von 1997 bis 2000, Archäologische Berichte aus dem Yemen 9, Mainz, 41–91.

Germer, R.
1982 *s.v.* Myrrhe, Lexikon der Ägyptologie IV, Wiesbaden, 275–276.
1986 *s.v.* Weihrauch, Lexikon der Ägyptologie VI, Wiesbaden, 1167–1169.

al-Ghabban, A. I. – André-Salvini, B. – Demange, F. – Juvin, C. – Cotty, M. (Eds.)
2010 Routes d'Arabie. Archéologie et histoire du Royaume d'Arabie Saoudite, Paris.

Giménez, J. – Sánchez, J. A. – Solano, L.
2015 Identifying the Ethiopian Origin of the Obsidian found in Upper Egypt (Naqada period) and the most likely Exchange Routes, Journal of Egyptian Archaeology 101, 349–359.

Giveon, R.
1971 Les bédouins Shosou des documentes égyptiens, Documenta et Monumenta Orientis Antiqui 22, Leiden.

Görg, M.
1976 Zur Geschichte der *Šꜣśw*, Orientalia 45, 424–428.
1979 Tuthmosis III. und die *Šꜣśw*-Region, Journal of Near Eastern Studies 38, 199–202.

Hallmann, S.
2006 Die Tributszenen des Neuen Reiches, Ägypten und Altes Testament 66, Wiesbaden.

Harrauer, H.
1983 Ausländische Waren in Ägyptens Papyri, in: Araber in Ägypten. Freundesgabe für Helene Loebenstein zum 65. Geburtstag, Wien, 51–64.

Hartung, U.
2001 Umm el-Qaab II. Importkeramik aus dem Friedhof U in Abydos (Umm el-Qaab) und die Beziehungen Ägyptens zu Vorderasien im 4. Jahrtausend v. Chr., Archäologische Veröffentlichungen, Deutsches Archäologisches Institut, Abteilung Kairo 92, Mainz.

Hausleiter, A.
2010 L'oasis de Taymâ', in: A. I. Al-Ghabban – B. André-Salvini – F. Demange – C. Juvin – M. Cotty (Eds.), Routes d'Arabie. Archéologie et histoire du Royaume d'Arabie Saoudite, Paris, 218–239.
2011 Das antike Tayma': Eine Oase im Kontaktbereich der Kulturen, in: U. Franke – J. Gierlichs (Eds.), in collaboration with S. Vassilopoulou – L. Wagner, Roads of Arabia – The archaeological treasures of Saudi Arabia, Berlin, Roads of Arabia. Archäologische Schätze aus Saudi-Arabien, Tübingen, 100–123.
2012 Divine Representations at Taymā', in: I. Sachet (Ed.) en collaboration avec Ch. Robin, Dieux et déesses d'Arabie. Images et représentations, Actes de la table ronde tenue au Collège de France (Paris) les 1er et 2 octobre 2007, Orient et Méditerranée 7, Paris, 299–338.

Hausleiter, A. – Intilia, A.
2010a 102. Pédestal/autel décoré de scènes rituelles ("cube d'al-Hamra'"), in: A. I. Al-Ghabban – B. André-Salvini – F. Demange – C. Juvin – M. Cotty (Eds.), Routes d'Arabie. Archéologie et histoire du Royaume d'Arabie Saoudite, Paris, 254.

2010b 103. Stèle d'al-Hamra', in: A. I. Al-Ghabban – B. André-Salvini – F. Demange – C. Juvin – M. Cotty (Eds.), Routes d'Arabie. Archéologie et histoire du Royaume d'Arabie Saoudite, Paris, 255.

Hausleiter, A. – Schaudig, H.
2010a 100. Stèle cintrée de Nabonide, roi de Babylone, in: A. I. Al-Ghabban – B. André-Salvini – F. Demange – C. Juvin – M. Cotty (Eds.), Routes d'Arabie. Archéologie et histoire du Royaume d'Arabie Saoudite, Paris, 252–253.
2010b 101. Objet en forme de disque portant une inscription du roi Nabonide, in: A. I. Al-Ghabban – B. André-Salvini – F. Demange – C. Juvin – M. Cotty (Eds.), Routes d'Arabie. Archéo-logie et histoire du Royaume d'Arabie Saoudite, Paris, 253.

Heimpel, W.
1988 *s. v.* Magan, Reallexikon der Assyriologie und Vorderasiatischen Archäologie 7, Berlin, 195–199.

Helck, W.
1965 Materialien zur Wirtschaftsgeschichte des Neuen Reiches, Bd.5: Eigentum und Besitz an verschiedenen Dingen des täglichen Lebens, Mainz.
1971² Die Beziehungen Ägyptens zu Vorderasien im 3. und 2. Jahrtausend v. Chr., Ägyptologische Abhandlungen 5, Wiesbaden.
1974 Die altägyptischen Gaue, Beihefte zum Tübinger Atlas des Vorderen Orients B/5, Wiesbaden.
1975 Wirtschaftsgeschichte des Alten Ägypten im 3. und 2. Jahrtausend vor Chr., Handbuch der Orientalistik 1.1.5, Leiden.

Hennig, D.
2003 Sicherheitskräfte zur Überwachung der Wüstengrenzen und Karawanenwege im ptolemäischen Ägypten, Chiron 33, 145–174.

Hoffmann, F.
1996 Der Kampf um den Panzer des Inaros. Studien zum P. Krall und seiner Stellung innerhalb des Inaros-Petubastis-Zyklus, Mitteilungen aus der Papyrussammlung der Österreichischen Nationalbibliothek 26.
2000 Ägypten. Kultur und Lebenswelt in griechisch-römischer Zeit. Eine Darstellung nach den demotischen Quellen, Studienbücher Geschichte und Kultur der Alten Welt, Berlin.
2004 Zwei neue demotische Erzählungen (P. Wien D 62), in: F. Hoffmann – H. J. Thissen (Eds.), Res severa verum gaudium. Festschrift für Karl-Theodor Zauzich zum 65. Geburtstag am 8. Juni 2004, Studia Demotica 6, Löwen, 249–259.

Hoffmann, F. – Quack, J. F.
2007 Anthologie der demotischen Literatur, Einführungen und Quellentexte zur Ägyptologie 4, Münster.

Hölbl, G.
1979 Beziehungen der ägyptischen Kultur zu Altitalien, 2 Bde., Études préliminaires aux religions orientales dans l'empire romain 62, Leiden.
2004² Geschichte des Ptolemäerreiches. Politik, Ideologie und religiöse Kultur von Alexander dem Großen bis zur römischen Eroberung, Darmstadt.

Honigman, S.
2002 Les divers sens de l'ethnique ''APAΨ dans les sources documentaires grecques d'Égypte, Ancient Society 32, 43–72.

Huntingford, G. W. B.
1980 The Periplus of the Erythrean Sea by an unkown author. With some Extracts from Agatharkhidēs 'On the Erythrean Sea', London.

Ingraham, M. – Johnson, T. – Rihani, B. – Shatla, I.
1981 Preliminary Report on a Reconnaissance Survey of the Northwestern Province (with a note on a brief survey of the Northern Province), Atlal - The journal of Saudi Arabian Archaeology 5, 59–84.

Intilia, A.
2011 Area O, in: R. Eichmann – A. Hausleiter – M. H. al-Najem – S. F. al-Said, Tayma – Autumn 2005 and 2006 (Spring and Autumn), 3rd Report on the Joint Saudi-Arabian-German Archaeological Project, Atlal - The journal of Saudi Arabian Archaeology, 21, 97–102.
2012 Excavations in Area O, in: R. Eichmann – A. Hausleiter – M. H. al-Najem – S. F. al-Said, Tayma 2007, 4th Report on the Joint Saudi-Arabian-German Archaeological Project, Atlal - Journal of Saudi Arabian Archaeology, 22, 100–106.
2017 Excavations in Area O, in: A. Hausleiter – R. Eichmann – M. H. al-Najem – S. F. al-Said, Tayma 2008 – 5th Report on the Saudi Arabian-German Archaeological Project, Atlal - Journal of Saudi Arabian Archaeology 24, 40–46.

Jändl, B.
2009 Altsüdarabische Inschriften auf Metall, Epigraphische Forschungen auf der Arabischen Halbinsel 4, Tübingen.

Jones, R. N. – Hammond, P. C. – Johnson, D. J. – Fiema, Z. T.
1988 A Second Nabataean Inscription from Tell esh-Shuqafiya, Egypt, Bulletin of the American Schools of Oriental Research 269, 47–57.

Kammerzell, F.
1993 Studien zu Sprache und Geschichte der Karer in Ägypten, Göttinger Orientforschungen IV/27, Wiesbaden.

Kaumanns, L. – Sperveslage, G.
2015 Ägypten als Ausgangspunkt römischer Expansion. Die Feldzüge des Aelius Gallus nach Arabien und des Publius Petronius nach Nubien, Sokar 31, 80–91.

Kensdale, W. E. N.
1952 Three Thamudic Inscriptions from the Nile Delta, Muséon 65, 285–290.

Kirwan, Sir L. P.
1984 Where to Search for the Ancient Port of Leuke Kome, in: A. R. T. al-Ansary (Ed.), Studies in the History of Arabia II: Pre-Islamic Arabia, 55–61.

Knauf, E. A.
1990 The Persian Administration in Arabia, Transeuphratène 2, 202–217.

Krzyżaniak, L.
1977 Early Farming Cultures on the Lower Nile. The Predynastic Period in Egypt, Travaux du Centre d'Archéologie Méditerranéenne de l'Académie Polonaise des Sciences 21, Varsovie.

Liesker, W. H. M. – Tromp, A. M.
1986 Zwei ptolemäische Papyri aus der Wiener Papyrussammlung, Zeitschrift für Papyrologie und Epigraphik 66, 79–89.

López Martínez, M. P.
1998/1999 Greeks, Barbarians and Strangers in Papyrological Fragments of Lost Novels, LVCENTVM 17/18, 221–227.

Lüddeckens, E.
1988 Ein demotischer Papyrus aus Mittelägypten. Papyrus Lüddeckens II, Zeitschrift für ägyptische Sprache und Altertumskunde 115, 52–61.

Lüddeckens, E. *et al.*
1980–2000 Demotisches Namenbuch, begründet von E. Lüddeckens, fortgeführt von H.-J. Thissen, bearbeitet von W. Brunsch, G. Vittmann und K.-Th. Zauzich, Wiesbaden.

MacDonald, B.
1980 Excavations at Tell el-Maskhuta, The Biblical Archaeologist 43, 49–58.

Macdonald, M. C. A
1991 HU 501 and the Use of s³ in Taymanite, Journal of Semitic Studies, 11–36.

Mahfouz, E. – Manzo, A. – Pirelli, R.
2007 Textual Evidence, in: K. A. Bard – R. Fattovich (Eds.), Harbor of the Pharaohs to the Land of Punt. Archaeological Investigations at Mersa/Wadi Gawasis, Egypt, 2001–2005, Neapel, 217–238.

Manzo, A.
2012 Nubians and the Others on the Red Sea. An Update on the Exotic Ceramic Materials from the Middle Kingdom Harbour of Mersa/Wadi Gawasis, Red Sea, Egypt, in: D. A. Agius – J. P. Cooper – A. Trakadas – C. Zazzaro (Eds.), Navigated Spaces, Connected Places. Proceedings of Red Sea Project V held at the University of Exeter, 16–19 September 2010, British Archaeological Reports International Series 2346, British Foundation for the Study of Arabia Monographs 12, Oxford, 47–58.

Manzo, A. – Perlingieri, C.
2007 Finds: Pottery, in: K. A. Bard – R. Fattovich (Eds.), Harbor of the Pharaohs to the Land of Punt. Archaeological Investigations at Mersa/Wadi Gawasis, Egypt, 2001–2005, Neapel, 101–134.

Maraqten, M.
1996 The Aramaic Pantheon of Taymā', Arabian Archaeology and Epigraphy 7, 17–31.

Marek, C.
1993 Die Expedition des Aelius Gallus nach Arabien im Jahre 25 v. Chr., Chiron 23, 121–156.

Meeks, D.
2003 Locating Punt, in: D. O'Connor – S. Quirke (Eds.), Mysterious Lands, Abingdon, 53–80.

Meyer, C.
1992 Glass from Quseir al-Qadim and the Indian Ocean Trade, Studies in Ancient Oriental Civilisation 53, Chicago.

Mlaker, K.
1943 Die Hierodulenlisten von Ma'in. Nebst Untersuchungen zur altsüdarabischen Rechtsgeschichte und Chronologie, Sammlung orientalistischer Arbeiten 15, Leipzig.

Moorey, P. R. S.
1994 Ancient Mesopotamian Materials and Industries. The Archaeological Evidence, Oxford.

Müller, W. M.
1900 Die Schlusszeilen der Stele Louvre C1, Orientalistische Literaturzeitung 3, 46–49.

Müller, W. W.
1978 *s.v.* Weihrauch, in: Realencyclopädie der Classischen Altertumswissenschaft, Supplementband 15, Stuttgart, 700–777.
1988 Zu den in demotischen Urkunden in den Schreibungen *wjlw* und *ʿwmɜjlw* belegten semitischen Namen, Zeitschrift für ägyptische Sprache und Altertumskunde 115, 84–85.
2002 Rezension zu: A. Sima, Die lihyanischen Inschriften von al-ʻUḏayb (Saudi-Arabien), Epigraphische Forschungen auf der arabischen Halbinsel 1, 1999, Die Welt des Orients, 32, 264–268.

Müller, W. W. – al-Said, S. F.
2002 Der babylonische König Nabonid in den Taymanischen Inschriften, in: N. Nebes (Ed.), Neue Beiträge zur Semitistik. Erstes Arbeitstreffen der Arbeitsgemeinschaft Semitistik in der Deutschen Morgenländischen Gesellschaft vom 11. bis 13. September 2000 an der Friedrich-Schiller-Universität Jena, Wiesbaden, 105–122.

Müller, W. W. – Vittmann, G.
1993 Zu den Personennamen der aus Ägypten stammenden Frauen in den sogenannten „Hierodulenlisten“ von Maʼīn, Orientalia 62, 1–10.

Nappo, D.
2010 On the Location of Leuke Kome, Journal of Roman Archaeology 23, 335–348.

Netzer, E.
2003 Nabatäische Architektur. Insbesondere Gräber und Tempel, München.

Obsomer, C.
1993 La date de Nésou-Montou (Louvre C 1), Revue d'égyptologie (Kairo) 44, 103–140.

Otto, E.
1938 Beiträge zur Geschichte der Stierkulte in Aegypten, Leipzig.

Paice, P. – Holladay, J. S., Jr. – Brock, E. C.
1996 The Middle Bronze Age / Second Intermediate Period Houses at Tell El-Maskhuta, in: M. Bietak (Ed.), Haus und Palast im Alten Ägypten. Internationales Symposium 8. bis 11. April 1992 in Kairo. Untersuchungen der Zweigstelle Kairo des Österreichischen Archäologischen Institutes 14, Wien, 159–173.

Parr, P.
1988 Pottery of the Late Seond Millennium B.C. from North West Arabia and its Historical Implications, in: D. T. Potts (Ed.), Araby the Blest. Studies in Arabian Archaeology, Carsten Niebuhr Institute Publications 7, Kopenhagen.

Peacock, D. P. S. – Blue, L. (Eds.)
2006 Myos Hormos – Quseir al-Qadim. Roman and Islamic Ports on the Red Sea, Vol. I: Survey and Excavations 1999–2003, Oxford.
2011 Myos Hormos – Quseir al-Qadim. Roman and Islamic Ports on the Red Sea, Vol. II:

Finds from the Excavations 1999–2003, British Archaeological Reports International Series 2286, University of Southampton Series in Archaeology 6, Oxford.

Petrie, W. M. F.
1906 Hyksos and Israelite Cities, Worcester.
1939 The Making of Egypt, Worcester.

Porten, B. – Lund, J. A.
2002 Aramaic Documents from Egypt: A Key-Word-in-Context Concordance, Winona Lake.

Posener, G.
1969 Achoris, Revue d'égyptologie (Kairo) 21, 148–150.

Quack, J. F.
2005 Einführung in die altägyptische Literaturgeschichte III. Die demotische und gräko-ägyptische Literatur, Einführungen und Quellentexte zur Ägyptologie 3, Münster.

Ranke, H.
1935 Die ägyptischen Personennamen, Bd.1: Verzeichnis der Namen, Glückstadt.

Retsö, J.
2003 The Arabs in Antiquity. Their History from the Assyrians to the Umayyads, Abingdon.

Rice, M.
2003[2] Egypt's Making. The Origins of Ancient Egypt 5000–2000 BC, London.

Roaf, M.
1974 The Subject Peoples on the Base of the Statue of Darius, Cahiers de la Délégation française en Iran 4, 73–160.

Robin, C.
1974 Monnaies provenant de l'Arabie du nord-est, Semitica 24, 83–125.
1994 L'Égypte dans les inscriptions de l'Arabie méridionale préislamique, in: C. Berger – G. Cleric – N. Grimal (Éd.), Hommages à Jean Leclant, Vol. 4: Varia, Bibliothèque d'Étude 104/4, Paris, 285–301.

Rollinger, R.
2008 The Median "Empire", the End of Urartu and Cyrus' the Great Campaign in 547 BC (Nabonidus Chronicle II 16), Ancient West & East 7, 51–65.

Ryholt, K.
2010 A Sesostris Story in Demotic Egyptian and Demotic Literary Exercises (O. Leipzig UB 2217), in: H. Knuf – C. Leitz – D. von Recklinghausen (Eds.), Honi soit qui mal y pense. Studien zum pharaonischen, griechisch-römischen und spätantiken Ägypten zu Ehren von Heinz-Josef Thissen, Orientalia Lovaniensia Analecta 194, Löwen, 429–438.
2012 The Carlsberg Papyri 10: Narrative Literature from the Tebtunis Temple Library. Carsten Niebuhr Institute Publications 35, Kopenhagen.

al-Said, S. F.
2000 Hamlat al-malik al-bābilī Nabūnīd ʻalā šamāl ġarb al-ǧazīra al-ʻarabiyya. Dirāsa fi t-taʾrīḫ al-ʻarabī al-qadīm, Riyadh.
2003 Al-ʻalāqāt alḥaḍāriyya bayna al-ǧazīra al-ʻarabiyya wa Miṣr fi ḍawʾ an-nuqūš al-ʻarabiyya al-qadīma, Riyadh.

2009 Eine neu entdeckte Erwähnung des Königs Nabonid in den thamudischen Inschriften, Zeitschrift für Orient Archäologie 2, 258–263.

Saleh, A.-A.
1978 Arabia and the Northern Arabs in Ancient Egyptian Records, in: Book of the 50th Anniversary of Archaeological Studies in Cairo University, Part III, The Journal of the Faculty of Archaeology, Special Issue, 69–77.

Sayed, A. M. A. H.
1984 Reconsideration of the Minaean Inscription of Zayd'il bin Zayd, Proceedings of the Seminar for Arabian Studies 14, 93–99.

Schaudig, H.
2001 Die Inschriften Nabonids von Babylon und Kyros' des Großen samt den in ihrem Umfeld entstandenen Tendenzschriften. Textausgabe und Grammatik, Alter Orient und Altes Testament. Veröffentlichungen zur Kultur und Geschichte des Alten Orients und des Alten Testaments 256, Münster.
2010 The Cuniform Inscription of the Stele TA 488, in: R. Eichmann – A. Hausleiter – M. al-Najem – S. F. al-Said, Tayma – Autumn 2004 and Spring 2005. 2nd Report on the Joint Saudi Arabian-German Archaeological Project, Atlal - The journal of Saudi Arabian Archaeology 20, 137–138.
im Druck Cuneiform Texts from Tayma, in: M. C. A. Macdonald, Taymāʾ II - Catalogue of the Inscriptions from the Saudi-German Excavations, Berlin – Oxford.

Schneider, T.
1992 Asiatische Personennamen in ägyptischen Quellen des Neuen Reiches, Orbis Biblicus et Orientalis 114.
1997 Beiträge zur sogenannten „Neueren Komparatistik", Lingua Aegyptia 5, 189–209.
2002 Lexikon der Pharaonen. Die altägyptischen Könige von der Frühzeit bis zur Römerherrschaft.
2006 The Relative Chronology of the Middle Kingdom and the Hyksos Period (Dyns. 12-17), in: E. Hornung – R. Krauss – D. A. Warburton (Eds.), Ancient Egyptian Chronology, Handbuch der Orientalistik I.83, Leiden, 168–196.

Seidlmayer, S. J.
2009 Prestigegüter im Kontext der Breitenkultur im Ägypten des 3. und 2. Jahrtausends v. Chr., in: B. Hildebrandt – C. Veit (Eds.), Der Wert der Dinge. Güter im Prestigediskurs, Münchner Studien zur Alten Welt 6, München, 309–333.

Sethe, K.
1933 Urkunden des Alten Reiches, Leipzig.

Shaheen, A. el-din M.
2000 Egyptianized Artifacts on the Western Coast of the Arabian Gulf: A Case of Discussion, Göttinger Miszellen 176, 89–102.

Sidebotham, S. E.
1986 Roman economic policy in the Erythra Thalassa: 30 BC – AD 217, Mnemosyne Supplement 91.
1997 Caravans Across the Eastern Desert of Egypt: Recent Discoveries on the Berenike-Apollinopolis Magna-Coptos Roads, in: A. Avanzini (Ed.), Profumi d'Arabia. Atti del convegno, Rom, 385–393.
2011 Berenike and the Ancient Maritime Spice Route, Berkeley.

Sima, A.
1999 Die lihyanischen Inschriften von al-ʻUḏayb (Saudi-Arabien), Epigraphische Forschungen auf der arabischen Halbinsel 1, Rahden/Westfalen.
2001 Isis und Horus in Arabien?, Mediterranean Language Review 13, 161–174.

Somaglino, C. – Tallet, P.
2011 Une mystérieuse route sud-orientale sous le règne de Ramsès III, Bulletin de l'Institut Français d'Archéologie Orientale 111, 361–369.
2013 A Road to the Arabian Peninsula in the Reign of Ramesses III, in: F. Förster – H. Riemer (Eds.), Desert Road Archaeology in Ancient Egypt and Beyond. Towards Establishing a New Field of Archaeological Research, Africa Praehistorica 27, Köln, 511–518.

Sperveslage, G.
2011 Die Stele Ramses' II. von Tell er-Rataba und die vermeintlichen Städte der Shasu, Journal of Egyptian History 4, 118–128.
2013 Ägyptische Einflüsse auf der Arabischen Halbinsel in vorislamischer Zeit am Beispiel der Oase von Tayma, Zeitschrift für Orient-Archäologie 6, 234–252.
2014 Ägypten und Arabien. Ein Beitrag zu den interkulturellen Beziehungen Altägyp tens, Dissertationsschrift FU Berlin; Publikation in Vorbereitung für Alter Orient und Altes Testament.
2016 Intercultural Contacts between Egypt and the Arabian Peninsula at the Turn of the 2nd to the 1st Millennium BCE, in: J. C. (Ed.) Moreno García, Dynamics of Production in the Ancient Near East 1300–500 BC, Oxford, 303–330.

Sperveslage, G. – Eichmann, R.
2012 Egyptian Cultural Impact on North-west Arabia in the Second and First Millennium BC, Proceedings of the Seminar for Arabian Studies 42, 371–383.

Spiegelberg, W.
1931 Die demotischen Papyri Loeb, München.

Stadler, M. A.
2004 Isis, das göttliche Kind und die Weltordnung. Neue Religiöse Texte aus dem Fayum nach dem Papyrus Wien D. 12006 recto, Mitteilungen aus der Papyrussammlung der Österreichischen Nationalbibliothek 28, Wien.

Staubli, T.
1991 Das Image der Nomaden im Alten Israel und in der Ikonographie seiner sesshaften Nachbarn, Orbis Biblicus et Orientalis 107, Freiburg.

Stephens, S. A. – Winkler, J. J.
1995 Ancient Greek Novels. The Fragments. Introduction, Text, Translation, and Commentary, Princeton.

Strugnell, J.
1959 The Nabataean Goddess al-Kutba' and her Sanctuaries, Bulletin of the American Schools of Oriental Research 156, 29–36.

Tarn, W. W.
1929 Ptolmy II. and Arabia, The Journal of Egyptian Archaeology 15, 9–25.

Thissen, H. J.
1974 Rezension zu: De Cenival, F. 1973, Cautionnements démotiques du début de l'époque ptolémaïque (P dém. Lille 34 à 96), Société d'histoire du droit, Collection d'histoire institutionnelle et sociale 5, Enchoria 4, 165–172.

Tokunaga, R.
2003 South Arabic Graffiti in the Eastern Desert (Wadi Hammamat and Wadi Manih), Annales du Service des antiquités de l'Egypte 77, 181–188.

Tomber, R.
2004 Rome and South Arabia: New Artefactual Evidence from the Red Sea, Proceedings of the Seminar for Arabian Studies 34, 351–360.
2008 Indo-Roman Trade. From Pots to Pepper, London.

Vittmann, G.
1998 Beobachtungen und Überlegungen zu Fremden und hellenisierten Ägyptern im Dienste einheimischer Kulte, in: W. Clarysse – A. Schoors – H. Willems (Eds.), Egyptian Religion. The Last Thousand Years. Studies Dedicated to the Memory of Jan Quaegebeur, Bd.2, Orientalia Lovaniensia Analecta 85, Leuven, 1231–1250.
2003 Ägypten und die Fremden im ersten vorchristlichen Jahrtausend, Kulturgeschichte der antiken Welt 97, Mainz.
2004 Iranisches Sprachgut in ägyptischer Überlieferung, in: T. Schneider (Ed.), Das Ägyptische und die Sprachen Vorderasiens, Nordafrikas und der Ägäis. Akten des Basler Kolloqiums zum ägyptisch-nichtsemitischen Sprachkontakt, Basel 9.-11. Juli 2003, Alter Orient und Altes Testament, Veröffentlichungen zur Kultur und Geschichte des Alten Orients und des Alten Testaments 310, Münster, 129–182.

Wagner, G.
1976 Une dédicace à Isis et à Héra de la part d'un négociant d'Aden, Bulletin de l'Institut français d'archéologie orientale 76, 277–281.

Ward, C. – Zazzaro, C.
2007 Finds: Ship evidence, in: K. A. Bard – R. Fattovich (Eds.), Harbor of the Pharaohs to the Land of Punt. Archaeological Investigations at Mersa/Wadi Gawasis, Egypt, 2001–2005, Neapel, 135–163.

Whitcomb, D. S.
1996 Quseir al-Qadim and the Location of Myos Hormos, Topoi 6, Lyon, 747–772.

Widmer, G.
2002 Pharaoh Maâ-Rê, Pharaoh Amenemhat and Sesostris: Three Figures from Egypt`s Past as Seen in Sources of the Graeco-Roman Period, in: K. Ryholt (Ed.), Acts of the Seventh International Conference of Demotic Studies, Copenhagen, 23–27 August 1999, Carsten Niebuhr Institute Publications 27, Kopenhagen, 377–393.

Wiener, M. H.
1984 Crete and the Cyclades in LM I: The Tale of the Conical Cups, in: R. Hägg – N. Marinatos (Eds.), The Minoan Thalassocracy. Myth and Reality. Proceedings of the Third International Symposium at the Swedish Institute in Athens, 31 May–5 June, 1982, Stockholm, Skrifter utgivna av Svenska Institutet i Athen 4°, XXXII, Stockholm, 17–26.

Winnett, F. V. – Reed, W. L.
1970 Ancient Records from North Arabia, Toronto.

Winnicki, J. K.
2000 Zustrom und Ansiedlung der Nomaden vom Nordosten Ägyptens im Niltal in der griechisch-römischen Zeitperiode, The Journal of Juristic Papyrology 30, 165–178.
2009 Late Egypt and Her Neighbours. Foreign Population in Egypt in the First Millennium BC, The Journal of Juristic Papyrology, Supplement 22, Warschau.

Winter, E.
1983 Der Apiskult im Alten Ägypten, Mainz.

von Wissmann, H.
1976 Die Geschichte des Sabäerreiches und der Feldzug des Aelius Gallus, in: H. Temporini (Ed.), Aufstieg und Niedergang der Römischen Welt. Geschichte und Kultur Roms im Spiegel der neueren Forschung, II/9.1, Berlin, 308–544.

Zadok, R.
1992 Egyptians in Babylonia and Elam during the 1st Millennium B.C., Lingua Aegyptia 2, 139–146.

Zarins, J.
1989 Ancient Egypt and the Red Sea Trade: The Case for Obsidian in the Predynastic and Archaic Periods, in: A. Leonard – B. Beyer Williams (Eds.), Essays in Ancient Civilization presented to Helene J. Kantor, Studies in Ancient Oriental Civilisation 47, Chicago, 339–368.
1990 Obsidian and the Red Sea Trade. Prehistoric Aspects, in: M. Taddei (Ed.), South Asian Archaeology 1987. Proceedings of the Ninth International Conference of the Association of South Asian Archaeologists in Western Europe, held in the Fondazione Giorgio Cini, Island of San Giorgio Maggiore, Venice, Part I, Serie Orientale Roma 66.1, Rom, 507–541.

Zarins, J. – Mughannum, A. S. – Kamal, M.
1984 Excavations at Dhahran South - The Tumuli Field (208–92) 1403 A.H. 1983. A Preliminary Report, Atlal - The journal of Saudi Arabian Archaeology 8, 25–54.

Quellen

Plinius:
Pliny. Natural History in ten Volumes with an English Translation by H. Rackham; 1967–1971, London.

Strabo:
The geography of Strabo in eight Volumes with an English Translation by Horace Leonard Jones, 1917–1932, London.

Cicero rab. Post.
M. T. Cicero: Pro Rabirio Postumo, in:
M. Tulli Ciceronis Orationes, herausgegeben von A. C. Clark und W. Peterson. 6 Bde., 1905–1918, Oxford.

Aurelian:
Divus Aurelianus, in:
The scriptores historiae Augustae in three volumes with an English Translation by David Magie, 1921–1932, Cambridge.

Herodot:
Herodot. Historien, Gesamtausgabe (Buch I–IX), H. W. Haussig (Ed.), August Horneffer (Übersetzer), 1971, Stuttgart.

Diodor:
Diodorus of Sicily. The Library of History in twelve volumes with an English Translation by Charles H. Oldfather, 1933–1967, Cambridge.

Dromedare in der sabkha von Tayma (DAI, Orient-Abteilung, A. Zur).

جمل في سبخة تيماء (© معهد الآثار الألماني، قسم الشرق، أ. تزور)

UNTERSUCHUNGEN ZU DEN 'ARABISCHEN' TOPONYMEN UND ZUR REZEPTION DER 'ARABER' IN DEN HISTORISCHEN QUELLEN DER ASSYRER

Ariel M. Bagg

***Abstract**: Contacts between Assyrian and Arabian tribes took place in a vast area, ranging from the Southern Levant, the Ǧazīra and southern Babylonia to East- and South Arabia. These contacts constituted not only military confrontations, but moreover formed a political framework that enabled peaceful relations and commercial exchange, too. Whereas direct contacts took place on the southern border of the Assyrian empire, in northern Arabia and also in eastern Arabia during the time of Esarhaddon relations with central and southern Arabia were indirect and consisted of trade or payment of tribute. As intruders who were a direct threat to the Assyrian provinces or Assyrian satellite states or indirectly threatened through their alliances with Assyrian enemies, Arabian tribes were not tolerated and were fought intensively. Nevertheless, their submission was never followed by territorial annexation. This also did not occur in the two instances in which the Assyrians penetrated into the Arabian Peninsula, namely during Sennacherib's campaign to Adummatu and during Esarhaddon's campaign against Bāzu. The geoclimatic conditions of the Arabian desert were everything other than favourable for an Assyrian occupation. The Assyrians were aware of this fact, and they also knew that the treasures of this region were only accessible through control of trade routes. However, because they did not own the necessary camels, the Assyrians were dependent upon the camel breeders who also led the caravans. On the other hand, an area-wide occupation was not necessary, if the last stretches of the trade routes stood under Assyrian control. In addition, the Assyrians benefited indirectly from this trade through the tribute paid by Arabian tribes or tribute from states with whom they maintained commercial relations.*
***Keywords**: Arabians, Assyrians, trade, caravans, nomads*

آرييل باغ: حدثت الاحتكاكات بين الآشوريين و القبائل العربية على رقعة واسعة من الأرض امتدت من جنوب بلاد الشام، الجزيرة، جنوب بلاد بابل حتى شرق و جنوب الجزيرة العربية. لم تتألّف هذه الاحتكاكات من المواجهات العسكرية فقط، بل تعدّت ذلك لتشكّل إطاراً سياسياً مكّن أيضاً من إقامة علاقات سلمية و تبادل تجاري. و في حين حصلت الاتصالات المباشرة على الحدود الجنوبية للامبراطورية الآشورية خلال فترة حكم أسرحدون في شمال و شرق الجزيرة العربية فإن العلاقات مع مركز و جنوب الجزيرة العربية لم تكن مباشرة و تمثّلت بالتجارة أو دفع الإتاوة. شكّلت القبائل العربية تهديداً مباشراً للأقاليم الآشورية أو للدول التابعة لها كدخلاء أو غير مباشر بتحالفها مع أعداء الآشوريين و لهذا لم يتسامح الآشوريون معها و حاربوها بلا هوادة. مع ذلك لم يتبع إخضاع هذه القبائل أي عملية ضم للأراضي أبداً و هذا الأمر لم يحصل في الحالتين اللتين توغّل الآشوريون خلالهما في شبه الجزيرة العربية، المقصود هنا هو حملة سنحاريب إلى أدُمّاتو و حملة أسرحدون ضد بازو. لم تكن الظروف الجغرافية و المناخية مناسبة على الإطلاق لاحتلال آشوري و كان الآشوريون مدركين لهذه الحقيقة كما أنهم كانوا يعرفون أن الوصول إلى كنوز هذه المنطقة كان متاحاً فقط من خلال السيطرة على طرق التجارة. كان الآشوريون في حاجةٍ أيضاً إلى مربّي الإبل الذين كانوا في نفس الوقت قادة القوافل و ذلك بسبب عدم حيازة الآشوريين للجمال الكافية. من ناحية أخرى، لم يكن ضرورياً القيام باحتلالٍ لمساحاتٍ واسعةٍ عندما تكون آخر المراحل من الطرق التجارية تحت السيطرة الآشورية. بالإضافة إلى ذلك فقد استفاد الآشوريون بشكلٍ غير مباشر من التجارة و ذلك عن طريق دفع الإتاوة من قبل القبائل العربية أو من قبل الدول التي أقاموا معها علاقات تجارية.
كلمات البحث: العرب، الآشوريون، التجارة، القوافل، البدو.

1 Einführung

„Schick mir jede mögliche Nachricht über die Araber, die du hören kannst“, soll im 7. Jahrhundert der assyrische König Assurbanipal einem in Nordbabylonien tätigen Beamten namens Nabû-šuma-lēšir befohlen haben.[1] Am Ende des 8. Jahrhunderts[2] schrieb Adda-ḫati, Gouverneur von *Ḫamat* in Syrien, an Sargon II.: „Wir haben nichts besonders über die Araber gehört“.[3] Zu dieser Zeit waren die *lúarbāja,* die „Araber“, schon längst zu einer staatlichen Angelegenheit im assyrischen Reich geworden. Der Terminus, den wir als ‘Araber’ bzw. ‘Land der Araber’ übersetzen, wird in den neuassyrischen Quellen als *Arabi, Aribi, Aribu, Arubu* und mit dem Ethnonym *Arbāja* wiedergegeben.[4] Hinter der Bezeichnung ‘Araber’, die zunächst für Nomaden am südwestlichen Rand des Fruchtbaren Halbmondes verwendet wurde,[5] verbirgt sich dennoch eine komplexe Realität. Die Beziehungen zwischen den Assyrern und den Arabern sind ebenfalls vielfältig und lassen sich nicht auf eine kriegerische Auseinandersetzung zwischen einer urbanen Großmacht und Nomaden, die in einer unfruchtbaren und menschenfeindlichen Umgebung leben, reduzieren.

Aribi[6] ist zunächst eine allgemeine Bezeichnung für Nomaden der syrischen und nordarabischen Wüste, kann sich aber auch auf spezifische Stämme der arabischen Halbinsel beziehen:[7] *Ḫajappa, Ibādidi, Idiba’il, Marsīmani, Qidru, Sumu’il* und *Tamudi*. Gewöhnlich wird *Aribi* als Eigenbezeichnung verstanden, d. h. als die Bezeichnung, die die Nomaden für sich selbst benutzt haben, da sie gleichzeitig in angeblich voneinander unabhängigen Quellen vorkommt, nämlich in den assyrischen Texten und in der hebräischen Bibel (Eph’al 1976, 228; 1984, 7). Diese Texte können allerdings nicht als voneinander unabhängig bewertet werden, da einerseits die kulturelle Interaktion zwischen Mesopotamien und Syrien-Palästina gut bezeugt ist, so dass diese Quellen nicht isoliert entstanden sein können. Andererseits ist es unwahrscheinlich, dass die zahlreichen Bevölkerungsgruppen der arabischen Halbinsel ein klares Bewusstsein von einer gemeinsamen ethno-linguistischen oder sozio-politischen Zugehörigkeit hatten. Die Quellen in diesem Gebiet zeigen dagegen eine deutliche Heterogenität.

Den ältesten Beleg für *Aribi* liefert eine Inschrift Salmanassars III. aus der Mitte des 9. Jahrhunderts (RIMA 3, 102.2, ii, 94). Die ältesten biblischen Belege sind jünger und werden gegen Ende des 7. Jahrhunderts datiert (Jer 3:2, Jer 25:24). In den altsüdarabischen Inschriften des ersten Jahrtausends findet man eine solche Bezeichnung nicht; der Terminus ist erst in sabäischen Inschriften aus dem ersten Jahrhundert u. Z. bezeugt (Eph’al 1984, 8). Selbst wenn die Etymologie und die sprachliche Zugehörigkeit von *Aribi* unklar sind,[8] ist es nicht

---

[1] *um-ma ṭè-em šá lúar-a-bi ma-la ta-šem-mu-ú*, SAA 18, 149, 10–11.

[2] Falls nichts anders angegeben wird, verstehen sich alle Datierungen als ‚v. u. Z‘.

[3] *ṭ*[*e-e-mu ḫar-ṣ*]*u ša lú*ar-ba-a-a la-a ni-iš-me*, SAA 1, 173, 11–13; auch SAA 1, 174, 11–Rs. 2’.

[4] Orthographien: 1. Arabi (*kura-ra-bi, lúa-ra-bi*), 2. Aribi (*a-ri-bi, kura-ri-bi, lúa-ri-bi, lú kura-ri-bi*), 3. Aribu (*kura-ri-bu*), 4. Arubu (*kura-ru-bu, lúa-ru-bu*) und 5. als Nisbe Arbāja (*ar-ba-a-a, kurar-ba-a-a, kurar-pa-a-a, kurár-pa-a-a, lúar-ba-a-a, lúár-ba-a-a #*). Meist bezeugt sind die Schreibungen kurAribi, lúAribi, lúAribu und lúArbāja.

[5] In Sargons Inschriften (Fuchs 1994, Prunk 69–70 und Ann. 184–190) wird die Bezeichnung ‘im Gebiet der Araber von Sonnenaufgang’ als dichterische Umschreibung für die nomadisierenden Stämme des iranischen Hochlandes verwendet, siehe Fuchs 1994, 347 Anm. 452 und Lanfranchi 2004, 218.

[6] Ich verwende hier *Aribi* als normalisierte Form des Ortsnamens.

[7] Zu den Arabern in den keilschriftlichen Quellen aus dem ersten Jahrtausend siehe Byrne 2003; Eph’al 1984; Lanfranchi 2004; Macdonald 1995; Musil 1927, 477–493; Retsö 2003, 119–211; Rosmarin 1932; zu möglichen Hinweisen auf Araber im 2. Jahrtausend siehe Arnaud 1995.

[8] Eph’al 1984, 7; Zadok 1985, xix (Arabi) schlägt eine westsemitische Herkunft vor; Lanfranchi 2004, 225 dagegen legt keine akkadische oder semitische Etymologie vor.

unwahrscheinlich, dass der Terminus in Assyrien entstand, später in die Bibel aufgenommen[9] und schließlich in der arabischen Welt verwendet wurde.[10]

Zur Rekonstruktion der Beziehungen zwischen den Assyrern und den Arabern stehen uns unterschiedliche Quellen zur Verfügung. Hauptquelle sind die neuassyrischen Königsinschriften und Briefe, auf die sich diese Untersuchung im Wesentlichen stützen wird. Hinzu kommen einige auf Neubabylonisch verfassten Briefe aus der Korrespondenz der assyrischen Herrscher sowie die babylonischen Inschriften eines Herrschers von *Suḫu* am mittleren Euphrat. Weitere Angaben zu den arabischen Stämmen finden sich in der hebräischen Bibel, die ich in diesem Zusammenhang nur am Rande behandeln kann.[11] Darüber hinaus verfügen wir über ikonographisches Material, namentlich die neuassyrischen Palastreliefs, wo Darstellungen von Auseinandersetzungen aus den Regierungszeiten Tiglatpilesers III., Sargons II. und Assurbanipals vorhanden sind (Reade 1998; ferner Meissner 1926; Opitz 1931–1932), die wir mit Passagen aus den Königsinschriften in Verbindung bringen können.[12]

2 Arabien in der assyrischen *mental map*

In der assyrischen *mental map* stellt das Land der *Aribi* die südliche Grenze des Reiches dar (Abb. 1). Es handelt sich um eine Grenze, die mit einer natürlichen Barriere in Verbindung stand, nämlich der (arabischen und syrischen) Wüste, die einer assyrischen Expansion nach Süden entgegenstand. Diese Region, die sich zum größten Teil südlich des Fruchtbaren Halbmondes erstreckte,[13] hatte keine festen Grenzen, sie weitete sich aus bzw. schrumpfte zusammen, je nachdem welche Gebiete gerade unter assyrische Kontrolle gerieten.

Die Annahme, dass die Assyrer Arabien als Ödland und die Araber als Nomaden angesehen haben, scheint zunächst durch die Quellen bestätigt zu werden. Die Assyrer empfanden in der Tat Abscheu und Ablehnung vor der Wüste: „Was das weit entfernte Land *Bāzu* anbelangt, ein vergessenes Stück trockenen Landes, ein Salzgebiet, eine Stätte des Durstes – 120 Doppelstunden (ca. 1.300 km[14]) Sandgebiet mit Disteln und (...), wo Schlangen und Skorpione wie Ameisen das Feld bedecken" (RINAP 4, Nr. 1, iv, 53–56). Auf diese Weise beschreibt Asarhaddon den Weg zum Land *Bāzu* in Ostarabien. Eine ähnliche Beschreibung findet sich in den Inschriften Assurbanipals: Die Wüste sei „eine Stätte des Durstes und des *Verschmachtens*, wo die Vögel des Himmels nicht fliegen, wo Onager und Gazellen nicht weiden" (BIWA, A, viii, 87–90 (Übersetzung auf S. 247); vgl. auch BIWA, A, viii, 108–110). Gewiss kein passender Ort für eine organisierte urbane Gesellschaft. Die Bewohner dieser Wüste, die in Zelten wohnen[15] werden in den Annalen Sargons entsprechend folgendermaßen geschildert: „Die weit entfernten Araber (...), Wüstenbewohner, die weder Aufseher noch Leiter kennen und die niemals irgendeinem König Tribut gebracht hatten (...)" (Fuchs 1994, Ann. 120–122).

---

[9] bibl. *'arbî* (HAL, 82). Außerdem werden Nomaden als 'Leute aus dem Osten', *bᵉnê qedem* bezeichnet.

[10] Für diese These siehe Lanfranchi 2004, 219–225.

[11] Zu den Arabern in der hebräischen Bibel siehe Eph'al 1984, 60–72; Retsö 2003, 212–234; Rouillard-Bonraisin 1995. Die aramäischen Texte aus Taymā' sind jünger: KAI 228–230 (5.–4. Jahrhundert). Weitere aramäische Texte: Degen 1974 und Beyer – Livingstone 1987.

[12] Außerdem sind die Angaben der Chroniken über Asarhaddons Feldzug gegen *Bāzu* zu erwähnen: TCS 5, Nr. 1, IV, 5–6 (Babylonische Chronik) und TCS 5, Nr. 14, 7. 8. 13 (Asarhaddons Chronik), den Vertrag mit den Qedariten: SAA 2, 10 und Deller – Parpola 1968 und Verwaltungsurkunden: SAA 11, 33.

[13] Entsprach in etwa dem nördlichen Teil von *Arabia deserta* und *Arabia petrea* der römischen Quellen.

[14] 1 *bēru* = ca. 10.800 m, Liverani 1999–2001, 67.

[15] „Die Steppenhäuser, die Zelte, in denen sie wohnten (...)": BIWA, B, viii, 10; BIWA, B, viii; A, vii, 121.

Betrachtet man die Texte genauer, so wird deutlich, dass nicht alle Wüstenbewohner Nomaden sind, dass die Wüste gar nicht so unfruchtbar und arm ist und dass die große Entfernung nicht unüberwindbar ist. Nachdem Sanherib das Lager der arabischen Königin Te'elḫunu erfolgreich angegriffen hat, verfolgt er sie bis nach *Adummatu*, das mit Dūmat al-Ǧandal am Wadi Sirḥān identifiziert wird. Dieser Ort liegt mitten in der Wüste, in einer „Gegend des Durstes, in der es weder Weide noch Tränke gibt" (RINAP 3/1, Nr. 35, Rs. 53'–59'). Asarhaddon betrachtet dasselbe Ereignis retrospektiv und bezeichnet *Adummatu* als „Festung der Araber".[16] Ferner erobert er in Ostarabien sechs „befestigte Städte im Gebiet des Landes *Bāzu* zusammen mit den kleinen Ortschaften in ihrer Umgebung".[17] Diese Beispiele zeigen, dass es bereits zu dieser Zeit nicht nur Zeltlager in der Wüste gab.

Obwohl sich die Araber vornehmlich durch ihre Beweglichkeit und Heterogenität auszeichnen, sind sie auch organisiert und ihre Institutionen den Assyrern nicht vollkommen fremd, wie die aus dem eigenen kulturellen Umfeld stammende Bezeichnung *šarru* 'König' für ihre Führer zeigt.[18] Ein wichtiges Merkmal der damaligen arabischen Welt, nämlich die häufige Präsenz von Frauen in führenden Positionen,[19] für die der Terminus *šarratu* 'Königin' verwendet wird,[20] wird ohne jegliche Kommentare als eine Tatsache empfunden (Lanfranchi 2004, 231–232).

Die Wüste ist auch kein armes und wirtschaftlich uninteressantes Gebiet, sondern vielmehr reich an exotischen Steinen, Aromata und hauptsächlich Kamelen, alles kostbare Produkte, die durch Beute, Tribut oder Handel in das assyrische Reich gelangten. Auf diese Thematik werde ich später zurückkommen. An dieser Stelle seien lediglich einige Beispiele erwähnt: Tiglatpileser erbeutete 30.000 Kamele von der Königin Samsi (RINAP 1, Nr. 42, 20'), und Sanherib mehrere Tausende von der bereits erwähnten Te'elḫunu.[21] Assurbanipal soll seinerseits so viele Kamele während seiner Araber-Feldzüge ergattert haben, dass er sie an die Einwohner Assyriens verteilen konnte und sogar eine Senkung des Kaufpreises verursachte (BIWA, A, ix, 42–52; BIWA, B, viii, 12–22; BIWA, C, x, 17–28; siehe Lanfranchi 2004, 230).

In den Beziehungen zwischen dem assyrischen Reich und den Arabern spielen Kamele eine entscheidende Rolle, und zwar aus einem einfachen Grund: Um die Wüste durchqueren zu können, braucht man Kamele.[22] Wer unter den harten geo-klimatischen Bedingungen der Wüste

---

[16] „Was Adummatu anlangt, die Festung der Araber (*āl dannutu ^{lú}aribi*), die Sanherib, der König von Assyrien, der Vater, der mich erzeugte, erobert hatte", RINAP 4, Nr. 1, iv, 1–2.

[17] RINAP 4, Nr. 77, 24–27. Die Formulierung ist sehr standardisiert und es könnte sich in der Tat um einen Topos handeln, jedoch werden die sechs Städte auch mit Namen erwähnt: *Ḫandasu, Magalānu*, *Alpijana, Diḫrānu, Qatabu', Padê* und *Udēru* (s. RGTC 7/2, *s. v.*).

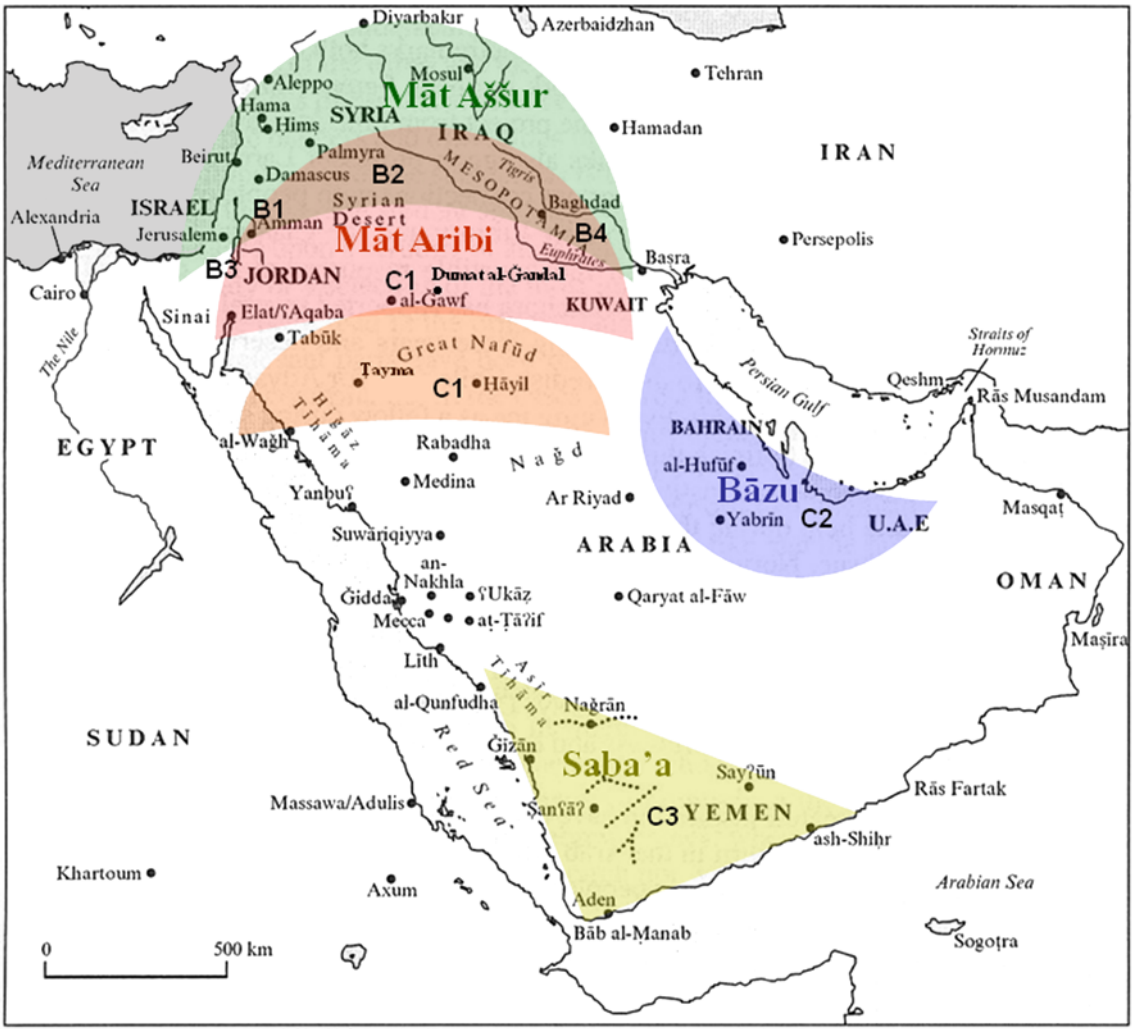
[18] Siehe RGTC 7/2, *s. v.* Arubu. Es werden keine anderen Bezeichnungen für die arabischen Herrschern verwendet, wie zum Beispiel im Falle der Meder (*bēl āli*) oder der Bevölkerungsgruppen am mittleren Euphrat (*nāsiku*), Lanfranchi 2004, 232 mit Anm. 46.

[19] Es handelt sich um folgende Herrscherinnen (in Klammern der entsprechende neuassyrische König): Aṭijā (Assurbanipal), Apkallatu (Asarhaddon; = Te'elḫunu nach Borger 1957, 9–10; siehe auch Frahm 1997, 135 Komm. zu Z. 53'), Baslu (Asarhaddon), Jaite'e (Sanherib), Japa' (Asarhaddon), Samsi (Tiglatpileser III., Sargon II.), Tabu'a (Asarhaddon, jedoch in Ninive zur Zeit des Sanherib ausgebildet), Te'elḫunu (Sanherib), Zabibē (Tiglatpileser III.).

[20] Te'elḫunu, die in Sanheribs Inschriften als *šarrat ^{lú}Arabi* 'Königin der Araber' bezeichnet wird (RINAP 3/1, Nr. 35, Rs. 53'), wird in einer rückblickenden Darstellung in Assurbanipals Inschriften als *kumirtu*-Priesterin präsentiert (BIWA 70, 12 [K 3087 und parallel K 3405 und Rm 2, 558]).

[21] RINAP 3/1, Nr. 35, Rs. 53'–54', wie viele Tausende ist leider nicht erhalten.

[22] Es handelt sich in diesem Kontext eigentlich um einhöckrige Kamele, nämlich um Dromedare (*Camelus dromedarius*, akkadisch *gammalu, ibilu*). Bezeugt sind auch die Termini *anaqātu* 'Dromedarstute' und *bakru* 'Dromedarjunges'. Ihr Lebensraum sind Wüsten- und Steppengebiete in Arabien, Afrika, Australien, Pakistan und Indien. Zweihöckrige Kamele, nämlich Trampeltiere (*Camelus ferus bactrianus*, akkadisch *udru*) sind bereits in der mittelassyrischen Zeit (RIMA 2, 89.7, iv, 26–28) und später in den neuassyrischen Texten bezeugt. Nach Heimpel (1976–1980, 330) kamen sie aus dem Gebiet des heutigen Iran. Heute beschränkt sich der Lebensraum von wilden Trampeltieren auf die Wüste Gobi; domestizierte Trampeltiere sind in Zentralasien, China, der Mongolei und Kasachstan zu finden (siehe Potts 2004). Zu den Darstellun-



Karte 1 *Arabien in der assyrischen* mental map *mit Angabe der mit 'arabischen' Ortsnamen verbundenen Regionen (siehe Anhang; Grundkarte: Retsö 2003, map 1).*

الخريطة١: بلاد العرب في 'خريطة ذهنية' آشورية تشير إلى المناطق المقترنة بأسماء الأماكن "العربية" (قارن الملحق؛ الخريطة الأساسية من Retsö ٢٠٠٣، map 1).

überleben will, Handel treiben oder Feldzüge unternehmen möchte, kann auf Kamele nicht verzichten, und die Assyrer hatten weder Kamele noch das entsprechende know-how im Umgang mit diesen Tieren. Sie waren auf die Kooperation der Araber angewiesen, und dies erforderte eine andere Politik als die übliche der Ausbeutung und Bestrafung, die meist mit einer Annexion endete. Die Domestizierung des Kamels in der zweiten Hälfte des 2. Jahrtausends veränderte grundlegend die Wirtschaft und die Organisation der nomadischen Stämme sowie die Struktur der Karawanen (Liverani 2003, 133–136). Karawanen mit Kamelen können lange Strecken in der Wüste bewältigen, sie brauchen aber aus organisatorischen und Sicherheitsgründen eine große Anzahl von Tieren[23] und müssen von den Kamelzüchtern selbst geführt werden (Liverani 2003, 134–136).

gen von Kamelen auf den assyrischen Reliefs siehe Mitchell 2000.

[23] Im Fall von militärischen Kampagnen durch die Wüste musste alles Notwendige mitgenommen werden, d. h. Wasser und Proviant für Menschen und Tiere. Auf der Basis von Feldzügen im 19. Jahrhundert (z. B. Napoleons Feldzüge) ergibt sich, dass, um 1.000 Mann zu unterstützen (ohne das Wasser und Futter für die Tiere einzuberechnen, die viel mehr als Menschen benötigen), für Wasservorräte für drei Tage zumindest 200 Kamele notwendig sind; Eph'al 1984, 139–140.

Das Land der Araber bildete die südliche Grenze des assyrischen Reiches und lag am Rande der damals bekannten Welt.[24] Die Beziehungen zwischen Zentrum und südlicher Peripherie erfolgten durch direkte, zumeist wenig friedliche Kontakte in der syrischen Wüste, in Nordarabien und ferner in Ostarabien sowie durch indirekte Kontakte mit Zentral- und Südarabien. Durch den Einsatz von Kamelen waren die Assyrer zum ersten Mal außerdem in der Lage, einen Feldzug gegen Ägypten durch die Sinai-Wüste zu unternehmen und somit die südwestliche Grenze des Reiches zu überschreiten.

3 Die geographischen Gebiete nach den Ortsnamen in den assyrischen Quellen

In den neuassyrischen Quellen gibt es 68 Ortsnamen, die mit den Arabern in Verbindung gebracht werden können (s. Anhang), wobei diese Verbindung in einigen Fällen lediglich auf etymologischen Erwägungen beruht.[25] Abgesehen von der allgemeinen Bezeichnung *Aribi*, dem problematischen Terminus *Urbi*[26](A) und drei Bergnamen (D)[27] können die Ortsnamen in zwei Gruppen eingeteilt werden (Karte 1): Eine Gruppe (B) umfasst Gebiete und Bevölkerungsgruppen außerhalb der arabischen Halbinsel, während die andere Gruppe (C) Gebiete und Bevölkerungsgruppen der arabischen Halbinsel einschließt. Die Gebiete außerhalb der arabischen Halbinsel befinden sich am südlichen Rand des Fruchtbaren Halbmondes und sind das nördliche Ostjordanland (B1), die syrische Wüste (B2), der nördliche Negev (B3) und Babylonien (B4).[28] Für das Gebiet am mittleren Euphrat liefern die assyrischen Texte nur indirekte Beweise, die Kontakte werden hauptsächlich in babylonischen Quellen beschrieben.

Unter den Gebieten der arabischen Halbinsel lassen sich drei Regionen erkennen: Nord- und Zentralarabien (C1), Ostarabien (C2) und Südarabien (C3). Nordarabien ist die Region unmittelbar südlich des Fruchtbaren Halbmondes und stimmt ungefähr mit der *Arabia deserta* der Römer und dem Großen Nafūd überein. Diese Region hat keine festen Konturen im Süden; die auf der Karte eingezeichnete Grenze ist konventionell und entspricht der maximalen Reichweite assyrischer Feldzüge in diesem Gebiet *(Adummatu)*. Ostarabien wurde nur von Asarhaddon im Laufe seines Feldzugs gegen das Land *Bāzu* erreicht, eine Region am persischen Golf, gegenüber von Bahrein (neuassyrisch *Tilmun*), die sich vielleicht sogar von Kuwait bis an die Grenze zu Oman erstreckte.[29] *Tilmun* spielt in den neuassyrischen Texten keine wichtige Rolle. Zuletzt sei Südarabien erwähnt, möglicherweise durch den Ortsnamen *Saba'a* vertreten, ein Gebiet, welches die Assyrer nie betreten haben und das zur Zeit der Römer *Arabia felix* hieß.

Sobald die Assyrer nach Süden expandierten und in Syrien-Palästina oder in Babylonien tätig wurden, stießen sie auf Nomadenstämme, die immer wieder versuchten, in den Fruchtbaren Halbmond einzudringen. Die Bezeichnung 'Land der Araber' *(māt aribi)* bezog sich in erster Linie auf dieses Grenzgebiet, das die syrische Wüste und den nördlichen Teil der arabischen Wüste umfasste. Seine Konturen waren flexibel. Die assyrischen Texte informieren uns darüber, wo sich diese Gruppen aufhielten bzw. wo die Auseinandersetzungen mit den Assyrern stattfanden. Die Wege, auf denen die arabischen Stämme und ihre Produkte Mesopotamien und

---

[24] In der so genannten Geographie Sargons (7. Jahrhundert) wird *Bāzu* als eine der Grenzen der Welt angegeben, Sargons Geographie 1–3; siehe Liverani 1999–2001, 59–60 mit Karte 1 auf S. 61.

[25] Es handelt sich hauptsächlich um die Ortsnamen aus Babylonien.

[26] Geschrieben ^{lú}*ur-bi* und ^{lú}*úr-bi*.

[27] *Ḫazû* in Ostarabien, *Ḫukkuruna* im Ostjordanland, *Saqurri* = Ǧabal ad-Durūz oder am Wadi Sirḥān?

[28] Zu den Arabern in Babylonien siehe Eph'al 1974; Livingstone 1989.

[29] Liverani 1999–2001, 70–71 gegen Potts 1982, der das Land *Bāzu* am Wadi Sirḥān in Nordwestarabien lokalisiert.

die Levante erreichten, lassen sich nicht anhand der keilschriftlichen oder biblischen Quellen rekonstruieren, da keine Itinerare überliefert sind und nur wenige Ortsnamen identifiziert werden können. Zu den identifizierten Orten gehören *Adummatu*/Dūmat al-Ǧandal, *Kapānu*/Kāf und *Tēma*/Taymāʾ.

Nach Auskunft jüngerer Quellen gab es in Medina *(Yaṯrib)*, wo sich die Routen aus Südarabien verzweigten, mehrere Möglichkeiten in das südliche Mesopotamien oder in die südliche Levante zu gelangen (Karte 2). Eine erste Route (1) führte von Medina über Hāyil bis an-Naǧaf (1.060 km), von wo die südmesopotamischen Städte erreichbar sind. Eine zweite Route (2) verband Medina mit Taymāʾ über Khaybar und Fadak. In Taymāʾ hatten drei Hauptrouten ihren Anfang. Eine (2a) führte über Dumāt al-Ǧandal nach Babylon (1.530 km), eine zweite (2b) über Tabūk und Maʿān nach Amman, von wo Damaskus und Tyros erreichbar waren (860 km bis Tabūk) und eine dritte Route (2c) ermöglichte, Amman über den westlichen Teil des Wadi Sirḥān zu erreichen. Von Medina (3) konnte man auch nach Tabūk und Maʿān über Dedan (al-ʿUlā) reisen (760 km).[30] Die Assyrer sind nur zweimal in die arabische Halbinsel eingedrungen: Sanherib zog bis *Adummatu* in Nordarabien und Asarhaddon nach *Bāzu* in Ostarabien. Die genauen Routen sind nicht bekannt.[31]

Weitere Hinweise auf eine arabische Präsenz innerhalb des assyrischen Reiches können durch die Untersuchung des neuassyrischen Onomastikons gewonnen werden. Vorarbeiten in dieser Richtung hat Zadok geleistet (Zadok 1981; 1990), der ca. 80 Personennamen, die angeblich südwestsemitischer Provenienz sind, zusammengetragen und analysiert hat. Zadok muss jedoch zugeben, dass die ethno-linguistische Zuweisung in den meisten Fällen nicht sicher ist. Von den 80 Individuen mit vermeintlich arabischen Namen befinden sich ca. 40 in Assyrien selbst, 20 in Südmesopotamien und weitere 20 in nordmesopotamischen Gebieten, was auf eine breite Verteilung hindeuten könnte.

4 Die kriegerischen Auseinandersetzungen mit den Arabern

Von der zweiten Hälfte des 9. Jahrhunderts, d. h. seit ihrer ersten Erwähnung in den neuassyrischen Quellen bis zum Ende des 8. Jahrhunderts finden wir in Syrien-Palästina Araber, die in den Widerstand der westlichen Staaten gegen die assyrische Expansion involviert sind. So nimmt der Araber Gindibu' im Jahr 853 mit 1.000 Kamelen *(anše gammalu)* an der Schlacht von *Qarqaru* teil, in der eine anti-assyrische Koalition, geleitet durch die Könige von Damaskus und *Ḫamat*, Salmanassar III. (858–824) entgegenstand (RIMA 3, 102.2, ii, 94). Mehr als hundert Jahre später erwähnen die Annalen Tiglatpilesers III. (745–727), dass Zabibē, Königin der Araber, zusammen mit anderen Königen im Jahr 738 Tribut zahlte, wobei die explizite Nennung von Dromedaren, Dromedarstuten und Dromedarjungen bemerkenswert ist.[32] Es ist das erste Mal, dass Araber Tribut zahlen.

Nach der Eroberung von Damaskus im Jahr 733 rechnet Tiglatpileser III. mit der arabischen Königin Samsi ab, die zweifelsohne auf der Seite von Damaskus stand und ihren Treueeid gebro-

[30] Wir wissen auch nicht, aus welcher Richtung sich Sanherib *Adummatu* näherte, wahrscheinlich von Damaskus über den Wadi Sirḥān, Potts 1988, 129–130.

[31] Man sollte auch bedenken, dass die Karawanen nicht unbedingt bestimmte Routen von einem Brunnen zum anderen gezogen sein müssen. Wasserstellen waren eigentlich gefährlich, da dort oft Räuber auf ihre Opfer warteten. Die Karawanenführer mussten vielmehr verschiedene Möglichkeiten erwägen, von einem Punkt zum anderen zu gelangen. In Winter zum Beispiel sammelt sich Regenwasser zwischen den Dünen, das auch als Trinkwasser genutzt werden konnte, Potts 1988, 127–128.

[32] RINAP 1, Nr. 14, 10–12 und Nr. 15, 1–5 (bes. Z. 4–5); in RINAP 1, Nr. 35, iii, 19, wird Zabibē im gleichen Zusammenhang erwähnt, die einleitenden Zeilen der Passage schreiben jedoch von einem Tribut der Qedariten (und?) Araber (Z. 1–2).

chen hatte.[33] Ihr Lager wird angegriffen und ausgebeutet, und sie wird bis zu ihrem Zufluchtsort in der Wüste verfolgt und besiegt. Ein assyrischer Aufseher *(lúqēpu)* wird über sie gesetzt (RINAP 1, Nr. 42, 19'–34'; siehe Lanfranchi 2004, 233 Anm. 49). Nach diesem Ereignis müssen auch die Leute aus *Mas'a, Tēma, Saba'a,*[34] *Ḫajappa, Badāni, Ḫatte* und *Idiba'il*, „die an der Grenze zu den westlichen Ländern wohnen", Tribut *(madātu)* leisten (Gold, Silber, Dromedare, Dromedarstuten, Gewürze aller Art) (RINAP 1, Nr. 42, 27'–35', auch id., Nr. 47, Rs. 3'–6'). Darstellungen dieser Ereignisse finden sich auf den Reliefs des Zentralpalastes in *Kalḫu* (Barnett – Falkner 1962, pl. xiii–xx, xxiii–xxx). Ein Relief zeigt eine arabische Frau, die Kamele als Tribut bringt – vielleicht handelt es sich um Samsi selbst (Barnett – Falkner 1962, pl. xxvi; Eph'al 1984, 85 Anm. 261). Im 7. Regierungsjahr Sargons (721–705) werden einige arabische Stämme besiegt und ein Teil der Bevölkerung wird nach *Samerīna* (Samaria) deportiert.[35] Der König von Ägypten sowie Samsi, Königin der Araber[36] und It'amra, König von *Saba'a* müssen Tribut *(madātu)* zahlen (Gold, erlesene Steine, Elfenbein, Samen von Ebenholz, Duftstoffe aller Art, Pferde und Dromedare) (Fuchs 1994, Ann 123–125; Fuchs 1994, Prunk 27). Ein Relief aus dem Saal X in Sargons Palast in *Dūr-Šarrukīn* zeigt passend dazu Kamele, die dem König als Geschenk gebracht werden (Botta – Flandin 1849, pl. 98 [128])**.**

Einige Briefe aus der Korrespondenz Sargons II. zeugen von Arabern in Zentralsyrien[37] und in der Ǧazīra, am Wadi Ṯarṯār.[38] Araber plündern das Gebiet zwischen dem Wadi Ṯarṯār und dem mittleren Euphrat, da sie wegen der Dürre verhungern. Sie werden jedoch nicht verfolgt, vielmehr gestattet man ihnen, dort zu weiden (SAA 1, 82). In den westlichen Provinzen wird der Gouverneur von *Ḫamat* von Arabern überfallen, als er Beute von Damaskus nach Assur transportieren will (SAA 1, 175). Bēl-iqbi, Gouverneur von *Ṣupat*, verteidigt sich in einem Brief an Sargon gegen den Vorwurf, man habe in der Stadt *Ḫuzaza* Eisen an die Araber verkauft. Bēl-iqbi versichert, dass Steuereinnehmer in *Ṣupat* und *Ḫuzaza* eingesetzt wurden und dass sich die Araber nun von diesen Städten fernhalten (SAA 1, 179, 20–Rs. 12). Da Eisen für die Herstellung von Waffen verwendet wurde, versteht sich die Sorge des Königs. Darstellungen von Arabern aus dem Westen des assyrischen Reiches sind in *Til Barsip* (Tall Aḥmar) bezeugt.[39] Eine weitere frühe Darstellung eines Kamelreiters stammt aus *Guzāna* (Tall Ḫalaf) in Nordmesopotamien.[40]

Der älteste Beleg für arabische Präsenz in Babylonien ist ein Brief an Sargon II., in dem die Plünderung von *Sippar* erwähnt wird (SAA 1, 84). Einige Jahre später (702) besiegt Sanherib bei *Kiš* eine Koalition von Chaldäern, Aramäern und Elamiern, die den Chaldäer Marduk-apla-iddina unterstützen. An dieser Schlacht nahm ein gewisser Basqānu teil, der als 'Bruder von Jati'e, der Königin der Araber' bezeichnet wird (RINAP 3/1, Nr. 1, 28; RINAP 3/2, Nr. 213, 28). In der Schlacht wurden Dromedare (und Trampeltiere) eingesetzt, die von den Assyrern erbeutet wurden (RINAP 3/1, Nr. 1, 29; RINAP 3/2, Nr. 213, 29). Einige der eroberten ummauerten Städte können mit arabischen Namen in Verbindung gebracht werden, was auf eine Ansiedlung

---

[33] RINAP 1, Nr. 20, 18' (*māmit* ^{d}Šamaš)

[34] Siehe Anm. 63.

[35] *Tamudi, Ibādidi, Marsīmani* und *Ḫajappa*; Fuchs 1994, Ann. 120–123 und Zyl. 20.

[36] Die in SAA 11, 162, 1'–8' erwähnte Samsi ist vielleicht mit der Königin der Araber zu identifizieren, Eph'al 1984, 86.

[37] SAA 1, 173–175 Briefe von Adda-ḫati, Gouverneurs von *Ḫamat*; SAA 1, 177–180, Briefe von Bēl-iqbi, Gouverneur von *Ṣupat*.

[38] SAA 1, 82 und 85, Briefe von Ṭāb-ṣill-Ešarra, Gouverneur von *Aššur*; siehe Fales 1989.

[39] Thureau-Dangin – Dunand 1936, Taf. 51–52; Wäfler 1975, 153 datiert sie etwa in die Zeit des Salmanassar V. (725–722).

[40] Kalksteinplatte aus Tall Ḫalaf (9. Jahrhundert?), Hoyland 2001, 92 pl. 15 (Walters Art Gallery).

von Arabern in Babylonien hindeuten könnte.[41] Zwischen 691 und 689 findet ein Feldzug gegen die Araber in Nordarabien statt. Es handelt sich um die bereits erwähnte Eroberung von *Adummatu*/Dūmat al-Ǧandal.[42] Te'elḫunu, Königin von Arabien, und Ḫazā'il, dessen Titel nicht erhalten ist,[43] werden von Sanherib verfolgt und besiegt. Für die Einnahme der Stadt werden Belagerungsgeräte eingesetzt, was auf eine Stadtbefestigung hinweist. Nicht nur die Götterstatuen werden nach Assyrien verschleppt, sondern erlesene Steine (*pappardilû*, *papparminu*), eine Zypressenart (*ḫašurru*) und Spezereien. Da Sanherib im Jahr 694 einem der neuen Stadttore von Ninive den Namen 'Die Gaben der Leute von *Sumu'il* und *Tēma* gelangen hier hinein[44]' gegeben hatte, waren den gewaltsamen Auseinandersetzungen anscheinend friedliche (Handels-)Kontakte vorausgegangen.[45]

Sanheribs Nachfolger Asarhaddon (680–669) mischt sich zum ersten Mal in die dynastischen Angelegenheiten der Araber ein. Er kommt Ḫazā'ils Bitte entgegen und erstattet ihm die Götterstatuen, die sein Vater nach Ninive verschleppt hatte, zurück.[46] Darüber hinaus setzt er die Prinzessin Tabu'a, die in Sanheribs Palast erzogen worden war, als Königin ein (wahrscheinlich als Ehefrau eines lokalen Königs). Nach Ḫazā'ils Tod setzt Asarhaddon seinen Sohn Jata' als König ein und wird ihn später unterstützen, als ein lokaler Fürst (Uabu) gegen ihn rebelliert (RINAP 4, Nr. 1, iv, 19–31; RINAP 4, Nr. 1, iv, 1–16 u. Nr. 2, ii, 46–62). Asarhaddon ist der einzige assyrische Herrscher, der nach Ostarabien zog und der am weitesten in die arabische Halbinsel vordrang. Um 677/676 fand gegen das Land *Bāzu* eine Kampagne statt,[47] in deren Verlauf sechs Könige und zwei Königinnen besiegt und getötet wurden.[48] Einen weiteren König aus diesem Gebiet, der sich vor den Assyrern fürchtete und nach Ninive ging, um sich ihnen zu unterwerfen, setzte Asarhaddon über *Bāzu* ein.[49] Der Erfolg dieser Politik zeigte sich Jahre später bei den Ägypten-Feldzügen. Asarhaddon ist der erste asiatische Herrscher, der über die Sinai-Wüste nach Ägypten gelangte. Wie er das geschafft hat, erzählt uns der König selbst: „Kamele (*anše gammalu*) von allen Königen von Arabien ließ ich kommen und sie Wasserschläuche und Wasserflaschen tragen".[50]

Während der Regierung Assurbanipals (669–627) sind arabische Stämme in den Krieg zwischen dem assyrischen König und seinem Bruder Šamaš-šuma-ukīn, dem König von Babylon, involviert, und zwar als Verbündete des babylonischen Königs, d. h. auf der von Assyrien aus gesehen 'falschen' Seite. Nach einer langjährigen Politik der Eindämmung kam es schließlich im 7. Jahrhundert zum endgültigen Bruch der Assyrer mit den Arabern. Die chronologische Rekonstruktion der Ereignisse lässt im großen und ganzen drei Phasen erkennen:[51] 1. Um 652 kämpfte

---

[41] *Dūr-Abijata', Dūr-Bir-Dāda, Dūr-Uajit*.

[42] RINAP 3/1, Nr. 35, Rs. 53'–59' u. 1''–9''. Retrospektiv berichtet auch Asarhaddon über diesen Feldzug, RINAP 4, Nr. 1, iv, 1–31. Siehe Frahm 1999, 87 Anm. 47.

[43] In den Inschriften Asarhaddons und Assurbanipals wird er als 'König der Araber' und 'König der Qedariten' bezeichnet; siehe Eph'al 1984, 119 Anm. 401–402.

[44] *kadrê lúSumu'il u lúTēme qerebša errub*, RINAP 3/1, Nr. 17, vii, 96–viii, 1 und *kadrê lúTēme u lúSumu'il qerebša errub*, RINAP 3/1, Nr. 18, vii, 37'–38'; siehe Frahm 1999, 89 Anm. 54.

[45] Zur Lage dieses Tores siehe Frahm 1997, 274 gegen TAVO (Tübinger Atlas des Vorderen Orients) B IV 20.1.

[46] Ḫazā'ils Tribut wird nur um 65 Kamele (*anše gammalu*) und 10 Esel erhöht, RINAP 4, Nr. 1, iv, 17–18.

[47] Nirgendwo steht jedoch, dass der Feldzug nach *Bāzu* gegen „Araber" unternommen wurde.

[48] RINAP 4, Nr. 1, iv, 53–77; id., Nr. 2, iii, 93–96; id., Nr. 60, 4'–5'; id., Nr. 77, 24–27; id., Nr. 93, 12–13; TCS 5, 126, 13; TCS 5, 83, iv, 5–6.

[49] Es handelt sich um Lajalê von Jadi', RINAP 4, Nr. 1, iv, 72–77.

[50] RINAP 4, Nr. 34, Rs. 2 (Lesung nach Borger 1957–58, 118, zu § 77, 10); s. auch RINAP 4, Nr. 36, 10. In RINAP 4, Nr. 2, vi, 33 zählt Asarhaddon Kamele zu seinen militärischen Tierbeständen, Elat 1998, 50. Zu diesem Feldzug siehe Radner 2007 und Radner 2008.

[51] Ich folge hier der Rekonstruktion von Eph'al 1984; siehe ferner Weippert 1974–74; Gerardi 1992; Lan-

Assurbanipal im südlichen Syrien-Palästina gegen den Stamm *Qidru*, der sich schon einmal unterworfen und einen Eid geschworen hatte;[52] 2. Zwischen 651 und 648, während des Bruderkrieges, stieß die assyrische Armee mit arabischen Stämmen zusammen, die Šamaš-šuma-ukīn Hilfe leisten wollen;[53] 3. Erst 646, nach dem Ende des Bruderkrieges und der Eroberung von Susa, konnte Assurbanipal mit den Stämmen *Qidru*, *Sumu'il* und *Nabajāti* abrechnen, die 'Razzien' in der Palmyrene durchführten.[54] Die Verräter, die den Treueeid gebrochen haben und Verbündete des Feindes waren, wurden erbarmungslos verfolgt. In der Palmyrene ließ Assurbanipal Wachposten an den Wasserstellen Wache halten, so dass der Feind in der Steppe verdurstet: „Getränk machte ich rar für ihren Mund. Durch Durst und *Verschmachten* verloren sie das Leben. Die Übrigbleibenden schnitten ihre Reitkamele auf. Gegen ihren Durst tranken sie immer wieder Blut und Darmflüssigkeit".[55]

Die Ereignisse aus der ersten Phase der Araberkriege Assurbanipals sind wahrscheinlich an den Wänden des Raums L im Nordpalast in Ninive dargestellt (Barnett 1976, pl. xxxii–xxxiii und C; Nadali 2004; Eph'al 1984, 151 mit Anm. 517). Die Reliefs haben keine Beischriften, aber in einer Beischriftensammlung werden Ammuladi, König von *Qidru* und Aṭijā, Königin der Araber, in Zusammenhang mit der Plünderung und Brandschatzung ihrer Zeltlager erwähnt.[56] Auf den Reliefs ist die Plünderung eines Zeltlagers zu sehen, darunter wahrscheinlich die Misshandlung von Frauen, was einmalig in der assyrischen Ikonographie wäre (Barnett 1976, pl. xxxiii, slab 9 [BM 124927]; Nadali 1994, 73 Anm. 55 und Dubowsky 2009).

5 Die Handelsbeziehungen

Seit dem 9. Jahrhundert sind in den Keilschriftquellen Nomaden bezeugt, die von der arabischen Halbinsel in das assyrische Reich eindringen. Da sie 'Razzien' im Süden von Syrien-Palästina, in der Ǧazīra und in Babylonien durchführten oder sich mit Feinden des assyrischen Königs in der Levante oder in Babylonien verbündeten (zuerst mit Marduk-apla-iddina, dann mit Šamaš-šuma-ukīn), war eine militärische Konfrontation unvermeidbar. Auf der anderen Seite kontrollierten die Araber die Handelswege, die von Südarabien in die südliche Levante und nach Babylonien führten. Die Assyrer kontrollierten ihrerseits seit der Eroberung von Damaskus durch Tiglatpileser III. (733) die 'outlets' der Karawanenwege in der südlichen Levante. Die Araber waren daran interessiert, den Handel mit Spezereien, erlesenen Steinen, Gold und Kamelen weiter treiben zu können. Die Assyrer wollten selbstverständlich von diesem florierenden Handel profitieren und waren gleichzeitig für das Durchqueren der Wüste von den Kamelzüchtern abhängig. Eine Annexion der arabischen Halbinsel war unmöglich, und die pragmatischen Assyrer waren klug genug, dies nie versucht zu haben. Kein Gebiet auf der arabischen Halbinsel wurde jemals in eine assyrische Provinz umgewandelt, wie es auch im Falle der phönizischen Küstenstädte zu konstatieren ist, die ungestört florieren durften, solange sie regelmäßig ihren Tribut nach Ninive schickten. Produkte von der arabischen Halbinsel erreichten das assyrische Reich nicht nur in der Form von Beute und Tribut. Hinweise auf Handelsbeziehungen legen nahe, dass arabische Händler geduldet wurden, solange die Aktionen der Araber keine ernsthafte Gefahr für Assyrien darstellten.

---

franchi 2004, 239–244.

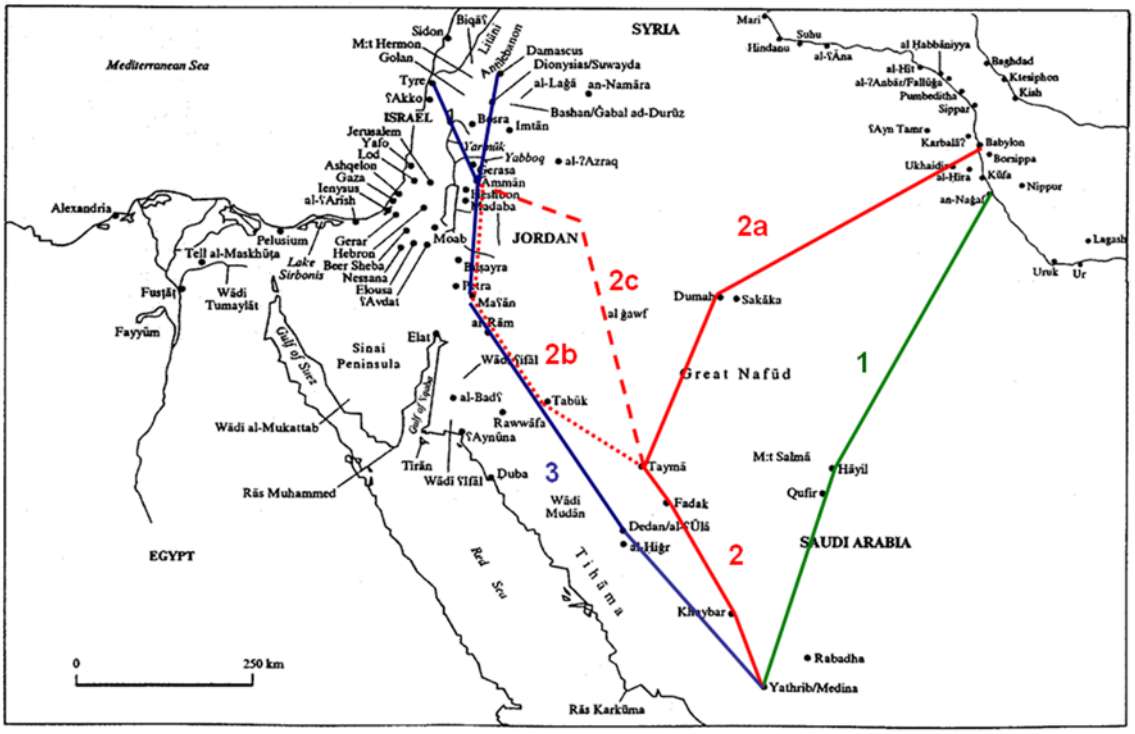
[52] Ein Vertrag des Assurbanipal mit den Qedariten ist nur fragmentarisch erhalten, SAA 2, 10.

[53] Es handelt sich wieder um Qedariten, geleitet von Abijate' Sohn des Te'ri, Ajammu Sohn des Te'ri, und Uaite' Sohn des Bir-Dadda, König von *Sumu'il*.

[54] Der Feldzug gegen Natnu, König von *Nabajāti*, könnte eine vierte Phase darstellen, Eph'al 1984, 165.

[55] BIWA, A, ix, 31–37 (hier übersetzt nur 34–37), diese Episode gehört zur Phase 3.

[56] BIWA 317–318, 79–82; Aṭijā wird auch im 'Großen Gottesbrief' erwähnt, BIWA 77–78, 45–49, siehe Übersetzung in Weippert 1973–74, 83, Ep. 5.



Karte 2 *Schematische Darstellung der Karawanenrouten in Zentral- und Nordarabien (Grundkarte: basiert auf Retsö 2003, maps 2–3. Routen: nach Angaben von Eph'al 1984, 14 und Karte Seite 241).*

الخريطة ٢: رسم تخطيطي لطرق القوافل في وسط و شمال الجزيرة العربية (الخريطة الأساسية من Retsö ٢٠٠٣، maps 2–3. مسارات الطرق وفق Eph'al ١٩٨٤، 14 و الخريطة من الصفحة ٢٤١).

Handelsbeziehungen zwischen Babylonien und der arabischen Wüste sind in den assyrischen Texten bezeugt. Produkte von der arabischen Halbinsel sind im Tribut enthalten, den Tiglatpileser III. dem babylonischen König Marduk-apla-iddina auferlegt hatte: Gold, erlesene Steine, buntgefärbte Gewänder, sowie Spezereien jeglicher Art (RINAP 1, Nr. 47, 28; siehe Elat 1998, 46). In einem Brief an Assurbanipal wird berichtet, dass Ammīni-ilu, ein Händler aus *Tēma*, der zum babylonischen König gekommen war, am Stadttor von *Sippar* verhaftet und gefesselt nach *Dūr-Šarrukku* gebracht wurde.[57]

Kontakte mit der Levante sind ebenfalls bezeugt. Als der Chaldäer Marduk-apla-iddina dem König Hiskija von Juda eine Gesandtschaft schickte, zeigte Hiskija den babylonischen Boten seine Schätze, darunter Gold und Spezereien.[58] Weitere Zeugnisse der arabischen Beziehungen zu Juda sind die Ostraka mit südarabischer Schrift, die in Jerusalem gefunden wurden.[59] Darüber hinaus lagerten Beduinenstämme im Gebiet zwischen Gaza und dem Wadi al-'Arīš und kontrollierten die Strecke der Via Maris, die über die Sinai-Halbinsel verlief. Die geopolitische

[57] SAA 18, 153, 4–11; siehe Elat 1998, 43. Eine Onyxperle (*pappardillû*?) aus Sanheribs Palast (Galter 1987, 74), ein Geschenk von (Nabû)-Zēr-kitti-līšir, Sohn des Marduk-apla-iddina, zeugt ebenfalls von Kontakten mit der arabischen Halbinsel; Frahm 1999, 89–91.

[58] 2 Kön 20:12–13; Jes 39:1–2. In der Liste der Schätze von Hiskija in 2 Chr 32:27–28 werden auch Edelsteine erwähnt.

[59] Shiloh 1987 interpretiert alle drei Inschriften als südarabisch (7.–6. Jahrhundert v. u. Z.). Die drei Scherben, die von Nicht-Judäern in Jerusalem zeugen, stammen aus lokal produzierten Keramikgefäßen. Elat (1998, 47) hält die Inschriften ebenfalls für südarabisch und datiert sie paläographisch zwischen dem 8. und dem 4. Jahrhundert v. u. Z.; er argumentiert außerdem, dass auch in anderen judäischen Städten Ostraka mit derartigen Schriftzeichen entdeckt worden sind. Dagegen könnten die Inschriften auf den Scherben 2 und 3 nach Sass 1999 griechisch sein.

und wirtschaftliche Bedeutung dieses Territoriums wurde bereits von Tiglatpileser erkannt, als er einen arabischen Scheich als ‚Aufseher' in diesem Gebiet einsetzte.[60] In seinem fünften Regierungsjahr (716) betraute Sargon ebenfalls einen nomadischen Scheich (*nasīku* aus *Laban*, in der Nähe von Raphia) mit der Aufsicht über neuangesiedelte Deportierte in diesem Gebiet (SAAS 8, iiie, 1–7 mit Anm. 23 auf S. 57; Eph'al 1984, 93). Bereits in seinem Akzessionsjahr (721) leitete Sargon Handelsbeziehungen mit Ägypten ein: „Den versiegelten Hafen des Landes *Muṣur* öffnete ich, vermengte die Einwohner von Assyrien und Ägypten miteinander und ließ sie Handel treiben" (Fuchs 1994, Ann 17–18). Der erwähnte Hafen befand sich im Gebiet zwischen dem Wadi Gaza und dem Wadi al-ʻArīš.[61] Ausgrabungen in dieser Region zeugen von der assyrischen Siedlungspolitik (Tall Abū Salima, 15 km südwestlich von Raphia; Tel Haror, 20 km westlich von Beerscheba; Ruqaiš und Tall Jemmeh, 10 km südlich von Gaza). In Tall Jemmeh wurde eine Anzahl von Dromedarknochen gefunden, ein weiterer Hinweis, dass der Warentransport in den Händen von Arabern lag.[62]

Den ältesten Beleg für Karawanen von der arabischen Halbinsel liefert eine (neubabylonisch verfasste) Inschrift eines Herrschers von *Suḫu* am mittleren Euphrat, der in der Mitte des 8. Jahrhunderts, kurz vor Tiglatpileser III. regierte. Eine große Karawane aus *Tēma* und *Saba'a*[63] wird von Truppen aus *Suḫu* überfallen, als sie *Ḫindānu* (etwa in der Nähe von Abū Kamāl) erreicht. 200 Kamele *(*^{anše}*gammalu)* werden samt ihrer Last erbeutet. Darunter befinden sich purpurgefärbte Textilien, Eisen und Alabaster (Cavigneaux – Ismail 1990, Text Nr. 2, iv, 27–38). *Ḫindānu* scheint bereits im 9. Jahrhundert Endstation einer Karawanenstraße aus Südarabien gewesen zu sein (Liverani 1992, 111–112). Tukultī-Ninurta II. (890–884) erhielt aus *Ḫindānu* Trampeltiere *(udru)*, Myrrhe und Antimon (RIMA 2, 100.5, 76–79). Sein Nachfolger Assurnasirpal II. (883–859) machte eine ähnliche Beute wie der König von *Suḫu*: Trampeltiere (*udru*), purpurgefärbte Textilien und Alabaster.[64] *Ḫindānu* verdankte seinen Wohlstand und seine Unabhängigkeit von den anderen Staaten am mittleren Euphrat dem Handel mit der arabischen Halbinsel. Im 11. Jahrhundert, zur Zeit des Tiglatpileser I. (1114–1076), gehörte *Ḫindānu* zu *Suḫu* und lieferte noch keine exotischen Waren. Das heißt, dass sich die Handelsbeziehungen mit den Arabern (vielleicht mit Südarabien) im 10. Jahrhundert (zwischen 1075 und 890) entwickelt haben dürften. Die hebräische Bibel spiegelt diese Beziehungen vielleicht in der Geschichte von Salomo und der Königin von Saba wider. Wenn sie auch sicherlich nicht genau so stattfand, wie sie dort erzählt wird, legen die erwähnten Keilschriftquellen dennoch nahe, dass die Geschichte einen historischen Hintergrund gehabt haben könnte (1 Kön 10:1–13; siehe Liverani 1999–2001, bes. 112 u. 114).

Materielle Zeugnisse der Kontakte mit Nord- und Südarabien sind glücklicherweise erhalten geblieben. Es handelt sich um mehrere Perlen, eigentlich zylinderförmige, meist durchbohrte Objekte aus Chalzedonvarietäten wie Onyx und Achat (nicht Perlmutt!), die in Sanheribs Palast gefunden wurden und beschriftet sind. Vermutlich waren sie ursprünglich auf Ketten gezogen,[65]

---

[60] „Den Idibi'ilu setze ich in ein Torwächteramt gegenüber Ägypten ein", RINAP 1, Nr. 47, Rs. 6' und Nr. 42, 34'; Eph'al 1984, 93 und 215–216.

[61] Wahrscheinlich ist der genannte Hafen mit Tall Abū Salima zu identifizieren, Reich 1984.

[62] Elat 1998, 49. Zur Rolle des nördlichen Negev im arabischen Handel siehe Singer-Avitz 1999.

[63] Ob *Saba'a* hier mit Südarabien zu identifizieren ist, ist umstritten (siehe bereits oben). Auch im Falle der ersten assyrischen Erwähnung von *Saba'a*, ebenfalls zusammen mit *Tēma*, in den Inschriften Tiglatpilesers (RINAP 1, Nr. 42, 27'; id., Nr. 44, 9'; id., Nr. 47, Rs. 3'), gibt es Zweifel. Die südlichsten Städte, die Tiglatpileser III. während des Feldzugs gegen Philistia erreichte, liegen mehr als 500 km von Taymāʾ und 1.500 km von Südarabien entfernt. Eph'al 1984, 88–89 postuliert ein *Saba'a* in Nordarabien; Liverani 1999–2001 dagegen plädiert für Südarabien, so auch Galter 1993, 30–31 und Macdonald 1997, 338.

[64] Unter Salmanassar III. liefert auch *Suḫu* Elfenbein und Weihrauch, RIMA 3, 102.90.

[65] Eine Kette aus zylindrischen Perlen, die am königlichen Bett hängt, ist auf dem Relief dargestellt, das als 'Assurbanipal in der Gartenlaube' bekannt ist, Barnett 1976, pl. LXV (BM 124929); siehe Frahm 1999, 80

könnten aber auch als Gründungsbeigaben sekundär verwendet worden sein. Durch die Inschriften erfahren wir, dass einige Perlen Geschenke fremder Herrscher waren (*nāmurtu*), andere wurden im Laufe von Feldzügen erbeutet (*kišittu* ‚Kriegsbeute'). Sechs Perlen waren ein Geschenk von Karibili, König von *Saba'a* (Galter 1987, Nr. 47, 49, 51, 53, 59, 66). In einer Tontafel findet sich ebenso der Hinweis, dass Karibili dem König Sanherib *pappardillû*-Steine und wohlriechende Essenzen schenkte.[66] Vermutlich wollten die Sabäer mit ihren Gaben verhindern, dass die Assyrer den Fernhandel auf der Weihrauchstraße beeinträchtigten. Es scheint weiterhin plausibel, dass zwei der in den assyrischen Texten erwähnten Königsnamen mit sabäischen Mukarriben-Herrschern, die in altsüdarabischen Inschriften bezeugt sind, zu identifizieren sind.[67] In Sanheribs Annalen werden vier Perlen als 'Beute aus *Dumetu*/*Duma (= Adummatu)*' bezeichnet (Galter 1987, Nr. 46, 54, 56, 60), die vermutlich bei der Eroberung dieser Stadt durch Sanherib gemacht wurde. Ein weiteres Zeugnis von Handelsbeziehungen mit der arabischen Halbinsel stellt ein assyrisches Rollsiegel mit einer Legende in 'protoarabischer' Schrift dar, das in die Regierungszeit Sanheribs datiert wird.[68]

6 Zusammenfassung: Zwischen Krieg und Integration

Die Kontakte zwischen Assyrien und den arabischen Stämmen fanden in einem ausgedehnten Gebiet statt, das sich von der südlichen Levante, der Ǧazīra und Südbabylonien bis Ost- und Südarabien erstreckte. Nicht nur militärische Auseinandersetzungen bestimmten diese Kontakte, sondern es wurde außerdem ein politischer Rahmen geschaffen, der friedliche Beziehungen und Handelaustausch ermöglichte. Während an der südlichen Grenze des assyrischen Reiches, in Nordarabien und zur Zeit Asarhaddons sogar in Ostarabien direkte Kontakte stattgefunden haben, stützte sich das Verhältnis zu Zentral- und Südarabien auf indirekte Beziehungen in der Form von Handel oder Tributleistung. Als Eindringlinge, die assyrische Provinzen oder assyrische Vasallenstaaten unmittelbar oder durch Bündnisse mit Feinden bedrohten, wurden sie nicht toleriert und mit aller Gewalt bekämpft.

Der Unterwerfung folgte jedoch in keinem Fall die territoriale Annexion. Dies geschah auch nicht in den zwei Fällen, in denen die Assyrer in die arabische Halbinsel eindrangen, nämlich bei Sanheribs Feldzug bis *Adummatu* und während der Kampagne Asarhaddons gegen *Bāzu*. Die geo-klimatischen Bedingungen der arabischen Wüste standen einer assyrischen Okkupation im Wege. Die Assyrer waren sich dieses Tatbestandes bewusst und sie wussten auch, dass die Schätze dieser Region nur erreichbar waren, wenn man die Handelswege kontrollierte. Da sie aber nicht die notwendigen Kamele besaßen, waren sie von den Kamelzüchtern, die die Karawanen leiteten, abhängig. Andererseits war eine flächendeckende Besatzung gar nicht nötig, wenn auch die letzten Strecken der Handelsrouten unter assyrischer Kontrolle standen. Darüber hinaus konnte man über den Tribut der arabischen Stämme bzw. der Staaten, die mit den Arabern Handelsbeziehungen unterhielten, von diesem Handel profitieren.

Auf diese Weise flossen im Laufe der Jahre u. a. kostbare Steine und Spezereien aller Art nach Ninive. Darüber hinaus sind in verschiedenen Regionen des assyrischen Reiches Individuen mit arabischen Namen nachweisbar, die in die lokalen Gemeinschaften integriert gewesen sein dürften. In der Regierungszeit Asarhaddons konnte durch den Einsatz von Kameleinheiten

---

mit Anm. 8.

[66] RINAP 3/2, Nr. 168, 48–51.

[67] It'amra (Sargon II.) = Yiṯa''amar Bayyin, Karibili (Sanherib) = Karib'il Watar, Frahm 1999, 86. siehe auch Galter 1993.

[68] Porada 1948, 84–85, 180 pl. 104 (Nr. 702); war der Siegelbesitzer ein Kaufmann aus *Tēma*?, Frahm 1999, 89 Anm. 55.

die südwestliche Grenze des Reiches überschritten werden. Ein Relief aus dem Palast Assurbanipals zeigt ein ummauertes Feldlager, in dem Araber Dienstleistungen für die Assyrer verrichten. Zwei Kamele liegen inmitten des Lagers (Barnett 1976, pl. LXVI (a); siehe Elat 1998, 50 Anm. 65). Ein weiteres, früheres Beispiel für Araber-Einheiten in der assyrischen Armee könnten die in den Inschriften Sanheribs erwähnten *lú urbi* darstellen,[69] wahrscheinlich Kampftruppen, die zu einem arabischen Stamm gehörten.[70] Reliefdarstellungen aus seinem Palast in Ninive zeigen in der Tat, dass Sanherib während des Feldzugs gegen Juda Kamele einsetzte.[71]

Beispiele für assyrischen Einfluss auf die Araber können ebenfalls genannt werden. Tabu'a, eine arabische Prinzessin, erhielt in Sanheribs Palast eine assyrische Erziehung und wurde später als Königin eines Araberstammes eingesetzt.[72] Von Karib'il Watar von *Saba'a* ist ein umfangreicher Tatenbericht überliefert, der uns über seine Feldzüge und Wasserbauten informiert. Diese Inschrift ist einzigartig innerhalb der sabäischen Literatur, jedoch typisch für das assyrische Schrifttum. Wenn Karib'il Watar mit dem Karibili der assyrischen Überlieferung identisch sein sollte, könnte eine Inschrift Sanheribs die sabäische inspiriert haben. Eine sabäische Delegation, die Ninive besuchte, ist außerdem bezeugt.[73] Assyrischer Einfluss im Bereich der Kunst wird im Falle eines Stelenfragments, das 1884 in Taymāʾ gefunden wurde und heutzutage im Louvre aufbewahrt wird (AO 29143) postuliert. Das reliefierte Fragment ist 30 x 35 cm groß und soll nach assyrischem Vorbild von einem lokalen Künstler angefertigt worden sein.[74]

Nach der aramäischen Überlieferung war der weise Aḫiqar Berater der assyrischen Könige Sanherib und Asarhaddon. Einer seiner Sprüche lautet: „Zeige [nicht] einem Araber das Meer und einem Sidonier [die Wege der Wüste], denn ihre Arbeiten sind verschieden!".[75] Unsere Quellen zeigen, dass die Assyrer diese Maxime beherzigt haben.

Ariel M. Bagg
Assyriologie
Institut für Sprachen und Kulturen des Vorderen Orients
Universität Heidelberg
Hauptstraße 126
69117 Heidelberg
Deutschland
ariel.bagg@ori.uni-heidelberg.de

[69] Im Zusammenhang mit dem Feldzug gegen Hiskija von Juda.

[70] Frahm 1997, 104–105. Nach Elat 2000 nur eine Variante von *Aribi*; für Eph'al 1984, 113 mit Anm. 75 dagegen nur eine Art Militärtruppe. Die Verwendung als Gentilizium wurde bereits von Delitzsch 1881, 305–306 vorgeschlagen.

[71] Barnett *et al.* 1998 pl. 333. 431c (Zeichnungen auf pl. 332. 431a und 335. 431b); pl. 372. 473a (nur Zeichnung); pl. 373. 475a (weitere Zeichnung auf pl. 373. 475b).

[72] RINAP 4, Nr. 1, iv, 15–16;; sogar der Name Tabu'a ist assyrisch, siehe dazu Lanfranchi 2004, 247. Darüber hinaus erwähnt Asarhaddon in der gleichen Inschrift, dass er die Götter(statuen), die sein Vater Sanherib erbeten hatte, zurückgibt. Er ließ darauf eine Inschrift schreiben, die eine klare Botschaft vermitteln sollte (RINAP 4, Nr. 1, iv, 1–14): „Ihr bekommt eure Götter dank der Großzügigkeit des assyrischen Königs zurück."

[73] Frahm 1997, 145–146; siehe Inschrift in TUAT I/6, 651–658 (W. W. Müller); siehe ferner Lanfranchi 2004, 248; siehe ferner Nebes 2007.

[74] Potts 1991. Auch im Fall eines Bronzereliefs mit sabäischer Inschrift, das in der Umgebung von Mārib gefunden wurde, wird mesopotamischer Einfluss postuliert, Gerlach 2000 u. Nebes 2000 (Inschrift); siehe ferner Lanfranchi 2004, 248–251.

[75] Aḫiqar, xvi, 1, zitiert von Frahm 1999, 79; siehe Bearbeitung in TUAT III/2, 320–347 (I. Kottsieper); ferner Israel 1990.

Anhang

'Arabische' Ortsnamen in den neuassyrischen Quellen [68]

A. Allgemeine Bezeichnungen [2; RGTC 7/2][76]
Aribi, Urbi (?)

B. Gebiete und Bevölkerungsgruppen außerhalb der arabischen Halbinsel [28]
(am südlichen Rand des Fruchtbaren Halbmondes)

B1 Nördliches Ostjordanland [10; RGTC 7/1]
Apparu, Enzikarme, Ḫulḫuliti, Manḫabbi, Marqanâ, Sarāqa, Saratein, Ta'nâ, Tenuquri, Ṣajuran/Zajuran

B2 Syrische Wüste/Palmyrene [6; RGTC 7/1]
Azalla 2, Ḫadattā, Ḫurarina, Isamme, Jarki, Laribda

B3 Nördlicher Sinai [*1; RGTC 7/1*]
Mu'na

B4 Babylonien [9; mit einer Ausnahme alle RGTC 7/3]
In Bīt-Dakkūri: Dūr-Abijata', Qidrina
In Bīt-Amukkāni: Dūr-Aqqīja, Dūr-Bir-Dāda, Dūr-Uajit, Dūr-Ugurri
In Südostbabylonien: Bīt-Ḫa'iri, Dimtu-ša-Dumeli, Ḫajamanu (RGTC 7/2)

B5 Lage unbekannt [2; RGTC 7/2]
Arbunâ, Qudāru[77]

C. Gebiete und Bevölkerungsgruppen in der arabischen Halbinsel [35]

C1 Nord- und Zentralarabien [17; mit zwei Ausnahmen alle RGTC 7/2]
Adummatu, Badāni (RGTC 7/1), Ḫajappa, Ḫatte, Ibādidi, Idiba'il, Kapānu, Marsīmanni, Mas'a, Nabajāti, Qedar/Qidru, Quraṣiti (RGTC 7/1), Saba'a (1?), Sumu'il, Tamudi, Tēma, Tēme (?)[78]

C2 Ostarabien [17; RGTC 7/3]
In Bāzu: Alpijana/Ilpiatu, Dihrānu, Diḫri?, Ga'uanu, Ḫaldisu/Ḫandasu, Iḫilu, Jadi' (oder in der Nähe von Bāzu), Magalānu, Padê/Puda' ,Qatabu', Uderi[79]
In Qadê: Izkê
Tilmun
In oder in der Nähe von Ostarabien: Ḫazmāni, Kuppi

C3 Südarabien [1; RGTC 7/3]
Saba'a (2)

D. Berge [3; mit einer Ausnahme alle RGTC 7/1]
Ḫazû (RGTC 7/2), Ḫukkuruna, Saqurri

---

[76] In eckigen Klammern steht die Anzahl der Ortsnamen, sowie im welchem Band von RGTC 7 sie zu finden sind.

[77] Ein Ortsname Siqa'in (Zadok 1981, 65 und Zadok 1990, 228) gibt es nicht. Die vermeintliche arabische Etymologie basiert auf der alten Lesung; der Ortsname heißt *Sina'ini* (SAA 11, 133, ii, 6').

[78] Eph'al 1984, 125 Anm. 437; s. dazu RGTC 7/2, 594, Kommentar *s. v.* Tēma.

[79] Ein Ortsname Quṭabati (Zadok 1981, 56) gibt es nicht. Die vermeintliche arabische Etymologie basiert auf der alten Lesung. Nach Kollation heißt der Ort Qudanāti (SAA 15, 223, 7).

Literaturverzeichnis

Arnaud, D.
1995 Les traces des «Arabes» dans les textes syriennes du début du IIe millénaire à l'époque néo-assyrienne: esquisse de quelques thèmes, in: H. Lozachmeur (Éd.), Présence arabe dans le Croissant Fertile avant l`Hégire, Paris, 19–22.

Barnett, R. D.
1976 Sculptures from the North Palace of Ashurbanipal at Nineveh, London.

Barnett, R. D. – Falkner, M.
1962 The sculptures of Assur-Nasir-Apli II (883–859 B.C.), Tiglath-Pileser III (745–727 B.C.) and Esarhaddon (681–669 B.C.) from the Central and South-West Palaces at Nimrud, London.

Barnett, R. D. – Bleibtreu, E. – Turner, G.
1998 Sculptures from the Southwest Palace of Sennacherib at Nineveh, London.

Beyer, K. – Livingstone, A.
1987 Die neuesten aramäischen Inschriften aus Taima, Zeitschrift der Deutschen Morgenländischen Gesellschaft 137, 285–296.

Borger, R.
1957 Assyriologische und altarabische Miszellen. Orientalia Nova Series 26, 1–11.
1957–58 Die Inschriften Asarhaddons. Nachträge und Verbesserungen, Archiv für Orientforschung 18, 113–118.

Botta, P.-E. – Flandin, E.
1849 Monument de Ninive II, Paris.

Byrne, R.
2003 Early Assyrian contacts with Arabs and the impact on Levantine vassal tribute, Bulletin of the American Schools of Oriental Research 331, 11–25.

Cavigneaux, A. – Ismail, B. K.
1990 Die Statthalter von Suḫu und Mari im 8. Jh. v. Chr. Anhand neuer Texte aus den irakischen Grabungen im Staugebiet des Qadissiya-Damms, Baghdader Mitteilungen 21, 321–456.

Degen, R.
1974 Die Aramäischen Inschriften aus Taima' und Umgebung, Neue Ephemeris für semitische Epigraphik 2, 79–98.

Delitzsch, F.
1881 Wo lag das Paradies?, Leipzig.

Deller, K. – Parpola, S.
1968 Ein Vertrag Assurbanipals mit dem arabischen Stamm Qedar, Orientalia Nova Series 37, 464–466.

Dubowsky, P.
2009 Ripping open pregnant Arab women: Reliefs in room L of Ashurbanipal's North Palace, Orientalia Nova Series 78, 394–419.

Elat, M.
1998 Die wirtschaftliche Beziehungen der Assyrer mit den Arabern, in: S. M. Maul (Hrsg.), *tikip santakki mala bašmu … .* Festschrift für Rykle Borger zu seinem 65. Geburtstag am 24. Mai 1994, Groningen, 39–57.
2000 Arguments for the identification of the ^{LÚ}Urbi in Assyrian royal inscriptions, in: G. Galil – M. Weinfeld (Eds.), Studies in Historical Geography and Biblical Historiography presented to Zecharia Kallai, Boston, 232–238.

Eph'al, I.
1974 "Arabs" in Babylonia in the 8th Century B.C, Journal of the American Oriental Society 94, 108–115.
1976 "Ishmael" and "Arab(s)": A transformation of ethnological terms, Journal of Near Eastern Studies 35, 225–235.
1984² The Ancient Arabs. Nomads on the Border of the Fertile Crescent 9th–5th Centuries B. C., Jerusalem.

Fales, F. M.
1989 Pastorizia e politica: nuovi dati sugli Arabi nelle fonti di età neo-assira, in: A. Avanzini (Ed.), Problemi di onomastica semitica orientale, Rom, 119–134.

Frahm, E.
1997 Einleitung in die Sanherib-Inschriften, Wien.
1999 Perlen von den Rändern der Welt, in: K. van Lerberghe – G. Voegt (Eds.), Languages and Cultures in Contact, Orientalia Lovaniensia Analecta 96, Löwen, 79–99.

Fuchs, A.
1994 Die Inschriften Sargons II. aus Khorsabad, Göttingen.

Galter, H. D.
1987 On beads and curses, Annual Review of the Royal Inscriptions of Mesopotamia Project 5, 11–30.
1993 „... an der Grenze der Länder im Westen". Saba' in den assyrischen Königsinschriften, in: A. Gingrich – S. Haas – G. Rasuly-Paleczek – T. Fillitz (Eds.), Studies in Oriental Culture and History, Festschrift für Walter Dostal, Frankfurt am Main, 29–40.

Gerardi, P.
1992 The Arab campaigns of Aššurbanipal: Scribal reconstruction of the past, State Archives of Assyria Bulletin 6, 67–103.

Gerlach, I.
2000 Zur Übernahme altorientalischer Motive in die Kunst Südarabiens. Eine reliefierte Bronzeplatte aus dem Jemen, Baghdader Mitteilungen 31, 259–296.

Heimpel, W.
1976–1980 *s. v.* „Kamel", in: Reallexikon der Assyriologie 5, 330–332.

Hoyland, R. G.
2001 Arabia and the Arabs: from the Bronze Age to the Coming of Islam, London.

Israel, F.
1990 La datazione del proverbio no 110 di Ahiqar, Semitica 38, 175–178.

Lanfranchi, G. B.
2004 Mesopotamia e Arabia nelle iscrizioni reali Assire, in: F. M. Fales – D. Morandi Bonacossi (Eds.), Mesopotamia e Arabia, Venedig, 219–253.

Liverani, M.
1992 Early Caravan Trade between South-Arabia and Mesopotamia, Yemen 1, 111–115.
1999–2000 The Sargon Geography and the Late Assyrian Mensuration of the Earth, State Archives of Assyria Bulletin 13, 57–85.
2003 The influence of political institutions on trade in the Ancient Near East (Late Bronze to Early Iron Age), in: C. Zaccagnini (Ed.), Mercanti e politica nel mondo antico, Rom, 119–137.

Livingstone, A.
1989 Arabians in Babylonia/Babylonians in Arabia: Some reflexions à propos new and old evidence, in: T. Fahd (Éd.), L`Arabie préislamique et son environnement historique et culturel, Strasbourg, 97–105.

Macdonald, M. C. A.
1995 North Arabia in the First Millennium BCE, in: J. Sasson (Ed.), Civilizations of the Ancient Near East, New York, 1355–1369.
1997 Trade routes and trade goods at the northern end of the „incence road“ in the first millennium B.C., in: A. Avanzini (Ed.), Profumi d‘Arabia, Rom, 333–349.

Meissner, B.
1926 Zwei Reliefs Assurbanipals mit Darstellungen von Arabern, Islamica 1, 391–397.

Mitchell, T. C.
2000 Camels in the Assyrian bas-reliefs, Iraq 62, 187–194.

Musil, A.
1927 Arabia Deserta. A Topographical Itinerary, New York.

Nadali, D.
2004 La campagna di Assurbanipal contro gli Arabi: proposta di lettura delle dinamiche di una battaglia in campo aperto, Studi micenei ed egeo-anatolici 46, 59–78.

Nebes, N.
2000 Zu den Inschriften auf einer reliefierten Bronzeplatte aus Jemen, Baghdader Mitteilungen 31, 297–308.
2007 Ita‘amar der Sabäer: Zur Datierung der Monumentalinschrift des Yiṯa’amar Watar aus Ṣirwāḥ, Arabian Archaeology and Epigraphy 18, 25–33.

Opitz, D.
1931–32 Die Darstellungen der Araberkämpfe Assurbanipals aus dem Palast zu Ninive, Archiv für Orientforschung 7, 7–13.

Porada, E.
1948 Corpus of Ancient Near Eastern Seals in North American Collections Vol. I: The Collection of the Pierpont Morgan Library, New York.

Potts, D. T.
1982 The road to Meluḫḫa, Journal of Near Eastern Studies 41, 279–288.
1988 Trans-Arabian routes of the Pre-Islamic period, in: J.-F. Salles (Éd.), L’Arabie et ses mers bordières. 1. Itinéraires et voisinages, (Travaux de la Maison de l’Orient N° 16), Paris, 127–162.
1991 Tayma and the Assyrian empire, Arabian Archaeology and Epigraphy 2, 10–23.

2004 Camel hybridization and the role of *camelus bactrianus* in the Ancient Near East, Journal of the Economic and Social History of the Orient 47, 144–165.

Radner, K.
2007 The winged snakes of Arabia and the fossil site of Makhtesh Ramon in the Negev, Wiener Zeitschrift für die Kunde des Morgenlandes 97 (Fs Hunger), 353–366.
2008 Esarhaddon's expedition from Palestine to Egypt in 671 BCE: A trek through Negev and Sinai, in: D. Bonatz – R. M. Czichon – F. J. Kreppner (Hrsg.), Fundstellen: Gesammelte Schriften zur Archäologie und Geschichte Altvorderasiens ad honorem Hartmut Kühne, Wiesbaden, 305–314.

Reade, J. E.
1998 Assyrian illustrations of Arabs, in: C. S. Phillips – D. T. Potts – S. Searight (Eds.), Arabia and its Neighbours. Essays on Prehistorical and Historical Developments Presented in Honour of Beatrice de Cardi, Turnhout, 221–232.

Retsö, J.
2003 The Arabs in Antiquity, London.

Rosmarin, T. W.
1932 Aribi und Arabien in den babylonisch-assyrischen Quellen, Journal of the Society of Oriental Research 16, 1–37.

Rouillard-Bonraisin, H.
1995 Présence et représentations des arabes dans les écrits bibliques, in: H. Lozachmeur (Éd.), Présence arabe dans le Croissant Fertile avant l`Hégire, Paris, 23–35.

Sass, B.
1999 Arabs and Greeks in Late First Temple Jerusalem, Palestine Exploration Quarterly 122, 59–61.

Shiloh, Y.
1987 South Arabian inscriptions from the City of David, Jerusalem, Palestine Exploration Quarterly 119, 9–18.

Singer-Avitz, L.
1999 Beersheba – A gateway community in Southern Arabian long distance trade, Tel Aviv, Journal of the Institute of Archaeology of Tel Aviv University 26, 3–74.

Thureau-Dangin, F. – Dunand, M.
1936 Til-Barsib, Bibliothèque archéologique et historique 23, Paris.

Wäfler, M.
1975 Nicht-Assyrer neuassyrischer Darstellungen, Kevelaer.

Weippert, M.
1973–1974 Die Kämpfe des assyrischen Königs Assurbanipal gegen die Araber, Die Welt des Orients. Wissenschaftliche Beiträge zur Kunde des Morgenlandes 7, 39–85.

Zadok, R.
1981 Arabians in Mesopotamia during the Late-Assyrian, Chaldean, Achaemenian and Hellenistic Periods Chiefly According to Cuneiform Sources, Zeitschrift der Deutschen Morgenländischen Gesellschaft 131, 42–84.
1985 Geographical Names According to New- and Late-Babylonian Sources (Wiesbaden 1985 = Répertoire Géographique des Textes Cunéiformes 8).
1990 On Early Arabians in the Fertile Crescent, Tel Aviv. Journal of the Institute of Archaeology of Tel Aviv University 17, 223–232.

Quellenverzeichnis

BIWA	Borger, R. 1996, Beiträge zum Inschriftenwerk Assurbanipals, Wiesbaden.
HAL	Koehler, L. – Baumgartner, W. 1974[3], Hebräisches und aramäisches Lexikon zum Alten Testament, Leiden.
KAI	Donner, H. – Röllig, W. 1962-1964, Kanaanäische und aramäische Inschriften, Wiesbaden.
RGTC	Répertoire Géographique des Textes Cunéiformes, Wiesbaden.
RGTC 7/1	Bagg, A. M. 2007, Die Orts- und Gewässernamen der neuassyrischen Zeit. Teil 1: Die Levante, Wiesbaden.
RGTC 7/2	Bagg, A. M. 2017, Die Orts- und Gewässernamen der neuassyrischen Zeit. Teil 2: Zentralassyrien und benachbarte Gebiete, Ägypten und die arabische Halbinsel, Wiesbaden.
RGTC 7/3	Bagg, A. M. in Vorbereitung, Die Orts- und Gewässernamen der neuassyrischen Zeit. Teil 3: Babylonien und die östlichen Gebiete, Wiesbaden.
RIMA	The Royal Inscriptions of Mesopotamia. Assyrian Periods, Toronto.
RIMA 2	Grayson, A. K. 1991, Assyrian Rulers of the Early First Millennium BC I (1114–859 BC), Toronto.
RIMA 3	Grayson, A. K. 1996, Assyrian Rulers of the Early First Millennium BC II (858–745 BC), Toronto.
RINAP	The Royal Inscriptions of the Neo-Assyrian Period, Winona Lake.
RINAP 1	Tadmor, H. – Yamada, Sh. 2011, The Royal Inscriptions of Tiglath-pileser III (744–727 BC) and Shalmaneser V (726–722 BC), Kings of Assyria, Winona Lake.
RINAP 3/1	Grayson, A. K. – Novotny, J. 2012, The Royal Inscriptions of Sennacherib, King of Assyria (704–681 BC), Part 1, Winona Lake.
RINAP 3/2	Grayson, A. K. – Novotny, J. 2014, The Royal Inscriptions of Sennacherib, King of Assyria (704–681 BC), Part 2, Winona Lake.
RINAP 4	Leichty, E. V. 2011, The Royal Inscriptions of Esarhaddon, King of Assyria (680–669 BC), Winona Lake.
SAA	State Archives of Assyria, Helsinki.
SAA 1	Parpola, S. 1987, The Correspondence of Sargon II, Part I. Letters from Assyria and the West, Helsinki.
SAA 2	Parpola, S. – Watanabe, K. 1988, Neo-Assyrian Treaties and Loyalty Oaths, Winona Lake.
SAA 11	Fales, F. M. – Postgate, J. N. 1995, Imperial Administrative Records, Part II: Provincial and Military Administration, Helsinki.

SAA 15 Fuchs, A. – Parpola, S. 2001, The Correspondence of Sargon II, Part III, Helsinki.

SAA 18 Reynolds, F. 2003, The Babylonian Correspondence of Esarhaddon, Helsinki.

SAAS State Archives of Assyria Studies, Helsinki.

SAAS 8 Fuchs, A. 1998, Die Annalen des Jahres 711 v. Chr., Helsinki.

TCS 5 Grayson, A. K. 2000, Assyrian and Babylonian Chronicles, Winona Lake.

TUAT I Texte aus der Umwelt des Alten Testaments. Neue Folge, herausgegeben von B. Janowski – G. Wilhelm, 2004, Gütersloh.

TUAT III Texte aus der Umwelt des Alten Testaments. Neue Folge, herausgegeben von B. Janowski – G. Wilhelm, 2006, Gütersloh.

Archaeological investigations in the north-western part of the Arabian Peninsula has increased during the last 15 years. One of the major sites in the region is the ancient oasis of Taymāʾ, known as a commercial hub on the so-called Incense Road connecting South Arabia with the Eastern Mediterranean. In the context of this new research a multidisciplinary project by the Saudi Commission for Tourism and National Heritage (SCTH) and the Orient Department of the German Archaeological Institute (DAI) has been investigating the archaeology and ancient environment of Taymāʾ since 2004. A major aim of this project was the development of new perspectives of the site and the region, characterised by elaborating the local socio-cultural and economic contexts. So far, Taymāʾ has been known mainly through exogenous sources.

The present volume is the first of the publication series of the Saudi-German archaeological project and focuses on three fundamental aspects of research at Taymāʾ: the current archaeological exploration of the oasis is contextualised with previous and ongoing research within the region, while at the same time offering a first overview of the settlement history of the site, which may have started as early as more than 6000 years ago. New information on the palaeoenvironment has been provided by multi-proxy-analysis of sediments from a palaeolake immediately north of the settlement. The results indicate an Early Holocene humid period in the region that is shorter than the so-called African Humid Period. The abrupt aridification at around 8 ka BP, known from other regions in the Near East, is also attested in north-western Arabia. The reconstruction of the past vegetation of the site and its surroundings demonstrates that oasis cultivation at Taymāʾ started during the 5th millennium BCE with grapes and figs, rather than with the date palm. According to hydrological investigations on water resources, groundwater aquifers provided the main source of local water supply. These were exploited through wells, some of which have been identified in the area of the ancient oasis. Finally, since the time of early travellers to Northwest Arabia evidence of cultural contacts has been observed in the records from the site, which had been occupied by the last Babylonian king, Nabonidus (556–539 BCE) for ten years. A historical-archaeological essay on Egypt and Arabia as well as a study on the ambiguous relationship between Assyria and Arabia – characterised by conflict and commerce – shed new light on the foreign relations of ancient Taymāʾ.

Arnulf Hausleiter **is researcher at the DAI's Orient Department for the Taymāʾ project, funded by the German Research foundation (DFG). He has been field director of the excavations at Taymāʾ since 2004 and has co-directed the project with Ricardo Eichmann.**

Ricardo Eichmann **is director of the Orient Department at the German Archaeological Institute in Berlin. He is the head of the German component of the Taymāʾ project and has co-directed it with Arnulf Hausleiter.**

Muhammad al-Najem **is head of the Antiquities Office of the Saudi Commission for Tourism and National Heritage (SCTH) and director of the Museum of Archaeology and Ethnography at Taymāʾ, Province of Tabuk, Saudi Arabia.**