Tracing Pottery-Making Recipes in the Prehistoric Balkans 6th–4th Millennia BC

edited by

Silvia Amicone
Patrick Sean Quinn
Miroslav Marić
Neda Mirković-Marić
Miljana Radivojević
# Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>List of Figures</td>
<td>ii</td>
</tr>
<tr>
<td>List of Tables</td>
<td>v</td>
</tr>
<tr>
<td>List of Contributors</td>
<td>vi</td>
</tr>
<tr>
<td>Preface and Acknowledgments</td>
<td>xi</td>
</tr>
<tr>
<td>Introduction. Tracing Pottery-Making Recipes in the Prehistoric Balkans, 6th-4th Millennia BC</td>
<td>1</td>
</tr>
<tr>
<td>Silvia Amicone</td>
<td></td>
</tr>
<tr>
<td>1. Tempering Expectations: What Do West Balkan Potters Think They Are Doing?</td>
<td>8</td>
</tr>
<tr>
<td>Richard Carlton</td>
<td></td>
</tr>
<tr>
<td>Biljana Djordjević</td>
<td></td>
</tr>
<tr>
<td>3. On the Organisation of Ceramic Production within the Kodjadermen–Gumelnia–Karanovo VI, Varna, and Krivodol–Sâlcu/a–Bubanj Hum Ia Cultures</td>
<td>38</td>
</tr>
<tr>
<td>Petya Georgieva</td>
<td></td>
</tr>
<tr>
<td>4. Clay Recipes, Pottery Typologies and the Neolithisation of Southeast Europe A Case Study from Džuljunica–Smărdeș, Bulgaria</td>
<td>54</td>
</tr>
<tr>
<td>Beatrijs de Groot</td>
<td></td>
</tr>
<tr>
<td>5. Looking into Pots: Understanding Neolithic Ceramic Technological Variability from Western Hungary</td>
<td>65</td>
</tr>
<tr>
<td>Attila Kreiter, Tibor Marton, Krisztián Oross and Péter Pánczél</td>
<td></td>
</tr>
<tr>
<td>6. Organic Residue and Vessel Function Analysis from Five Neolithic and Eneolithic Sites in Eastern Croatia</td>
<td>78</td>
</tr>
<tr>
<td>Ina Miloglav and Jacqueline Balen</td>
<td></td>
</tr>
<tr>
<td>7. Technological Variances between Tisza and Vinča Pottery in the Serbian Banat</td>
<td>96</td>
</tr>
<tr>
<td>Neda Mirković-Marić and Silvia Amicone</td>
<td></td>
</tr>
<tr>
<td>8. Pottery Technology and Identity: Some Thoughts from the Balkans</td>
<td>113</td>
</tr>
<tr>
<td>Laure Salanova</td>
<td></td>
</tr>
<tr>
<td>9. Pottery Production at Neolithic Pieria, Macedonia, Greece</td>
<td>129</td>
</tr>
<tr>
<td>Niki Saridaki and Kostas Kotsakis, Dushka Urem-Kotsou, Trîsevgeni Papadakou and Anna Papaioannou</td>
<td></td>
</tr>
<tr>
<td>10. Some Aspects Concerning Pottery Making at Radovanu-La Muscalu, Romania (first half of the 5th Millennium BC)</td>
<td>144</td>
</tr>
<tr>
<td>Cristian Eduard Ștefan</td>
<td></td>
</tr>
<tr>
<td>11. Petrological Analysis of Late Neolithic Ceramics from the Tell Settlement of Gorzsza (South-East Hungary)</td>
<td>156</td>
</tr>
<tr>
<td>György Szakmány, Katalin Vanicske, Zsolt Bendő, Attila Kreiter, Ákos Pető, Zsuzsa Lisztes-Szabó and Ferenc Horváth</td>
<td></td>
</tr>
<tr>
<td>12. Technology and Function: Performance Characteristics and Usage Aspects of the Neolithic Pottery of the Central Balkans</td>
<td>172</td>
</tr>
<tr>
<td>Jasna Vuković</td>
<td></td>
</tr>
</tbody>
</table>
List of Figures

Participants at the workshop Tracing Pottery-Making Recipes in the Prehistoric Balkans, 6th–4th Millennia BC (picture by Milica Rajačić). ........................................................................................................... xi

Chapter 1
Figure 1: The distribution of pottery-making using the hand-wheel in the western Balkans. .......................................................... 9
Figure 2: Dževad Delić with his clay and calcite stores at Malešići in 2015. .................................................................................... 11
Figure 3: Sorting crushed calcite at Malešići before grinding and sieving prior to mixing. .............................................................. 12
Figure 4: Dževad Delić mixing clay and calcite at Malešići in 2015. ............................................................................................... 12
Figure 5: Forming a calcite-tempered vessel at Malešići by coil-building and throwing. ................................................................. 13
Figure 6: Open workshop place within the workshop at Malešići. .................................................................................................... 14
Figure 7: Fired pots at Malešići in 2015. ........................................................................................................................................... 14
Figure 8: Coil-building on a hand-wheel at Potravljane. .................................................................................................................. 15
Figure 9: Dušan Knežević with freshly made pots at Potravljane in 2004. .................................................................................... 15
Figure 10: Firing pots at Potravljane in 1995. ............................................................................................................................... 16
Figure 11: The workshops of Stipe Bejić (above) and Pero Gavran at Ularice-Bejić in 2015. .............................................................. 17
Figure 12: The enclosed firing place of Pero Gavran in 2015 (above) and rebuilt in 2016. ................................................................. 18
Figure 13: Pero Gavran with over-fired pottery wasters dumped close to his workshop in 2015. ......................................................... 19
Figure 14: The kiln of Milan Savić at Zlakusa and fired pots, some displaying damage caused by over-firing (2017). ................ 22

Chapter 2
Figure 1: Digging clay for bread-baking pans. ............................................................................................................................... 27
Figure 2: Transport of clay on the back. ........................................................................................................................................ 28
Figure 3: Treading bread-baking pans. ........................................................................................................................................ 28
Figure 4: Modelling a bread-baking pan. ...................................................................................................................................... 29
Figure 5: Modelling a bread-baking pan. ...................................................................................................................................... 29
Figure 6: Coating a bread-baking pan with diluted cow dung. ......................................................................................................... 30
Figure 7: The engraved cross at the bottom of a bread-baking pan. ............................................................................................... 30
Figure 8: Putting glowing embers directly on bread dough. ........................................................................................................ 31
Figure 10: Bread baking in a bread-oven. ...................................................................................................................................... 31
Figure 9: Bread baked in a bread-baking pan. ............................................................................................................................. 31
Figure 11: A bread-baking pan after having been used for the first time. .................................................................................... 34

Chapter 3
Figure 1: Distribution of Late Eneolithic cultures Varna, Kojadjar—Gumelniţa—Karanovo VI and Krivodol—Sâlcuţa I-II—Bubanj Hum Ia. Settlements mentioned in the text: (1) Varna; (2) Devnya; (3) Provadia; (4) Golyamo Delchevo; (5) Vinitsa; (6) Smadove; (7) Ovcharove; (8) Devetashka cave; (9) Kozareva Mogila; (10) Dolnoslav; (11) Yunatsite; (12) Slatino; (13) Peklyuk; (14) Zaminets; (15) Krivodol; (16) Galatin; (17) Ohoden; (18) Sâlcuţa. ................................................................. 39
Figure 2: Chart of diameter lengths of Early (2) and Late (1) Eneolithic plates; x: vessel count; y: rim diameter, cm; 1a: table ware; 1b: kitchen ware (drawing by P. Georgieva). ................................................................................................. 42
Figure 3: Early (1-3) and Late (4-5) Eneolithic plates (1-3 after Chohadzhičev 2006, 125:2; 135: 3, 4; 4 after Berciu 1961, 123:2; 5 drawing by P. Georgieva). ................................................................................................. 43
Figure 4: Early (1-4) and Late Eneolithic (5-8) amphora-like vessels (1-4 after Chohadzhičev 2006, 123: 1, 4; 127:4; 133:7; 5-8 drawing by P. Georgieva). ................................................................................................. 44
Figure 5: Chart of the sizes of Late (1) and Early (2) Eneolithic amphora-like vessels with two vertically placed handles; x: rim diameter, cm; y: height, cm (drawing by P. Georgieva). ................................................................................................. 45
Figure 6: A potter’s workshop from a Late Eneolithic settlement at Kozareva Mogila. Two stages of exploration (1, 3) and reconstruction variants (4) of a potter’s kiln, wares (2), and lumps of clay (5) used for shaping wares and found by the kiln (photo by P. Georgieva). ................................................................................................. 47
Figure 7: Fragment of the upper part of the vault of the kiln (photo by P. Georgieva). .......................................................................... 48
Figure 8: Fragments of a plate from the inner part of the firing chamber of the kiln (photo by P. Georgieva). ........................................ 49

Chapter 4
Figure 1: Map of the sites mentioned in the text. ............................................................................................................................. 56
Figure 2: Metric Multidimensional scaling plot of the similarity between Đuzljinica phases I and II and a sample of other Neolithic ceramic assemblages. Pairwise similarities were calculated using the Jaccard Index which measures similarity between a finite pair of samples (site-phases) by dividing the size of the intersection (i.e. overlap of ceramic attributes) by the union (total amount of ceramic attributes) of the set of samples. These pairwise Jaccard values were transformed into a list of co-ordinates by the MDS algorithm, and visualised in this graph. The stress value indicates a measure of the distortion involved in configuring the Jaccard distance matrix in 2 dimensions. .................. 58
Figure 3: Photomicrographs of petrographic fabric groups. Images taken in crossed polars. Image width = 1.5 mm. .................. 60
Figure 4: Red-slip layer on sample 33. Images taken in crossed polars (XP) (A) and plane polarised light (PPL) (B). Image width = 1.5 mm. ............................... 61

Chapter 5
Figure 1: Geographical location of Balatonszárszó-Kis-erdei-dűlő in Hungary and the excavated area. ........................................... 66
Figure 2: Style groups of pottery at Balatonszárszó. ...................................................................................................................... 68
Figure 3: Main pottery form groups at Balatonszárszó. .................................................................................................................. 70
Figure 4: Fabrics of conical forms. a: Fabric 1a (Sample 92.), b: Fabric 2a (Sample 398.), c: Fabric 2b (Sample 136.), d: Fabric 2c (Sample 300.), e: Fabric 2d (Sample 301.). All micrographs are XP. .................................................................71

Figure 5: Fabrics of semi-spherical vessels. a: Fabric 2b (Sample 223.), b: Fabric 2c (Sample 431.), c: Fabric 2d (Sample 390.). All micrographs are XP. .........................................................72

Figure 6: Fabrics of large globular forms. a: Fabric 1a (Sample 282.), b: Fabric 2b (Sample 447.), c: Fabric 2d (Sample 288.), d: Fabric 3 (Sample 359.). All micrographs are XP. ...........................................73

Figure 7: Fabrics of biconical and globular forms. a: Fabric 1b (Sample 303.), b: Fabric 1a (Sample 206.), c: Fabric 2a (Sample 357.), d: Fabric 2b (Sample 367.). e: Fabric 2d (Sample 167.). All micrographs are XP. .........................................................74

Chapter 6
Figure 1: A map of Croatia with sites that provided sampled and analysed pottery sherds: 1) Vučedol near Vukovar; 2) Ervenica in Vinkovci; 3) Damića gradina in Stari Mikanovci; 4) Tomašanci-Palača near Đakovo; 5) Franjevac near Đakovo (map: www.ginkomaps.com). .................................................................79

Figure 2: Types of the vessels analysed by the GC-MS (source: the authors). ........................................................................104

Figure 3: Total ion chromatogram produced by the residue from the interior (a) and the exterior (b) of sherd ER 1 (Vučedol culture). Cx:y – fatty acid with x carbon atoms and y double bonds; br indicates a branched fatty acid with y carbon atoms; xM – monoacylglycerol incorporating a fatty acid with x carbon atoms; ▼ – alcohol; s – sugar; p – p-bthalate; IS – internal standard (after Steele 2011). ..................................................................................86

Figure 4: Chart showing the abundance of the main fatty acids, squalene and cholesterol in the residues (after Steele 2011) from sherd ER 1 of the Vučedol culture (photo: I. Miloglav). .............................................................................87

Figure 5: Total ion chromatogram produced by the residue from the interior (a) and the exterior surface (b) of sherd DG 1 (Vučedol culture). Cx:y – fatty acid with x carbon atoms and y double bonds; xM – monoacylglycerol incorporating a fatty acid with x carbon atoms; ▼ – alcohol; s – sugar; p – p-bthalate; IS – internal standard (after Steele 2011). ..................................................................................88

Figure 6: Chart showing the abundance of long chain fatty acids, long chain alcohols and alkanes in the residue from sherd DG 1 and the soil associated with the sherd (after Steele 2011) belonging to the Vučedol culture (photo: I. Miloglav). ..................................................................................89

Figure 7: Total ion chromatogram produced by the residue from the interior and the exterior of sherd TP 3 (after Stern 2011b) ascribed to the Starčevo culture (drawing: K. Rončević). ..................................................90

Figure 8: Total ion chromatogram produced by the residue from the interior and the exterior of the sherd FR 10 ascribed to the Kostolac culture (after Stern 2011a). .................................................................91

Figure 9: The storage vessel (amphora), belonging to the Kostolac culture, from which the sample was taken for GC-MS analysis (FR 10) (photo: J. Balen). .................................................................................92

Figure 10: Total ion chromatogram produced by the residue from the interior and the exterior of sherd ER 5 (after Stern 2011b) ascribed to the Vučedol culture (photo: I. Miloglav). ..................................................92

Chapter 7
Figure 1: Map of the Banat area. ..........................................................................................................................97

Figure 2: Map showing main material cultures during the Late Neolithic in the Vojvodina area. ..........................................................................................................................97

Figure 3: Vinča A vessels from Gradište-Iđoš. .........................................................................................................100

Figure 4: Vinča and Tisza vessels from Kremenjak-Coka. ......................................................................................101

Figure 5: Vinča and Tisza vessels from Akača-Nov Milošovo. ..............................................................................102

Figure 6: Analysed samples marked by fabric 1: a-d) Gradište-Iđoš, samples 12, 17, 18, 19; e-i) Kremenjak-Čoka, samples 8, 5, 6, 7, 9, j-k) Akača-Nov Milošovo, samples 1, 2. ..................................................................................103

Figure 7: Analysed samples marked by fabrics 2-5: a-b) Gradište-Iđoš, samples 23, 13 (fabric 2); c-g) Kremenjak-Čoka, sample 4, Gradište-Iđoš, samples 15, 24, 26, 22 (fabric 3); h) Gradište- Iđoš, sample 16, fabric 4 (f.v. 8mm, XP); i) Akača-Nov Milošovo, sample 3, fabric 5 (f.v. 4mm, XP). ..................................................................................104

Figure 8: Thin section photomicrographs of selected ceramic from the studied sites: a) Gradište- Iđoš, sample 14, fabric 1 (f.v. 4mm, XP); b) Gradište-Iđoš, sample 12, fabric 1 (f.v. 4mm, XP); c) Akača-Nov Milošovo, sample 2, fabric 1 (f.v. 4mm, XP); d) Kremenjak-Čoka, sample 9, fabric 1 (f.v. 4mm, XP); e) Gradište-Iđoš, sample 21, fabric 2 with plant tempering (f.v. 8mm, XP); f) Gradište-Iđoš, sample 24, fabric 3 with grog tempering (f.v. 8mm, PPL); g) Gradište- Iđoš, sample 16, fabric 4 (f.v. 8mm, XP). ..................................................................................105

Figure 9: Geological Map of the North Banat area. (Based on Yugoslavia Geological Map issued by the Federal Geological Institute. Sheet L34-77: 100 000). Sites locations are indicated by red dots. ..................................................................................106

Chapter 8
Figure 1: Map showing the main sites mentioned in the text. ...........................................................................114

Figure 2: Design periodisation of the pots from Kovačevo. Note the diversity of design and techniques during Period 2. 116

Figure 3: Methods developed relating to the pottery assemblage from Kovačevo. .........................................................117

Figure 4: The herringbone design from Period 1 at Kovačevo. ..................................................................................118

Figure 5: Diversity of pottery production painted with herringbone design. ...............................................................119

Figure 6: Serial production (a) and plastic decoration with animal design (b). .................................................................119

Figure 7: Painted pottery from Kovačevo 3 (a) and from Karanovo 1 (b). Lattice design on the rim, decorated feet, spirals and herringbone design are common to a large area. However, at Kovačevo the most frequent pattern from Period 1 is still in use during Period 3. .................................................................................................................................121

Figure 8: Percentages of decorated pottery in the lower level of Kovačevo (a). The buildings with amounts of painted pottery over the average are indicated in dark grey; those with impressed-incised decorations appear in black. Rates below average are shown in white. In insert (b): distribution of pottery with thicknesses over 12 mm. .................................................................................................122

Figure 9: Symmetry pattern of the most frequent painted design from Kovačevo 1. .................................................................................................123

Figure 10: Large bowls from the lower (a) and upper levels (b) from Kovačevo. Note the similarity of shapes and techniques. 123
Chapter 9

Figure 1: Map showing the location of the Neolithic sites in Peciera analysed in this study. .....................................................130

Figure 2: Simplified geological map of Peciera with the location of the Neolithic sites in Peciera analysed in this study. Adapted from IGME (1989) Seismotectonic map of Greece. ..................132

Figure 3: Early Neolithic ceramic vessels from Paliambela and Revenia .................................................................133

Figure 4: Late EN/early MN ceramic vessels from Paliambela, Revenia and Ritinei ...............................................................134

Figure 5: Early LN ceramic vessels from Mäkriyalos (after Urem-Kotsou 2006) ..........................................................135

Figure 6: Thin-section photomicrographs of EN pottery from Peciera analysed in this study: a) Pal.05 a coarse fabric of Pal.F1, showing tempering with organic inclusions; b) Pal.32 a coarse fabric of Pal.F2, showing quartz/quartzite, feldspars and micrite 7 calcite; c) Pal.18 a natural sediment with shells of Pal.F5; d) Geological sample Pal.GS5, fired at 700°C, showing compositional resemblance to Pal.F2; e) Rev.08 a coarse to medium calcareous clay of Rev. F2 showing quartz, gneiss rocks and micrite calcite; f) Rev.32 a fine calcareous clay of Rev.F4; g) Rev.09 a coarse calcareous clay with shells of Rev.F5; h) Geological sample Rev.GS11, fired at 700°C, showing compositional resemblance to Rev.F2. All images taken in crossed polars. Image width = 4.7 mm, except 7c = 1.2 mm. .......................................................136

Figure 7: Thin-section photomicrographs of Late EN to MN pottery from Peciera analysed in this study: a) Pal.08 a coarse fabric of Pal.F4, showing quartz, feldspars and volcanic rocks; b) Pal.96 a coarse fabric of Pal.F4, showing tempering with organic inclusions; c) Rev.35 a coarse to medium clay of Rev.F1 showing quartz, feldspars and gneiss rocks, in external surface identified slip, ferruginous very fine grained clay; d) Rev.68 a coarse to medium clay of Rev. F1 indicating clay mixing with a fine grained calcareous clay; e) Rit.37 a coarse to medium clay of Rit.F1 showing quartz, feldspars and gneiss rocks, in external surface identified slip, ferruginous very fine grained clay; f) Rit.74 a coarse to medium clay of Rit.F2 showing quartz, gneiss rocks and micrite calcite, showing concentric arrangement of voids and inclusions, indicating the use of the coating technique; g) Rit.40 a fine calcareous clay of Rit.F3, in external surface identified slip, ferruginous fine to medium grained clay; h) Geological sample Rit.GS06, fired at 700°C, showing compositional resemblance to Rit.F1. All images taken in crossed polars. Image width = 4.7 mm. .......................................................137

Chapter 10

Figure 1: Map of south-east Romania depicting the settlement of Radovanu-La Musculu. .........................................................145

Figure 2: The settlement of Radovanu-La Musculu (view from the north-east). .................................................................145

Figure 3: The settlement of Radovanu-La Musculu (after Comşa 1990, modified). .................................................................146

Figure 4: Level 3 of the settlement (after Comşa 1990). ........................................................................................................146

Figure 5: Level 2 of the settlement (after Comşa 1990). ........................................................................................................147

Figure 6: Level 1 of the settlement (after Comşa 1990). ........................................................................................................147

Figure 7: Plan of a typical dwelling (after Comşa 1990) .........................................................................................................148

Figure 8: Interior view of a dwelling (after Comşa 1990, modified by C. Georgescu). .............................................................148

Figure 9: Clay lumps from level 1 of Radovanu settlement. ..................................................................................................149

Figure 10: Steckdose vessel fragment. ...............................................................................................................................149

Figure 11: Potential chaîne opératoire of excised decoration. ..............................................................................................150

Figure 12: White paste used for decoration found in dwelling 3 from level 3. .................................................................150

Figure 13: Firing installation from level 3. ........................................................................................................................151

Figure 14: Thin section micrographs showing evidence for grog tempering (field of view: a-b = 1 mm; c-d = 8 mm, image by Silvia Amicone). ........................................................................................................152

Figure 15: X-ray diffractograms showing typical peaks of quartz, calcite and feldspar: a) diffractogram of the μ-XRD® analysis on the white decoration found on a sherd from Radovanu b) diffractogram of the XRPD analysis on the white paste found by Comşa in Dwelling 3 Level 3 (image by Christoph Berthold and Silvia Amicone). .................................153

Chapter 11

Figure 1: The examined site in the Carpathian basin. ........................................................................................................157

Figure 2: The tell and its surrounding area. The tell raises some 3-4 m above the floodplain. ................................................157

Figure 3: Characteristic vessels types from Gorzsza: a) flowerpot form; b) collared vessel; c) large storage vessel; d) pot; e, g) hollow pedestal bowls; f) hollow pedestal chalice. ..............................................................................................................................159

Figure 4: Characteristic vessel types from Gorzsza tempered with plants: a, b, c) mugs; d) flowerpot form (incised); f) fragment of bottle (neck); e) and g) bowls; h) fragment of cup. Black scales are 5 cm. .............................................................................................................................................160

Figure 5: Geological map of the site and simplified well-log of the collected shallow drillings (after Gyalog 2005). .................................................................................................................................161

Figure 6: Examples of Tisza culture ceramics from the Gorzsza tell: a) type 2a (sample Gorker-155); b) type 5a (sample Gorker-118); c and e) type 2a (sample Gorker-111); d and f) type 1a (sample Gorker-102). Scales are 2 cm. .............................................................................................................................................161
Figure 7: Photomicrographs of Tisza culture ceramics from Gorzsa tell: a) fabric 1a (sample Gorker-001); b) fabric 1b (sample Gorker-150); c) fabric 2a (sample Gorker-006); d) fabric 2b (sample Gorker-123); e) fabric 3a (sample Gorker-120); f) fabric 3a (sample Gorker-124); g) fabric 4 (sample Gorker-152); h) fabric 4 (sample Gorker-154). All images were taken in plane polarised light. ...........................................163

Figure 8: Plant matter in fabric 3: a) fabric 3a (sample Gorker-118), bottom left recent Triticum sp. is shown; b) fabric 3a (sample Gorker-125), bottom left recent Triticum is shown; c) fabric 3b (sample Gorker-130); d) recent Triticum turgidum L. subsp. dicoccum. All images were taken in plane polarised light. ........................................................................164

Figure 9: Photomicrographs of very fine-grained daub fragments from Gorzsa tempered with vegetal materials, and photomicrographs of sediments from shallow drillings: a) sample Gorker-011; b) sample Gorker-012; c) drill Gorf-1; d) drill Gorf-2; e) drill Gorf-3; f) drill Gorf-4. All images, except b) were taken in plane polarised light. .......................................165

Figure 10: Backscattered electron images of ceramics and the argillaceous sediment samples from the site: a) fabric 1b (sample Gorker-150); b) fabric 2a (sample Gorker-009); c) fabric 2a (sample Gorker-009); d) fabric 3a (sample Gorker-120); e) drill Gorf-1; f) drill Gorf-2; g) drill Gorf-3; h) drill Gorf-4. ........................................................................167

Chapter 12
Figure 1: Vessel stability and centre of gravity: Early Neolithic (left), Late Neolithic (right). .................................................................176

Note: in the captions of the figures where is not otherwise specified, pictures credits belong to the authors.

List of Tables

Chapter 3
Table 1: Vinitsa: Distribution of vessels and lids by building. ..................................................................................................................46

Chapter 4
Table 1: Descriptions of the phase codes and main publications. ...........................................................................................................57
Table 2: Descriptions of sherds and fabric types. ...............................................................................................................................59

Chapter 5
Table 1: Distribution of conical vessel forms according to fabric groups during the early, transitional (style group 3) and late LBK pottery of Balatonszárszó. ................................................................................70
Table 2: Distribution of semi-spherical vessel forms according to fabric groups during the early, transitional (style group 3) and late LBK pottery of Balatonszárszó. .............................................................71
Table 3: Distribution of large globular vessel forms according to fabric groups during the early, transitional (style group 3) and late LBK pottery of Balatonszárszó. ........................................................................73
Table 4: Distribution of biconical and globular vessel forms according to fabric groups during the early, transitional (style group 3) and late LBK pottery of Balatonszárszó. .................................................................73

Chapter 6
Table 1: A summary of the results of organic residue analyses on sampled sherds (the analyses were conducted at the University of Bradford, UK, the Division of Archaeological, Geographical and Environmental Sciences). ........................................83

Chapter 7
Table 1: Samples selected for thin-section petrography. .................................................................................................................................107

Chapter 8
Table 1: Proportions of decorative techniques at Kovačevo. ....................................................................................................................115
Table 2: The summarized textural characteristics of the ceramic types and subtypes, daubs and sediments. ......................................................116
Table 3: Distribution of pottery in the nine houses from the lower level of Kovačevo. ..................................................................................120

Chapter 9
Table 1: Neolithic ceramic wares from Pieria, with numbers of samples per site and fabrics indicated. .........................................................131

Chapter 10

Chapter 11
Table 1: Summary of the analysed ceramics. .................................................................................................................................158
Table 2: The summarized textural characteristics of the ceramic types and subtypes, daubs and sediments. ........................................................................162
Table 3: Chemical compositions of ceramics and sediment matrices (wt%). ..............................................................................................166

Chapter 12
Table 1: Orifice constriction values and relative height of centre of gravity for the basic functional classes of the Early Neolithic Blagotin assemblage. ..............................................................................177
Table 2: The morphological metrical parameters related to function for all vessel classes (Blagotin). ................................................................................178
Table 3: The morphological metrical parameters related to function for Late Neolithic Vinča constricted vessels. .................................179
List of Contributors

Silvia Amicone is a Research Scientist at the University of Tübingen, Germany, within the Competence Centre Archaeometry Baden-Württemberg (CCA-BW), and an Honorary Research Associate at University College London, Institute of Archaeology. She completed an AHRC-funded doctoral research at the Institute of Archaeology, UCL, as member of the cutting-edge international project ‘The Rise of Metallurgy in Eurasia’. As a pottery analyst specialising in pottery technology in contexts of intense socio-cultural innovation, Silvia has contributed to several projects in the Balkans and the Mediterranean area and is an active member of the Ceramic Technology Research Network at the Institute of Archaeology (University College London). In 2016 she was holder of the Fitch Bursary award at the British School at Athens, where she carried out interdisciplinary research on cooking pottery production and consumption in the Greek and Roman site of Priene (Turkey). Since 2014, Silvia has promoted the creation of the first research network for pottery technology in the Balkans, in cooperation with the Institute of Balkan Studies and the Serbian Academy of Arts and Sciences.

Jacqueline Balen is a Museum Advisor at the Archaeological Museum in Zagreb (Croatia) and is president of the Croatian Association of Archaeologists. Since 2008 she has lectured on the basics of museum work at the Department of Archaeology, Faculty of Humanities and Social Sciences of the University of Zagreb. She has participated in many field research projects and excavations. Her main research interests focus on the Neolithic and Eneolithic Balkans. She is a member of the editorial board of the Journal of the Archaeological Museum in Zagreb.

Zsolt Bendő is a geologist, petrologist, and professional practitioner of scanning electron microscopy and electronbeam analysis. He has worked for the Eötvös Loránd University, Budapest, Hungary (SEM laboratory personnel) in the Department of Petrology and Geochemistry where his research project was to develop a completely non-destructive investigation method for polished stone tools. A second important research topic was to identify raw material provenances based on non-destructive analyses. He has also worked on ceramic and gemstone provenance studies. He is now working as coatings expert and laboratory leader for a leading technology company in the thermal spray coatings field.

Richard Carlton is a Visiting Fellow in the School of History, Classics and Archaeology at Newcastle University, UK where his main research interests lie in ceramic technology and ethnoarchaeology, specialising in the modern earthenware traditions of the west and central Balkans, where he first experienced the complexities involved in pottery-making at the hands of the potters of Iź in North Dalmatia. He has since carried out ethnographic and ethnoarchaeological research on pottery-making and aspects of the built heritage throughout the countries of former Yugoslavia and further afield, including Georgia, Turkey and Ukraine. In addition to ceramic research, as director of The Archaeological Practice in Newcastle he has completed hundreds of reports, many of them published, on archaeological projects in northern Britain, covering all periods from the Neolithic to the present and resulting in major discoveries, including multi-period prehistoric settlement sites, early and later medieval churches and the world’s earliest surviving standard gauge wooden railway.

Biljana Djordjević is a Museum Counsellor in the National Museum in Belgrade, Serbia where she runs the research project titled ‘Ceramics from the Neolithic period to the present day – technology and usage’. Her PhD degree in Archaeology/Ethnoarchaeology was entitled Ethnoarchaeological Research in Ceramic Technology: The Zlakusa Case Study. She completed the Zlakusa Case Study in 2016 in the Faculty of Philosophy, University of Belgrade. Her fields of interest are pottery technology, archaeology, ethnoarchaeology, and intangible cultural heritage, and she is the coordinator of important ethnoarchaeological projects in the Balkans. She has edited proceedings of two conferences: Traditional Pottery Making from the Ethnoarchaeological Point of View, Scientific Research and Safeguarding of Intangible Heritage (National Museum in Belgrade 2014), and Museums and Cultural Tourism: Connecting Differences (Regional Committees of ICOM, Belgrade 2015).

Petya Georgieva, is an Associate Professor at the Department of Archaeology, Faculty of History, Sofia University St Kliment Ohridski, Bulgaria. She trained as an archaeologist (Sofia University, Bulgaria) and acquired her PhD degree under the supervision of Henrieta Todorova. She teaches a course entitled Introduction to Prehistory, Neolithic and Eneolithic, Typology of Ceramics of the 7th–4th Millennia BC, and other lecture courses of the undergraduate and graduate curricula. She leads the excavations at the Kozareva Mogila prehistoric site (settlement mound and necropolis). Her research centers on the cultures of the 5th and 4th millennia BC within Bulgaria, technology and
typology of ceramics, and funerary rites. She has authored a book on the ceramics of the Krivodol–Sălcuța culture and has been the supervisor of eight doctoral students.

**Beatrijs de Groot** is a Leverhulme Postdoctoral Researcher at the University of Edinburgh. She completed Marie-Curie FP7-funded doctoral research at the Institute of Archaeology, University College London, where she contributed to the BEAN project (‘Bridging the European and Anatolian Neolithic’). This was an interdisciplinary project which combined state-of-the-art studies in ancient DNA, physical anthropology, computational modelling and archaeology to study demographic questions surrounding the spread of farming. Her role as early stage researcher involved studying long-term changes in ceramic assemblages in Neolithic Anatolia, Greece and the Balkans using ceramic petrography and multivariate statistics. In this context, she conducted a petrographic study on ceramics from Džuljunica-Smărdeș, Barcun Höyük and Aktoprakkhh C. She currently collaborates on a project hosted by the Institute for Heritage Sciences in Santiago de Compostela, studying technological changes in Iron Age pottery from Vigaña, north-west Spain.

**Ferenc Horváth** is an archaeologist and has worked at the Mora Ferenc Museum, Szeged, Hungary, for nearly four decades. At the same time, he has worked also as an associate professor at the Department of Archaeology, University of Szeged. He started his archaeological studies at the beginning of the 1970s. Medieval and Early Bronze Age archaeology were his fields of interest during the first decade of his activity, however he has focused on questions of the south-eastern European Neolithic for the last forty years. Excavation of the Late Neolithic tell of Gorza in southern Hungary was his most important project between 1978 and 1996. Analysis of the materials from this project is still ongoing. The techniques he developed at Gorza were, and continue to be, those by which tell excavations are measured. He has trained multiple generations of international scholars in the intricacies of tell excavation and he has been the academic mentor for many currently-practising archaeologists in Hungary and elsewhere.

**Kostas Kotsakis** is an Emeritus Professor in Prehistoric Archaeology in the Department of Archaeology at Aristotle University of Thessaloniki, Greece, and holds a PhD in prehistoric archaeology from the same university. He has taught theory of archaeology and the Neolithic in south-eastern Europe and the Near East, with particular emphasis on pottery. He has been visiting scholar at Cambridge University (1990), visiting professor at Stanford University (2002 and 2008), and honorary senior research associate of the Institute of Archaeology UCL (2011). He has also taught as visiting professor at the University of Thrace (1994-97) and at the School of Architecture of AUTH. He has excavated extensively at prehistoric sites in Thessaly and Greek Macedonia, mainly of the Neolithic period. He has directed excavations at Sesklo (1978–81), Çatal Hüyük, Turkey (1995–1998) and Paliambela Kolindros with Professor Paul Halstead. He is now in charge of the Dispilio Archaeological Project in Lake Kastoria. He has extensively researched questions of theory and method of archaeology and material culture, of public archaeology and outreach, and has directed more than 25 international research programs.

**Attila Kreiter** is an archaeologist and ceramic specialist, and head of the Laboratory for Applied Research at the Hungarian National Museum. His research interests include the utilization of interdisciplinary analysis in archaeological interpretation and the combination of interdisciplinary research with archaeological theory, the origins and transmission of ceramic technologies, continuity and change in ceramic technologies and the social meaning/application of these processes. Apart from ceramic petrography he employs a broad range of analytical techniques to gather data including X-ray Diffraction (XRD), X-Ray Fluorescence (XRF), Instrumental Neutron Activation Analysis (INAA), Scanning Electron Microscopy (SEM) and Laser Ablation (LA-ICP-MS, LA-ICP-AES). He mainly conducts research in Hungary analysing ceramics from the Neolithic to the medieval period.

**Zsuzsa Lisztes-Szabó** is a biologist (botanist) and works as a research fellow in the Isotope Climatology and Environmental Research Centre, Institute for Nuclear Research, Hungarian Academy of Sciences, and as assistant professor in the Department of Agricultural Botany, Biotechnology and Plant Physiology, University of Debrecen, Hungary. She started her studies of phytoliths six years ago. In the most recent years, her main research project has been to create phytolith reference assemblage data from plant materials as well as archaeobotanical and environmental reconstruction studies. Nowadays she extends her research to the studying of fossil plant remains.

**Miroslav Marić** is a Scientific Associate at the Institute for Balkan Studies of the Serbian Academy of Sciences and Arts. He obtained his PhD at the Department of Archaeology of the Faculty of Philosophy at the University of Belgrade. His main interest lies in the Late Neolithic period of the central Balkans and the southern edge of the Pannonian plain, primarily settlement patterning and organisation, the exploitation of raw resources, movement of goods and prehistoric communications. Miroslav has taken part in several international projects regarding the
Neolithic period of the region, such as the AHRC-funded ‘The Rise of Metallurgy in Eurasia’ (UCL) where he was involved as a field researcher and GIS specialist, the ERC-funded ‘The times of their lives: towards precise narratives of change in the European Neolithic through formal chronological modelling’ (Cardiff University and Historic England), and the FP7 Marie Curie Action project ‘Contributing to Preventive Archaeology’. At present, Miroslav is involved with the Borderlands ARISE project (Archaeological Research of Iđoš and Surrounding Environment) as one of the lead excavators on the Neolithic site of Iđoš.

Tibor Marton is an archaeologist and researcher at the Institute of Archaeology, Research Centre for the Humanities, Hungarian Academy of Sciences. His research comprises the investigation of Mesolithic antecedents of the Hungarian Neolithic and Neolithic sites in western Hungary. A substantial part of his work is related to the analyses of material culture, particularly ceramic typology and the examination of chipped stone industries. Based on the distribution of different artefact types, he also investigates complex taphonomic processes on extended, persistent settlements. Another field of his interest is the analysis of how various temporal and social interpretations of patterns, discovered in the archaeological record, can contribute to proper modelling of site dynamics and settlement structures.

Ina Miloglav is Assistant Professor at the Department of Archaeology, Faculty of Humanities and Social Sciences of the University of Zagreb, Croatia. She lectures on the documentation and methodology of archaeological sites and on the methodology of processing prehistoric pottery. She has participated in more than 70 field research projects and excavations, where her contribution has been in the role of research leader, associate and documentarist. Since 2013 she has organised the international scientific conference Methodology and Archaeometry at the Faculty of Humanities and Social Sciences in Zagreb. She is a member of the editorial boards of the journals Opuscula Archaeologica (Zagreb, Croatia) and Arhaika (Belgrade, Serbia).

Neda Mirković-Marić is an archaeologist at the Intermunicipal Institute for the Protection of Cultural Monuments Subotica, Serbia. Her research interests comprise cultural heritage studies, pottery studies, experimental archaeology and social boundaries. She has participated for years in numerous archaeological projects and has collaborated with different institutions in Serbia, as well as on some international projects such as ‘Rise of Metallurgy in Eurasia’ and the Serbian-Hungarian cross-border project ‘Common Heritage’. Since 2014 she has been one of the directors of the project of systematic archaeological research of Gradište-Iđoš site (ARISE project – Iđos site and its environment). The project aims to determine the nature of interaction between different societies of the Neolithic and Bronze Age period in the north part of the Serbian Banat and to reconstruct the environment, its use and changes over a larger time period. Since 2017 she has been the director of the ongoing project ‘Archaeological Map of Northern Bačka Region (Serbia)’.

Krisztián Oross is an archaeologist and a researcher at the Institute of Archaeology, Research Centre for the Humanities, Hungarian Academy of Sciences. Recent large-scale excavations directed by Krisztián and by his colleagues made it possible to gain an insight into the architecture and settlement layout of 6th millennium cal BC Neolithic sites of Transdanubia in western Hungary for the first time. The area attracts distinguished research interest because it served as a contact zone between the Balkans and Central Europe in various periods of the Neolithic. He is the principal investigator of an ongoing project that investigates early farming communities of the region together with the evaluation of excavated assemblages, field surveys and targeted further small-scale excavations. Another focus of his research is the absolute chronological dating of Neolithic settlements and the interpretation of the results within a Bayesian framework.

Péter Pánczél is a former geologist in the Laboratory for Applied Research at the Hungarian National Museum. He specialized in petrographic analysis of ceramics and stone artefacts. He uses technological assessment and petrographic analysis to examine production technology and raw material sources of ceramics. He is particularly interested in the provenance of ceramic and stone raw materials. Apart from ceramic petrography he employs a broad range of analytical techniques to gather data including X-ray Diffraction (XRD), X-Ray Fluorescence (XRF), Instrumental Neutron Activation Analysis (INAA), Scanning Electron Microscopy (SEM) and Laser Ablation (LA-ICP-MS, LA-ICP-AES).

Trisevgeni Papadakou concluded her undergraduate and master’s degrees in archaeology at the Aristotle University of Thessaloniki, Greece. She has worked as an archaeologist for the Greek Archaeological Service and contributes as a pottery expert to various research projects on Neolithic sites in northern Greece. Her PhD research is focused on the study of organic-tempered pottery from the early and early-middle Neolithic sites of northern Greece, including phytolith analysis of organic temper (in thin sections and SEM). Her research interests include
pottery technology and the relationship of pottery production with other practices, such as those related to agricultural and pastoral activities.

Anna Papaioannou studied archaeology at the Aristotle University of Thessaloniki, Greece, and is currently a PhD candidate at the same institution. She has worked for archaeological research projects at the university and on rescue excavations of the Greek Archaeological Service. In the framework of various research programmes she studies pottery from Neolithic sites in Northern Greece. The subject of her PhD research is the technology of early Neolithic pottery. Specifically, she studies the formation techniques of ceramic vessels from six sites in central and western Macedonia dating to the Early and Middle Neolithic.

Ákos Pető is an environmental scientist and works as an associate professor at Szent István University, Department of Nature Conservation and Landscape Ecology (Gödöllő, Hungary). His research focuses on integrated archaeobotanical approaches with an emphasis on phytolith analysis and geoarchaeology, with a specialisation on activity area analysis and subsistence strategies of the archaeological cultures of the Carpathian Basin.

Patrick Quinn is Principal Research Fellow in Ceramic Petrography at the Institute of Archaeology, University College London (UCL), UK and is an archaeological scientist specialising in the analysis and interpretation of ceramics, plasters and stone. He trained as a geologist (Keele University, UK) and micropalaeontologist (UCL), before applying his skills to archaeometry and ancient ceramics (University of Sheffield, UK). Patrick utilises the compositional and microstructural signatures of ceramics from pre-contact California, the Bronze Age Aegean, Qin period China and prehistoric and Roman Britain to tackle a variety of archaeological themes including trade and exchange, migration, cultural interaction, craft technology, organisation of production, tradition and identity. He is a leading analyst in the versatile geoarchaeological technique of thin-section ceramic petrography and has authored a key textbook on the approach. Patrick runs the Ceramic Technology Research Network (CTRN) at the Institute of Archaeology, UCL.

Miljana Radivojević is a Lecturer in Archaeomaterials at the UCL Institute of Archaeology and holds a PhD in Archaeometallurgy from the same institution. Her collaborations span across Europe and northern Eurasia, with emphasis set on research links across central and southeast Europe, Anatolia, northern Africa, Russian Federation, Kazakhstan and Uzbekistan. Current fieldwork projects that she co-directs include the 5th millennium BC Chalcolithic site of Pločnik in Serbia and the 2nd millennium BC Late Bronze Age settlement of Semiyarka in northeastern Kazakhstan. Dr Radivojević has published in high impact journals on the origins of metallurgy in the Balkans and southwest Asia, invention of tin bronze metallurgy, innovation and transmission of copper metallurgy across southeast Europe, and use and circulations of Bronze Age metals in Europe, experimental archaeometallurgy and aesthetics of ancient metal objects, as well as co-developed a novel method of re-assessing archaeological phenomena using complex networks analysis of metal supply systems in the Balkans. Her current research focus on the prehistory of Silk Roads in linking central Asia, the Eurasian Steppe and most of Europe during the 4th – 1st millennium BC, and more broadly addressing the pre-modern globalisation of Eurasian continent by looking at the (technological) knowledge economy at the time.

Laure Salanova is Directrice de Recherche at CNRS (AOrOc), specialises in early agrarian societies and their dynamics, from material remains to comparative approaches to symbolic and economic structures. In addition to her research on the Neolithic and Early Bronze Age in Atlantic Europe on burial structures and pottery production, she now studies the issue of the Early Neolithic, supervising and conducting pottery analyses in the Balkans and Northern Africa from an economic perspective. Her current research focus is on the prehistory of Silk Roads in linking central Asia, the Eurasian Steppe and most of Europe during the 4th – 1st millennium BC, and more broadly addressing the pre-modern globalisation of Eurasian continent by looking at the (technological) knowledge economy at the time.

Niki Saridaki studied archaeology at the Aristotle University of Thessaloniki, Greece. She has worked as an archaeologist for the Greek Archaeological Service and she participates as a pottery expert in various research projects on Neolithic and Bronze Age sites in northern Greece and Crete. At a doctoral level she has implemented petrography and pED-XRF analysis in the study of Neolithic ceramic assemblages from central and western Macedonia. The basic aim of her PhD thesis was to investigate pottery technology and mobility during the course of the Neolithic in northern Greece through the study of eight Neolithic pottery assemblages. Her research interests include pottery technology and production, and particularly mobility issues (mobility of craftsmen and/or mobility of technological knowledge).

Cristian Eduard Ştefan is an archaeologist at the Vasile Pârvan Institute of Archaeology, Romanian Academy. His main research interests are tell settlements, Neolithic material culture (pottery, figurines, lithic tools, etc.), Neolithic burials, ancient metallurgy, social structures, and archaeometry. His present research projects include archaeometric
György Szakmány is a geologist (petrologist) and works as associate professor in the Department of Petrology and Geochemistry, Eötvös Loránd University, Budapest, Hungary. He started his archaeometric studies more than 30 years ago. In the last twenty years, archaeometry has been his main research topic. Through archaeometrical techniques, he is analysing polished stone tools, particularly in order to outline or determine the provenance of their raw materials. Beside petrographic analyses, with his colleagues and his PhD students he works using different non-destructive/non-invasive techniques to analyse stone artefacts, namely by magnetic susceptibility, prompt gamma activation analyses, non-destructive SEM-EDX analyses on the original surface of stone tools. He studies ceramics through petrographic and SEM-EDX methods from different archaeological periods, mainly prehistoric pottery and Roman amphorae; to analyse their composition, production technology and provenance of their raw materials. He has also performed comparative analyses from several potential raw material sources collected from the possible provenances.

Dushka Urem-Kotsou is an Associate Professor in prehistoric archaeology at Democritus University of Thrace, Department of History and Ethnology, Greece. As a pottery expert, she has been working on prehistoric pottery assemblages from Greece and the Balkans. Apart from pottery and the integration of analytical methods (e.g. chemical analysis of organic residues, petrography) in its study, her research interests focus on archaeological theory and methods, and the prehistory of south-eastern Europe and the Aegean.

Katalin Vanicsek is a geologist. She is an expert in petrographic and SEM-EDX analyses of ancient pottery. She worked with Gorzsa ceramics during her BSc and MSc studies between 2011 and 2016 at the Eötvös Lorán University Department of Petrology and Geochemistry. Recently she has been working in the Ministry of Innovation and Technology, Budapest, Hungary.

Jasna Vuković is an Associate Professor at the Department of Archaeology, Faculty of Philosophy, University of Belgrade, specialises in Neolithic archaeology and pottery studies, considering a variety of topics including technology, use-alteration analyses, organisation of production and style. Her courses include archaeological methodology, pottery studies and archaeology and the public. She has participated in more than 25 international conferences and published more than 40 scientific papers. She is editor-in-chief of Arhaika, journal of the Department of Archaeology, Faculty of Philosophy, University of Belgrade.
Preface and Acknowledgments

The majority of chapters of this peer-reviewed volume originate from the workshop Tracing Pottery-Making Recipes in the Prehistoric Balkans, 6th–4th Millennia BC held in Belgrade between 19-20th September 2014. This event was jointly organised by the Institute of Archaeology, University College London (UCL) and the Institute of Balkan Studies (Serbian Academy of Sciences and Arts) and was generously sponsored by the Institute for Archaeo-Metallurgical Studies (IAMS) at UCL.

The aims of the event were to facilitate communication and exchange among scholars with an active interest in high-temperature ceramic technology during the 6th–4th millennia BC in the Balkans and to investigate the current state of art in the field. This international event brought together archaeologists and archaeomaterials scientists from several countries, including Croatia, Bulgaria, France, Hungary, Greece, Republic of North Macedonia, Romania, Serbia, and the United Kingdom. A diverse range of papers on the technology of Neolithic and Chalcolithic pottery from the Balkans were presented at the two-day meeting, many of which appear as chapters in this volume. Other relevant studies have also been included in order to produce the first dedicated book on the topic of early Balkan ceramic technology.

We thank all of the speakers and discussants for the stimulating atmosphere at the meeting. Many other people were instrumental in providing us with support and encouragement during the production of this volume. We would particularly like to thank Christoph Berthold, Annalisa Costa, Vanessa Forte, Kyle Freund, Maja Gori, Lars Heinze, Arvin Raj Mathur, Roberta Mentesana, Lionello Morandi, Juan Jesús Padilla Fernández, Marco Romeo Pittone, Milica Rajičić, Thilo Rehren, Giulia Russo, Elisa Norina Solera, Michela Spataro, Cynthia Spiteri, Nenad Tasić, Carmen Ting, Esther Travé Allepuz, Bruno Vindola and Maximilian Zerrer. We are also indebted to Institute of Balkan Studies (Serbian Academy of Sciences and Arts) and to the Rectorate of the University of Belgrade for securing the venue and helping with the organisation. Silvia Amicone would like also to thank the Competence Center Archaeometry Baden-Württemberg and the Excellence Initiative of the Eberhard Karls Universität Tübingen for their support during the preparation of this edited volume.

We would like to dedicate this volume to the memory of one of the participants of the workshop, our dear friend and colleague Ivan Suvandzhiev who sadly passed away.

Introduction.

Tracing Pottery-Making Recipes in the Prehistoric Balkans, 6th-4th Millennia BC

Silvia Amicone
Eberhard Karls University of Tübingen
University College London
silvia.amicone@uni-tuebingen.de

The Neolithic of southeastern Europe was one of the most dynamic periods in European prehistory as it saw the establishment of a fully sedentary settlement system that is reflected in the rise of large tell-settlements, the acceleration of agricultural and herding activities, and significant technological innovations. This period is also marked by rapid developments in pyrotechnology, particularly in pottery and metallurgy production. These processes, which appear to have taken place between c. 6500 and 4000 BC, blend into the Chalcolithic period and are characterised by very high standards of pottery firing and decorative techniques (Bailey 2000: 153-192).

Ceramic assemblages are abundantly preserved and provide a foundation for understanding technological and cultural developments during this time. To date, pottery studies in the Balkans are still dominated by extensive chrono-typological classifications, which are used to differentiate between various archaeological cultures (Childe 1929) that developed in the area and are traditionally equated with social groups, or even ethnic entities, whose distributions are often assumed to correlate with the boundaries of modern countries (e.g. Tsirtsoni 2017). This is explained by the fact that since the late 19th century the culture-historical approach has been the dominant theoretical framework adopted by researchers of the discipline (Maran 2017: 17). This approach to the later prehistory of the Balkans focuses on the chronology of pottery finds and the distribution of related archaeological cultures and is at the core of the notion of ‘archaeological culture’ in the Balkans remains a robust nomenclature that could be useful for studying interrelations between different material cultures and thereby creating larger synthesizes. At the same time, because of the centrality of this concept in the archaeological debate (Roberts and Vander Linden 2011), it is important to be critically engaged with questions about what archaeological cultures are. It is also crucial to reflect on how these complexes of associated traits have emerged and could acquire validity as tools of scientific investigation. In this regard, it is important to observe that although broad regional pottery typologies based on morphology and decoration helped to contribute to an initial understanding of developments in material culture, a more nuanced approach to the knowledge and skills behind pottery production is needed to fully utilise ceramics as a tool for tracing cultural phenomena. This necessity is well stated in various chapters of this volume where the authors, although still relying on the traditional notion of archaeological culture, also emphasise the importance of pottery as a proxy for acquiring useful information about aspects of ancient societies such as economy, identity and social networks. This largely reflects the scope of the present volume, which features contributions aiming to trace meaningful and real connections between pottery and people through the study of ceramic technology.

This interdisciplinary approach to pottery studies has its roots in the pioneering work of Shepard (1956). Her research laid the foundation of the two theoretical trends that dominated the studies of pottery in Anglo-American archaeology from the second half of the last century onwards: Ceramic Ecology and the Functionalistic Approach (Morris 1974; Bishop and Lange 1991; Santacreu 2014). These are part of the broader theoretical development of the so-called ‘New Archaeology’ (e.g. Binford 1965; Binford 1972; Clarke 1973). More precisely, ceramic ecology focuses on reconstructing the relationship between ceramics and the natural environment (e.g. Matson 1965; 1995; Rye 1981; Kolb 1988; Arnold 1993), while the functionalistic
Tracing Pottery-Making Recipes

Tracing Pottery-Making Recipes are demonstrating the enormous potential that this approach underlies the relationship between the vessel’s function and the potters’ behaviour (e.g. Braun 1983; Rice 1990; Schiffer and Skibo 1987; 1997).

These theories first had an impact on the study of prehistoric pottery in the Balkans during the 1970s as the result of international excavations at Selevac, Opovo (Tringham and Krstić 1990; Tringham et al. 1992) and the work of American and English scholars such as Gardner (e.g. 1978), Chapman (1981), and Kaiser (1984; 1990; Kaiser et al. 1986). These projects applied, with success and for the first time, new theoretical models to pottery assemblages from this region as part of doctoral research projects. After these important works, the study of ceramic technology in the prehistoric Balkans somehow stalled and did not develop in the same way as it did in other regions such as the neighbouring Aegean, where the study of technology was incorporated into pottery research on a regular basis (e.g. Day 1989; Whitbread 1989; Day et al. 1998). This is not surprising, however, if one considers the marginalisation of Balkan archaeology as a component part of broader geopolitical tensions and isolation during the 1990s. Besides, differently from the Balkans, Aegean archaeology served as laboratory for new Anglo-American theoretical approaches that led to the decline of diffusionist models in favour of studies more focused on regional dynamics within the Aegean (Gori and Ivanova 2017: 3). Culture history and diffusionist models remained the dominant paradigm in Balkan archaeology and anti-diffusionist positions entered mostly only in the debates on the autonomous invention of metallurgy (Renfrew 1969; Jovanović and Ottaway 1976; Todorova 1978; Roberts et al. 2009; Rađivojević et al. 2010).

Studies in pottery technology received a boost at the beginning of the 21st century, thanks to the general decline of culture-historical approaches and the opening of this region to other theoretical developments within archaeology. This is well demonstrated for example by the studies of scholars such as Gheorghiu (e.g. Gheorghiu and Nash 2007), Salanova (e.g. Salanova et al. 2010; Salanova 2012), Miloglav (e.g. 2012), and Vuković (e.g. 2013; 2015) who started to investigate aspects of ceramic technology such as manufacturing techniques, organisation of production, and specialisation. In addition, ethnographic approaches to Balkan pottery technology and production have also developed in recent decades (e.g. Djordjević 2007; 2014; Carlton 2014). The knowledge of prehistoric pottery manufacture and circulation has also benefitted from the use of material science, with notable projects including those of Kreiter (Kreiter 2010; Kreiter et al. 2017), Spataro (2014; 2017), Szakmány et al. (2011), and Gajić-Kvaščev (Gajić-Kvaščev et al. 2012a; 2012b). These studies and several other on-going projects on pottery technology are demonstrating the enormous potential that this approach has for furthering our understanding of ancient ceramic technology as archaeometric analysis can be used to detect patterns associated with the selection and provenance of raw materials and important aspects related to manufacturing processes such as pyrotechnology.

Despite the examples given above, the study of ceramic technology continues to occupy a marginal role in Balkan prehistory, and the various chapters of this volume bring together for the first time the multiple strands of current research on Neolithic and Chalcolithic pottery from this region. It reflects a field of study that is still largely dependent on culture-history models, but is nonetheless open to various theoretical and methodological approaches that emphasise the importance of studying ceramic technology and its function. A focus on ceramics and their relation to the environment is reflected in various contributions of this volume. Chapter 2 (Djordjević), for example, brings attention to the importance of experimental and ethnographic studies within research on pottery technology. She emphasises the importance of carrying out ethnographic research and archaeological experiments at a local level, namely in the same region once inhabited by past communities. In the Balkans, environmental conditions have not changed drastically since the Neolithic. Therefore, through ethnographic studies and archaeological experiments in the region, it is possible to formulate relevant models of the varied and interconnected ways in which past communities engaged with local resources that have the potential of disclosing histories of interactions among people and materials across different landscapes. Very importantly, this contribution demonstrates the urgency to protect the knowledge of traditional ceramic technologies as part of the intangible cultural heritage of Europe, a concern that also frames chapter 1 (Carlton). His contribution focuses on the tradition of calcite tempering in the contemporary domestic pottery production of the central and western Balkans with in-depth considerations about the environment, but also the function of the vessels manufactured by the interviewed potters.

Functionalistic approaches are echoed in the contributions by Vuković as well as Miloglav and Balen that suggest different perspectives to this topic. Chapter 12 (Vuković) discusses the tracing of pottery function through technology by focusing on the study of their performance characteristics. In doing so, Vuković investigates formal properties and morphology of Neolithic pots from Serbia, reaching meaningful conclusions that shed light on the shift in everyday-life between semi-sedentary and fully sedentary societies that accompanies the transition from the Early to Late Neolithic. On the other hand, chapter 6 (Miloglav and Balen) investigates the function of vessels through the
application of organic residue analysis. The latter has so far seen only limited use in the study of ancient pottery from the Balkans and the chapter demonstrates its potential, especially when combined with other lines of evidence provided by use wear analysis and contextual information.

At the core of this volume are also post-processual perspectives that emphasise technology as a reflection of social relations and cultural values, leading to the development of social anthropology of technology (e.g., Lemmonier 1986; 1992; Pfaffenberger 1988; 1992; Schlanger and Sinclair 1990; van der Leeuw 1993; Dobres and Hoffman 1994 and 1999; Stark 1998; Roux 2010), an approach that owes much to the pioneering work of archaeologists like Leroi-Gourhan (1964; 1965) and Lechtman (1977; 1984). Among these theoretical frameworks it is important to mention the widely adopted concepts of *chaîne opératoire* (e.g. Gourhan 1964; Roux 2017) and ‘technological choices’ (van der Leeuw 1993; Lemmonier 1993; Sillar and Tite 2000). These approaches resonate at different levels in the various contributions of this book. Chapter 8 (Salanova) for example examines technology as an expression of identity, through an approach that combines qualitative and quantitative analyses with a technological assessment of pottery from Kovačevo (6200-5600 BC, Bulgaria). The results of this work show that it is possible to distinguish different aspects of identity through the study of ceramics and thereby establish the base for a renewed debate on the earliest pottery production and agrarian development in the Balkans.

Chapter 3 (Georgieva) addresses themes such as the organisation of production and specialisation, focussing on pottery assemblages from Kôdîdermînî-Gumelniţa-Karanovo VI and Krivodol-Sâlciuţa-Bubanj Hum Ia cultures (Bulgaria, second half of the 5th millennium BC) in order to investigate the social transformation taking place between the Early and Late Eneolithic in this region. Chapter 10 (Ştefan) focuses on similar problems through the application of the *chaîne opératoire* to the pottery production at the Chalcolithic site of Radovanu (4800-4600 BC). This is achieved by combining macroscopic and microscopic observation, thus shedding new light on the technological traditions and connected cultural aspects of this important site.

The anthropology of technology also emphasises the socially organised nature of learning and the transmission of knowledge, topics at the core of archaeological research on material culture (Stark *et al.* 2008). Within archaeology, social learning and cultural transmission recently developed in two major directions. These lie on one hand in the development of ‘situated learning theory’ (Lave and Wenger 1991; Wenger 1998) and the related notion of ‘communities of practice’ (e.g. Sassman and Rudolfi 2001; Eckert 2008; 2012; Huntley 2008) and on the other hand on neo-Darwinian approaches such as the ‘dual-inheritance theory’ (e.g. Cavalli-Sforza and Feldman 1981; Boyd and Richerson 1985; Mesoudi and O’Brien 2008; Shennan 2008). In Chapter 7 (Mirković-Marić and Amicone), communities of practice of pottery-making are investigated through the technological studies of materials from the Late Neolithic phases (5200-4800 BC) of the archaeological sites of Gradište-Iđoš, Kremenjak-Čoka, Akača-Novosiloš (Serbia). These contexts are characterised by pottery assemblages marked by two different material cultures (Vinča and Tisza), and this study attempts to determine if these stylistic groups correspond with two technological traditions that reflect different communities of practice within pottery manufacturing.

Together with the aforementioned Chapter 10, Mirković-Marić and Amicone’s contribution thus presents another major theme at the core of this volume: the application of natural science-based approaches to the study of material culture. These often permit a degree of resolution that cannot be obtained with macroscopic analyses and thus have the potential for better understanding ancient technology (e.g. Rice 1987; Whitbread 1995; Evershed 2008; Tite 2008; Quinn 2009; 2013; Torrence *et al.* 2015; Hunt 2016). Our volume therefore aims to promote a dialogue between archaeologists and natural scientists. Often, archaeologists are not informed about the growing possibilities of scientific analysis, and natural scientists tend to be more focused on developing new methods rather than integrating their studies with the research questions of archaeologists (Sommer *et al.* 2019; Martinón-Torres and Killick 2015).

The application of archaeometry to the study of raw material procurement and processing is also exemplified by Chapters 11 (Szakmány *et al.*) and 4 (de Groot). The former is a study providing archaeometric data on ceramics from the Late Neolithic site of Hôdmezövásárhely-Gorzsa (4846-4495 cal BC) with the aim of assessing the composition and technological characteristics of ceramics. The latter by de Groot investigates the relationship between pottery types and clay preparation methods in the first pottery assemblages in southeastern Europe and western Anatolia by focusing on the Early Neolithic ceramic assemblages of Džuljunica-Smärđeš in NE Bulgaria (c. 6200-5900 BC). Ceramic petrography and multivariate statistics are combined to compare patterns in the similarities of typological elements of pottery assemblages and thereby also between clay preparation methods and clay recipes.

Finally, materials science approaches are discussed in chapters 5 (Kreiter *et al.*) and 9 (Saridaki *et al.*) that
emphasise themes such as technological continuity and change. In particular, Chapter 5 aims to trace the ceramic technology of major vessel forms at the Neolithic site of Balatonszárszó-Kis-erdei-dülő (c. 5350-4900 BC), with a focus on choices in raw materials and tempers to assess the changes in technological practices through different chronological horizons of the site. Chapter 9 investigates four Neolithic settlements in Pieria (northern Greece) and covers almost the whole span of the Neolithic period in the region, from the earliest phases to the early Late Neolithic (6700/6500-5000/4900 BC). This work combines diachronic and synchronic approaches, comparing pottery from different phases of each site with pottery from within a single phase.

Concluding Remarks

The variety of approaches, perspectives, and themes presented in this volume successfully capture the diversity of present-day Balkan pottery studies. This volume will hopefully serve as a reference for those interested in the production and technology of prehistoric and later ceramics. In addition, it offers insights on the past and present inhabitants of this rich and diverse region that is becoming a new laboratory for the burgeoning field of pottery technology. By gathering these different contributions, this volume ultimately attempts to compare varying perspectives that aim to trace pottery-making recipes. These embody aspects of human behaviour that are key to understanding people and their cultural traditions (O’Brien et al. 2010). Processes of adoption and transfer of technology and ideas are crucial concerns for present-day archaeology. Archaeological material cultures represent phenomena that have emerged through mechanisms of cultural transmission and specific learning activities. A technological approach to the study of pottery has the potential to shed new light on mechanisms governing the diffusion of ideas that catalyse the formation of shared material cultures. This could facilitate the establishment of broader generalisations and the investigation of networks among social groups that share common ideologies regarding the production and appearance of objects and their co-occurrence.

The volume is primarily intended for scholars working on Balkan archaeology, but will also be of interest to those working on archaeological theory and pottery more generally, as it offers strong archaeological correlates and case studies of theoretical concepts that have undergone increasing reassessment in recent years. These include technological change, innovation, social boundaries, and cultural transmission. In addition, given such a wide-ranging exploration of theoretical issues cross-cutting single research fields, this volume will also appeal to academics working in cognate disciplines such as archaeometry and anthropology.

Bibliography


