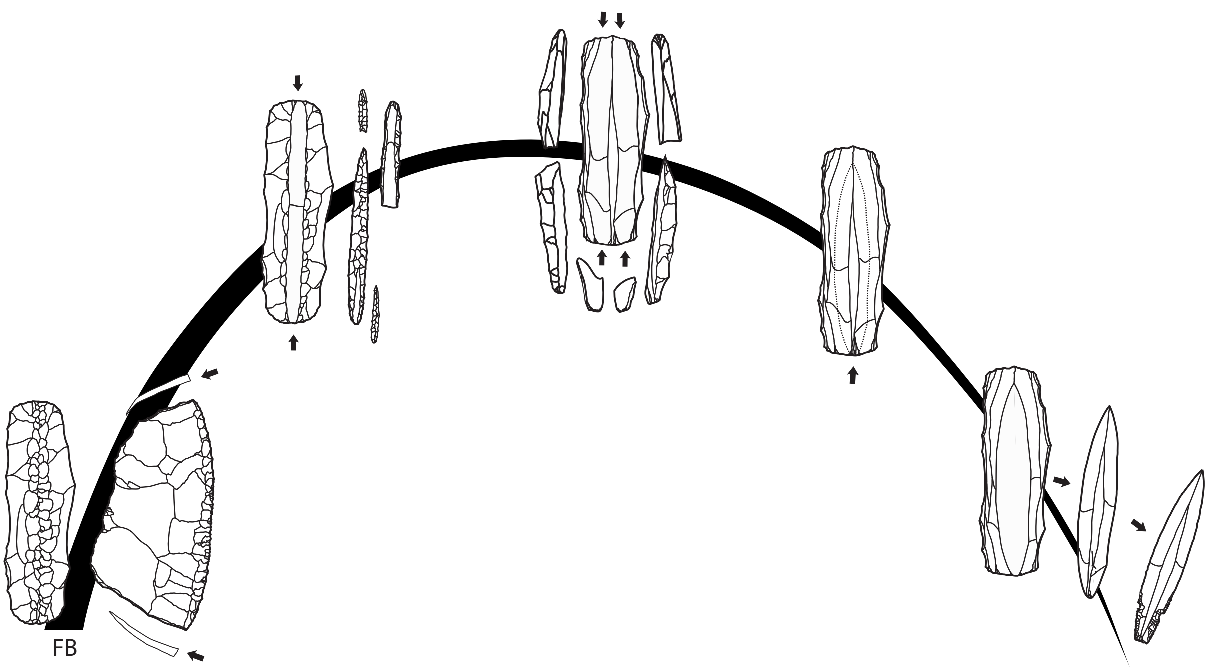
STUDIES IN MEDITERRANEAN ARCHAEOLOGY
VOL. CL

NEAR EASTERN LITHIC TECHNOLOGIES ON THE MOVE. INTERACTIONS AND CONTEXTS IN NEOLITHIC TRADITIONS

8th International Conference on PPN Chipped and Ground Stone Industries of the Near East, Nicosia, November 23rd–27th 2016

edited by

Laurence Astruc, Carole McCartney, François Briois
and Vasiliki Kassianidou



ASTROM EDITIONS
NICOSIA 2019

STUDIES IN MEDITERRANEAN ARCHAEOLOGY
Volume CL
Founded by Paul Åström

Cover image: Parekklisha *Shillourokambos,* Cypro-PPNB bipolar blade core technology
(drawing by F. Briois)

Published by Astrom Editions
Banérg 25 SE 752 37
Uppsala, Sweden
www.astromeditions.com

ISSN: 0081-8232
ISBN 978-9925-7455-3-1
Print: Bulls Graphics, Halmstad

This volume is dedicated to the late
Nikolaï Ottovitch Bader, Nur Balkan-Atlı, Edgar Peltenburg and Klaus Schmit

The opportunity to hear about ongoing field-work and new discoveries in parts of the Middle East—in spite of the devastation occurring elsewhere. Like our recently departed colleagues, whom we miss, we are united by a passion for prehistory. The PPN8 participants expressed this passion by reaching across ideological boundaries to share data, debate concepts and join in reveries that allow us to preserve the best of what makes the Near East so special to all of us.

Contents

Table of contents v

Editors' preface ix

List of contributors xi

Cyprus focus

1. Jean-Denis Vigne, François Briois and Jean Guilaine
Klimonas, the oldest Pre-Pottery Neolithic village in Cyprus 3

2. Alain Le Brun
Khirokitia on the move: a Late Aceramic Neolithic site in Cyprus 13

3. Jean-Denis Vigne, François Briois and Jean Guilaine
To what extent has insularity played a role in the Cyprus Neolithic transition? 19

4. Alan H. Simmons
No chipped stone is an island: a reimagining of the role of early Cyprus within the Neolithic world 31

5. François Briois and Laurence Astruc
Introduction, adaptation and development of the first Pre-Pottery Neolithic communities in Cyprus: the contribution of lithic industries in the Amathus area 45

6. Laurence Astruc and François Briois
Harvesting tools during the Pre-Pottery Neolithic in Cyprus 53

7. Carole McCartney and Giusi Sorrentino
Ayia Varvara *Asprokremnos*—a preliminary analysis of stone tools used in pigment processing and tanning with ochre 63

8. Jérôme Robitaille and Vasiliki G. Koutrafouri
'Message in a wall': macrolithic tools within PPNA constructions at *Klimonas* in the light of ethnoarchaeological evidence 79

9. Jérôme Robitaille and François Briois
Pebbles used as retouchers/compressors during the PPNA at Ayios Tychonas *Klimonas*, Cyprus 95

10. Renée Corona Kolvet
Ais Giorkis: reflections on an upland Cypro-PPNB ground stone assemblage 103

11. Shaun Murphy, Peter Bikoulis and Sarah T. Stewart
Finding the way: predictive modelling and the Early Neolithic in the eastern Troodos foothills of Cyprus 111

12. Theodora Moutsiou
Raw material circulation and the Early Holocene social landscape of Cyprus 119

Lithics in social and economic contexts

13. Dana Shaham and Leore Grosman
Engraved stones from Nahal Ein Gev II—portraying a local style, forming cultural links 133

14. Michal Birkenfeld, Lena Brailovsky-Rokser and Ariel Vered
'Ein Dishna, a new PPNA site in the Jordan Rift Valley, Israel 143

15. Sam Smith, Bill Finlayson and Steven Mithen
The end of the PPNA in southern Jordan: insights from a preliminary analysis of chipped stone from WF16 159

16. Dörte Rokitta-Krumnow
The chipped stone industry of Mushash 163: a PPNA/EPPNB site in the Badia/northeastern Jordan 173

17. Sumio Fujii, Takuro Adachi and Kazuyoshi Nagaya
Harrat Juhayra 202: an Early PPNB flint assemblage in the Jafr Basin, southern Jordan 185

18. Cristoph Purschwitz
The lithological landscape of the Greater Petra Region, Southern Levant. Availability of chert and other abiotic resources 199

19. Cristoph Purschwitz
Socio-economic changes in flint production and consumption among the PPNB lithic economies of the Greater Petra Region, Southern Levant 213

20. Nurcan Kayacan and Çiler Algül
A knapping area in an 8th millennium BC building at Aşıklı Höyük, east-central Anatolia 227

21. Semra Balcı
The obsidian industry of Pre-Pottery Neolithic levels at Tepecik-Çiftlik, central Anatolia 235

Technology and specialisation

22. Osamu Maeda and Cinzia Pappi
Bladelet production by pressure-flaking at the Proto-Neolithic site of Satu Qala in Iraqi Kurdistan 249

23. Ferran Borrell, Juan José Ibáñez, Juan Muňiz and Luís Teira
The PPNB chipped stone industries from Kharaysin (Zarqa Valley, Jordan): preliminary insights 257

24. Frédéric Abbès
Production de lamelles et de microlithes dans le Bal'as : un nouveau faciès du PPNA en Syrie 267

25. Christoph Purschwitz
A MPPNB bidirectional blade workshop at Shkârat Msaied, Southern Levant 277

26. Maya Oron, Ron Lavi and Joel Roskin
Mitzpe Ramon: a flint quarry and blade production workshop from late PPN to early PN in the Negev, Israel 287

Innovative stone technologies in the development of agricultural practices

27. Itay Abadi and Leore Grosman
Sickle blade technology in the Late Natufian of the Southern Levant 295

28. Fiona Pichon
Utilisation des outils en silex pour l'exploitation alimentaire et artisanale des végétaux à Dja'de el-Mughara durant le PPNB ancien (Syrie, 9ème millénaire) 305

29. Lena Brailovsky-Rokser and A. Nigel Goring-Morris
Pre-Pottery Neolithic B sickle blades in regional context: evidence from Galilee 323

Continuities and discontinuities

30. Iris Groman-Yaroslavski
The emergence of a blade-oriented industry during the PPNA—technology embedded in a Natufian concept 343

31. Tobias Richter and Maria Mawla
Continuity and discontinuity in the Late Epipalaeolithic (Natufian): the lithic industry from Shubayqa 1 359

32. Theresa Barket
Flaked-stone assemblage variation during the Late Pottery Neolithic B at 'Ain Ghazal: what could it mean? 369

33. Ferran Borrell, Fanny Bocquentin, Juan Francisco Gibaja and Hamoudi Khalaily
Defining the Final PPNB/PPNC in the Southern Levant: insights from the chipped stone industries of Beisamoun 381

34. Stuart Campbell and Elizabeth Healey
The obsidian from Umm Dabaghiyah, a Proto-Hassuna site in northern Mesopotamia 401

35. Danny Rosenberg, Iris Groman-Yaroslavski, Rivka Chasan and Ron Shimelmitz
Additional thoughts on the production of Chalcolithic perforated flint tools: a test case from Tel Turmus, Hula Valley, Israel 415

Interactions and diffusion beyond the PPN

36. Nigel Goring-Morris and Anna Belfer-Cohen
Packaging the Levantine Epipalaeolithic: a view from the Negev and Sinai 429

37. Makoto Arimura
Some reflections on the obsidian 'Kmlo tools' of the Early Holocene culture in Armenia 449

38. Bastien Varoutsikos and Arthur Petrosyan
Blade-making in Aknashen, Armenia, and the origins of the Neolithic in the southern Caucasus (7th–6th millennium cal. BC) 461

39. Yoshihiro Nishiaki and Farhad Guliyev
Neolithic lithic industries of the southern Caucasus: Göytepe and Hacı Elamxanlı Tepe, west Azerbaijan (early 6th millennium cal. BC) 471

40. Bogdana Milić
An addendum to the PPNB interaction sphere. The lithic package from 7th millennium BC Çukuriçi Höyük in western Anatolia 485

41. Denis Guilbeau and Burcin Erdoğu
Chipped stones from the earliest Neolithic occupation in the northern Aegean (Uğurlu, Gökçeada Island, ca 6800–6600 cal. BC) 503

42. Denis Guilbeau and Catherine Perlès
Please help us find the origins of Greek and Italian Early Neolithic lever pressure-flaking! 511

40
An addendum to the PPNB interaction sphere. The lithic package from 7th millennium BC Çukuriçi Höyük in western Anatolia

Bogdana Milić

Abstract

Neolithic chipped stone assemblages of the 7th millennium BC in western Anatolia are best represented by a strong blade component, a similar set of retouched tools and the use of obsidian combining Melian and Cappadocian sources in different proportions. Except for a few lithic scatters found during surveys, the period directly preceding the Neolithic has yet to be well defined for the entire western Anatolian coast. On the other hand, it can be said with certainty that Pre-Pottery Neolithic sites, which are known from other regions in Anatolia, are absent here. The tendency towards blade making that is demonstrated in the 7th millennium BC in western Anatolia contrasts with evidence for the Mesolithic sequence in the Aegean Basin, which is marked by a flake-based industry during the 9th and 8th millennia BC. This contrast implies that the Neolithic package, understood as a fully-developed village life with all of the accompanying elements entailed in the appearance of farming communities, did not result as an indigenous development.

Lithic technology, based on new data from Çukuriçi Höyük, is used here alongside subsistence strategies, materiality and symbolism to investigate the first colonisers of western Anatolia arriving from eastern regions. The site, located in the centre of the Anatolian Aegean coast, was occupied from ca 6700 cal. BC until the end of the 7th millennium BC and provides an insight into the Neolithic way of life in this area. The main feature of the Çukuriçi chipped stone assemblage is the extremely high amount of exotic obsidian and an abundance of standardised pressure blades in contrast to other contemporaneous settlements in the region of Izmir. The initial appearance of the pressure technique in Anatolia occurred in the 9th millennium BC but was limited to the southeastern region and Cappadocia. It seems the diffusion of the pressure technique into the other regions of Anatolia took place only after two additional millennia. The emergence of pressure blade making in western Anatolia is now confirmed at Çukuriçi Höyük in the first half of the 7th millennium BC with suggested origins in Upper Mesopotamia. This paper presents an in-depth analysis of the lithic technology from the site, which is used as a source for information pertaining to mobility, migration and the diffusion of know-how and transfer of knowledge. In addition, the lithic industry from central parts of the Anatolian Aegean coast is viewed in a wider context to question the character of the 'lithic package' that appeared in the 7th millennium BC. In particular, evidence concerning specialisation and certain practices can be understood by addressing how technological innovations spread alongside the first farmers. Finally, this paper aims to show how a single pottery Neolithic site of the 7th millennium BC relates to the 'PPNB interaction sphere', yet shows a way of life that is integrated into a completely different Neolithic world.

Introduction to western Anatolia and cultural background

The Neolithic lithic industry of western Anatolia

The Neolithic period of western Anatolia is defined through the occupation of coastal and inland habitats during the 7th millennium BC. The region's known sites spread from the Marmara Sea in the north to the Anatolian Aegean coast in the west, and Mediterranean coast and Lakes District in the south. An inland eastern fringe of the western Anatolian Neolithic, however, remains unclear due to the lack of reported sites, though an artificial border can be drawn between the modern towns of Eskişehir and Burdur. Despite the clear regionality demonstrated when considering the northwest, southwest and central-western parts of Anatolia separately, there are several key features that all these regions have in common regarding their lithic assemblages. These shared elements can be seen in aspects of the chipped stone assemblages, including the predominant production of blade blanks, the use of exotic raw materials, i.e. obsidian from Melos and Cappadocia, and similar toolsets consisting of retouched blades, sickle inserts, end- and circular scrapers and drills. The virtual absence of burins and

From *SIMA* 150. L. Astruc, C. McCartney, F. Briois, V. Kassianidou (eds), *Near Eastern Lithic Technologies on the Move. Interactions and Contexts in Neolithic Traditions*
 ISBN 978-9925-7455-3-1

projectile points is reported from the sites around the Sea of Marmara, where it is stated that the use of circular scrapers goes hand-in-hand with bullet core technology (Gatsov 2003, 2009; Gatsov & Nedelcheva 2011). A strong blade component is expressed through technologies concentrated on the use of both the pressure technique and direct percussion, while the role of indirect percussion remains poorly understood in the wider region. These elements of the lithic industry were previously known from sites dating to 6500 cal. BC onwards in western Anatolia. The Early Neolithic lithic industry, however, has not been clearly defined due to the small number of known sites occupied during the first half of the 7th millennium BC. This paper seeks to provide new data for this poorly known phase from the centre of the Anatolian Aegean coast, using the pottery Neolithic site of Çukuriçi Höyük as a case study.

Analyses of chipped stone assemblages from this region rest on a few important questions: 1) the character of the assemblages from single sites, 2) the nature of the lithic industry in comparison to that of the Izmir region (the coastal group of pottery Neolithic sites dated to the 7th millennium BC), and 3) the relationship between the coastal Neolithic and earlier periods of the Neolithisation process. In order to understand the latter, a crucial point to consider is the recognition of a pre-Neolithic sequence, specifically, whether a preceding Mesolithic period existed in the region and, if so, what was its cultural framework.

Diffusion or indigenous transformation

The western Anatolian coast has long been regarded as an 'empty' territory, devoid of evidence from the 9th and 8th millennia BC, in particular. The only Epipalaeolithic levels dated to the terminal Pleistocene have been reported from southwestern and northwestern Anatolia. The northwestern evidence refers to surveyed areas pointing to a few sites belonging to the so-called Ağaçlı group (Gatsov & Özdoğan 1994). In the southwest, there is the well-known evidence from the caves in the Antalya region providing long occupation sequences including the Epipalaeolithic (Storch *et al.* 1992; Otte *et al.* 1995; Kartal 2011). However, the Ağaçlı component has been recognised in the following Neolithic period in terms of chipped stone tool production, showing an influence from the East Marmara region (Gatsov 2001; Balcı 2011).

Sites clearly dated to the Epipalaeolithic and/or Mesolithic remain unclear in many aspects (see discussion in Milić 2018). Because focused investigation on the 9th–8th millennia BC is only a recent phenomenon, it is still true that the entire area of western Anatolia appears to have remained empty at this time. None-the-less, there are some newly-discovered sites, which could give more insight into the pre-Neolithic horizons of this region, for instance Girmeler in Fethiye province of southwest Anatolia (Takaoğlu *et al.* 2014). The latest survey results from the Karaburun Peninsula also have begun to fill the gap by demonstrating the existence of a Mesolithic component east of Izmir, where, for the first time, it became possible to talk about an extension of the Aegean Mesolithic to the western Anatolian coast (Çilingiroğlu *et al.* 2016; Çilingiroğlu 2017: 34). The Mesolithic period of the Aegean Basin, belonging to the early Holocene, namely, the 9th and 8th millennia BC, is well documented and has a very particular outline. A flake-based lithic industry represents the major element of the Aegean Mesolithic, together with the expedient use of flakes and the non-geometric character of the tools (Runnels 1995; Galanidou & Perlès 2003; Sampson 2010, 2014; Carter *et al.* 2016; Kozłowski 2016). Only occasionally, a minor blade component coincides with the main flake-based technology, but there is a complete absence of the pressure technique and bidirectional knapping systems used elsewhere for blade production. Additionally, these foragers were integrated into the Aegean obsidian distribution networks that continued in use to the later Neolithic period associated with sources from the island of Melos (Carter *et al.* 2018). The evidence from Karaburun, which lies close to the focus area of this paper, corresponds well with the previously described Aegean Mesolithic industry, sharing a very similar technology of tool production and choice of raw materials (Çilingiroğlu *et al.* 2016).

No Pre-Pottery Neolithic (PPNA, PPNB), known from other regions in Anatolia (e.g. the southeast) and throughout the Near East, has been attested in western Anatolia. Two surveyed locations, Çalca and Musluçesme, close to the coastal strip in the far northwest of Anatolia have been described as possible PPN contexts due to the lack of pottery and lithic scatters that resemble neither the local Epipalaeolithic or Mesolithic, nor the known Neolithic from the wider region (Özdoğan & Gatsov 1998). Yet, based on this evidence it was suggested that these sites might attest to 'forerunners' from the east, who arrived prior to what is regarded as the Neolithic westward expansion (Özdoğan 2008: 150). The closest confirmed PPNB or Aceramic sites to the western coast are located in central Anatolia, where lithic assemblages with a blade component involving bidirectional knapping systems are well-known (Balcı 2013). Until recently, western Anatolia, whilst not completely excluded, has been characterised as a periphery to the Neolithic core zone, yet this region has begun to be seen as another core area concerning the spread of the Neolithic to southeastern Europe (Özdoğan 2010: 427).

Early Neolithic sites from western Anatolia, dated to the first half of the 7th millennium BC, show only a minor role for pottery in the initial stages of occupation, while structures had red painted floors or were often both painted and plastered, as at Ulucak, Çukuriçi and Barcın Höyük (Horejs *et al*. 2015; Çevik & Abay 2016; Gerritsen & Özbal 2016). Though not equating to the nature of PPN sites, features like the plastered and painted floors imply a relationship to the PPNB or Aceramic tradition of the core zone. The term Aceramic Neolithic was proposed and used by several authors to address the distinctly regional developments of the Neolithic of the 9th and 8th millennia BC in central Anatolia in contrast to the Pre-Pottery Neolithic (PPN) in the Levant and southeastern Anatolia (see Özbaşaran & Buitenhuis 2002). On one hand, the architecture at some sites in the west shows building continuity related to superimposed houses at Neolithic Çukuriçi Höyük (Brami *et al.* 2016) that can be linked with evidence of technology and subsistence strategies at this site to show similarities with the eastern regions in the Levant and Upper Mesopotamia (Horejs *et al.* 2015). In contrast, the lithic assemblages of the western Anatolian Neolithic have been singularly observed independently from PPN contexts being outlined, as a very separate 'western' framework.

Bearing in mind the significantly different cultural outline of the pre-Neolithic sequence in the Aegean Basin and inland western Anatolia, despite the spread of farming (including a demic diffusion) in a westward expansion of the Neolithic in the beginning of the 7th millennium BC (Özdoğan 2008; Burger & Thomas 2011), additional cultural elements defined in terms of migration from the east should be questioned in the context of western Anatolia. Thus, while being aware of current chronological and geographical discrepancies, this chapter aims to address and evaluate the connections between the eastern PPNB and the western Pottery Neolithic in Anatolia in terms of the chipped stone, which, as noted above, includes not only the comparison of isolated types, but also the transmission of technological concepts in production, subsistence and accompanying elements of material culture.

The Çukuriçi Höyük case study

Çukuriçi Höyük is a tell site located at the centre of the western Anatolian coast (**Fig. 1**), which provides a long-lasting occupation from the Neolithic to the Early Bronze Age 1 period (7th to the 3rd millennia BC) with a hiatus during the Chalcolithic (Horejs 2012, 2017). The Neolithic is documented by six settlement phases labelled XIII–VIII from oldest to youngest. Çukuriçi is clearly a Pottery Neolithic site with its earliest C14 dates assigning the settlement foundation to 6684 ± 28 cal. BC according to the Gaussian Monte Carlo Wiggle Matching method (Horejs *et al*. 2015). According to the chronological terms used for western Anatolia (Clare & Weninger 2014), the Neolithic occupation of the site speaks in favour of the presence of both the Early and Late Neolithic. The Early Neolithic phases at Çukuriçi Höyük are dated between 6680 and 6600 cal. BC in phase XIII and from 6600 to 6500 cal. BC during phase XII. The Late Neolithic conventionally refers to the period around 6500 cal. BC, which at the site includes phases XI (6500–6400 cal. BC), X (6400–6300 cal. BC), IX (6300–6200 cal. BC) and finally phase VIII (6200–5970 cal. BC) (Horejs 2017: 17). Importantly, Çukuriçi Höyük was a coastal site in prehistory showing a preference for marine resources as part of the subsistence economy and in the procurement of exotic raw materials (Horejs *et al.* 2015; for the reconstruction

Figure 1. Map with sites mentioned in the text

of the coastline see Stock *et al.* 2015). Çukuriçi stands amongst the rare sites in western Anatolia attesting to occupation in the Early Neolithic, which seems to be characterised by regional differences during the first half of the 7th millennium BC. In contrast, the plethora of sites contributing to the understanding of the Late Neolithic of western Anatolia during the second half of the 7th millennium BC shows a diversity of cultural features viewed together as the developed phase of the Neolithic.

The main goal of this paper is to define the character of a local western Anatolian lithic industry, based on the techno-typological resemblance of assemblages from this region (following Barzilai 2013: 67), and to relate it to a wider context using the hypothesis that there is a 'lithic package' composed of elements that derive from elsewhere not already incorporated in the local pre-Neolithic sequence. In order to address the aforementioned questions, several steps are employed in this study based on the author's PhD thesis, dealing with lithics and the Neolithisation process as seen from the site of Çukuriçi Höyük in western Anatolia (Milić 2018). The chipped stone assemblage from the site was investigated through the study of raw materials employed together with technological and typological analyses of the artefacts produced, with a focus on understanding the mutual relations defined by a combination of these three aspects. The principal ideas are outlined by defining technological choices and toolsets, both of which are strongly correlated to the choice of raw materials used. In addressing the bigger picture, general trends revealing the knapping systems and techniques used were employed in the description of particular features belonging to the sites discussed in the paper.

The lithic assemblage from Neolithic Çukuriçi Höyük—towards a general overview

The key factor that should be addressed regarding the lithic assemblage of Çukuriçi Höyük (ca 18,000 artefacts) is the extremely high proportion of obsidian (taken to be an exotic material) throughout the entire sequence (up to 86%) within the assemblage (**Fig. 2**). In contrast, published data from contemporaneous sites in the region, such as Ulucak, Yeşilova Höyük and Ege Gübre, show the opposite with obsidian amounting to between only 3% to 36% in assemblages belonging primarily to the Late Neolithic dating after 6500 cal. BC (Derin *et al.* 2009; Derin 2012; Sağlamtimur 2012; Milić 2014; Çevik & Abay 2016: 192). The only exception in the region comparable to Çukuriçi Höyük is the site of Dedecik Heybelitepe, where obsidian comprises 50% of the assemblages in addition to chert and other knappable materials (Herling *et al.* 2008: 28). Yet, the material recovered from the latter site dates to the Late Neolithic and Early Chalcolithic phases at the end of the 7th and beginning of the 6th millennia BC. Interestingly, chipped stone production at Çukuriçi Höyük relied on obsidian procured from the great distance of 280km via sea routes, and should, therefore, be regarded as belonging to a supra-regional source area (Schwall *et al.* in press). Provenance studies on obsidian conducted using Neutron Activation Analysis (NAA) and pXRF (by E. Pernicka and Lisa Peloschek respectively) establish the exclusive use of Aegean sources located on the Cycladic island of Melos. On current evidence Cappadocian sources (Nenezi and Göllü Dağ) appear in the Çukuriçi assemblages only after 6500 cal. BC and were always extremely rare (Milić 2018). The use of Cappadocian obsidian sources most likely relates to connections between western and central Anatolia based on an occasional exchange of ready-made products recorded in the form of fragmented blades and flakes. The Melian obsidian sources were the dominant choice of raw material used in tool production with significantly lower proportions of cherts. The only major shift in raw material utilisation that occurred was recorded between the foundation of the settlement (phase XIII), where obsidian made up only 33% of the assemblage, jumping to 68% in the subsequent phase XII. Consequently, the beginning of the settlement shows a greater utilisation of chert when compared to any later phase, though the more rare but significant use of clear quartz (rock crystal) is shown only in the initial phase (**Fig. 2**).

The initial occupation is best understood as an integration of newcomers into a new network resting on the use of the Aegean obsidian sources (Horejs *et al.* 2015). Investigation of chert raw materials combined with a survey of sources in the vicinity of the settlement informed on the use of different varieties. Based on microscopic investigations and further geochemical analysis following the Multi Layered Chert Sourcing Approach (see Brandl 2016), preliminary results suggest there is a range of chert varieties both local and regional whose scale of use increases towards the end of the Neolithic. However, the use of different raw material varieties from the beginning of the settlement might speak in favour of a pioneer perspective with searches for sources made prior to settling in the region.

Early and Late Neolithic production and tool use

The shift in raw material use between the first and second Early Neolithic phases (XIII and XII) at Çukuriçi Höyük runs in parallel with changes in the production and use of tools. The dominance of blade production within the lithic technologies is recorded from the beginning until the end of the Neolithic sequence of the site. However, a slightly different outline in phase XIII was determined by the choices and accessibility of obsidian showing lower numbers of obsidian blades and flakes. Although the

Çukuriçi Höyük chipped stone assemblage	Early Neolithic (6680–6500 cal. BC)		Late Neolithic (6500–5970 cal .BC)			
	Phase XIII	Phase XII	Phase XI	Phase X	Phase IX	Phase VIII
Obsidian	33%	68%	80%	83%	85%	86%
Chert (and quartz)	54% chert 13% quartz	32%	20%	17%	15%	14%
No. of artefacts	216	301	2859	6127	4997	3360
Total amount	17,860 pieces (obsidian+chert)					

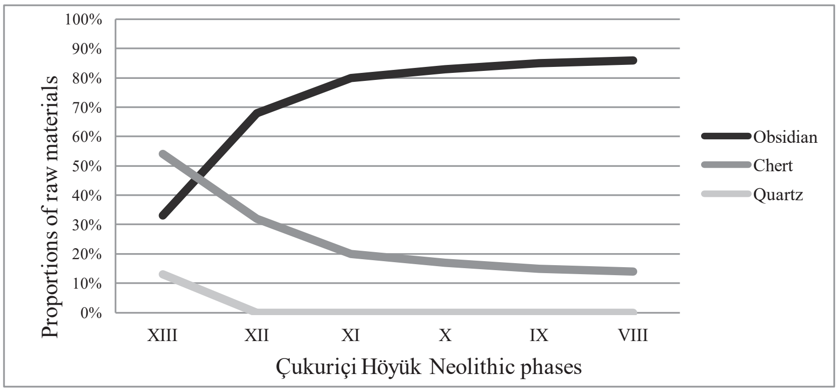


Figure 2. Proportions of obsidian, chert and clear quartz (rock crystal) used in chipped stone tool production through the Neolithic sequence of Çukuriçi Höyük

assemblage from the settlement foundation (phase XIII) is very small, technological analyses of obsidian, chert and quartz provided insights on the variety of production techniques (**Fig. 2**). The presence of cores, core preparation and rejuvenation elements, flakes and debris attest to tool-making on site. Significantly, the technical stigmata regarding regular blades demonstrate that knowledge of pressure blade making from obsidian existed from the very beginning of the settlement, phase XIII, until the end of the Neolithic sequence. Tool use in the earliest phase was constrained by raw material selection and technology.

In the beginning of the Early Neolithic, a number of combination tools suggest the idea of keeping certain raw materials in use as long as possible by re-using tools as indicated by repaired working edges. Additionally, there are several tool types, such as foliate points and lunates, appearing only in this phase (Horejs *et al.* 2015). The technological and typological shift within the Early Neolithic was shown through the comparison between phases XIII and XII. The latter shows more clearly that the focus of knapping on the production of blade blanks increased once obsidian reached the greater percentage in the assemblage. At the same time, clear quartz known only from phase XIII comprising completely exhausted small cores, micro-blades and small flakes, was fully abandoned afterwards, possibly in favour of the established introduction of obsidian raw material to the site. Only a couple of cores have been documented in the Early Neolithic, which has to do with small assemblages in the first two phases. However, the representation of cores in the later phases of the Neolithic at Çukuriçi Höyük (after 6500 cal. BC) does not exceed 1% in both obsidian and chert raw materials. The low number of cores can possibly be explained through the complete reduction of nodules, especially with exotic raw materials, but also as an outcome of a specialised pressure-flaking resulting in high numbers of blade(let)s and micro-blades from a single core reduction. At the same time, this could have also influenced the relatively small proportions of debris and waste products at the site in general (3–13% in obsidian and 1–5% in chert during the Early Neolithic, and 4–16% in obsidian and 2–15% in chert during the Late Neolithic phases).

The Late Neolithic assemblage (phases XI–VIII) was significantly larger, which permitted the understanding of the development of the Neolithic on the site. Obsidian core reduction systems demonstrate a clear blade-based technology completely dominated by pressure in the period after 6500 cal. BC when obsidian proportions reached more than 80% of the assemblage (**Fig. 2**). Meanwhile, although direct percussion, pressure-flaking and the less visible use of the punch technique speak in favour of regular blade production in chert, a flake-oriented technology emerged for this raw material (**Table 1**). Thus, the proportions of blade and flake blanks characterised the products made using each of the two raw materials during the Late Neolithic. It is possible that due to the specific needs of some tools, mainly scrapers and thick blades, chert production retained a minor blade component rather than being limited

Çukuriçi Höyük chipped stones	Early Neolithic (phases XIII–XII) 6680–6500 cal BC		Late Neolithic (phases XI–VIII) 6500–5970 cal BC	
	Obsidian	*Chert*	*Obsidian*	*Chert*
Technological features	Blade-oriented technology and production of blades by pressure and direct percussion (pressure modes 1–4)	Flake and blade production (direct percussion and pressure technique, modes 1–4) *quartz in phase XIII (production of micro-blades and small flakes)	Blade-based technology with dominant pressure technique (pressure modes 1–4). Appearance of complete long blades. Presence of wide blade fragments attesting to pressure-flaking by a lever (mode 5)	Flake-oriented technology and production of blades by direct percussion and pressure (modes 1–4). Presence of wide blade fragments attesting to pressure-flaking by a lever (mode 5)
Production techniques for blade making	56–62% pressure <4% direct percussion	32–41% pressure 15–54% direct percussion	48–66% pressure 0.8–3% direct percussion < 2% indirect percussion (large portion of undeter.)	22–50% pressure 7–12% direct percussion < 3% indirect percussion (large portion of undeter.)
Typological features	Retouched tools on blade and flake blanks, with more frequently retouched and used blade blanks	Retouched tools on blade and flake blanks. Appearance of combination tools and single examples of projectile points and geometric microliths (lunates)	Retouched tools mainly on blade blanks. Higher typological variety concerning retouched blades, scrapers and drills, including the appearance of backed bladelets and projectile points. Up to 30% retouched and used tools	Retouched tools on flake and blade blanks, with more frequently used flake blanks. Higher typological variety concerning retouched blades, scrapers and drills, including regular appearance of projectile points. Up to 30% retouched and used tools

Table 1. The overview of technological and typological features from the Early and Late Neolithic at Çukuriçi Höyük

to flake tools alone. Finally, the high number of chert flakes was influenced by on-site production with flakes comprising largely by-products. The knapping of obsidian was primarily limited to blank production after initial core preparation in the Late Neolithic phases. Core preparation and roughing out pre-forms are missing and most likely occurred elsewhere, possibly at the quarry itself, given the distance to the source and transportation costs. The introduction of already prepared or semi-prepared nodules and cores from the outcrops to the site can, therefore, be proposed as the pattern for obsidian blade production during the Late Neolithic at Çukuriçi Höyük.

Typological variability

In phases XI to VIII a high variety of blade cores was documented in both raw materials. Cores are mainly recorded in their exhausted forms, including different types such as wedge-shaped, conical, semi-conical and bullet cores, related to blade reduction. Blade(let) and micro-blade negatives on cores testify to the use of the pressure technique, supporting the evidence obtained from the majority of regular pressure blades from the same assemblages. Despite the fact that the majority of cores are unidirectional, several examples from the Late Neolithic phases suggest that some single-platform cores were turned for the purposes of complete reduction and extraction of the raw material, leaving bidirectional negatives. In-depth analysis of regular blades from the Late Neolithic at Çukuriçi Höyük gives secure evidence for the use of different pressure technique modes in both obsidian and chert raw materials, with the application of pressure from the hand, shoulder and a standing position using a long crutch (modes 1–4). The recognition criteria for different pressure technique modes follows the experimental study of Pelegrin (2012), based on the width sizes of regular blades.

From a diachronic point of view, a greater typological variety of tools is recorded for the Late Neolithic phases (XI–VIII) at Çukuriçi Höyük, especially around 6400 cal. BC (**Table 1**). The most important tools consist of blades and bladelets with retouched edges, blades with notches and truncations, more rarely denticulates, many end-scrapers and predominant circular scrapers, which were available in both raw materials. It is striking that the number of macroscopically unused obsidian blades became very high in comparison to retouched blades, while sickle inserts (recognised from macroscopic silica sheen) made on chert blades (and flakes) were extremely rare in the entire Neolithic sequence. The latter corresponds with results of the palaeobotanical evidence, where the lack of sickle elements goes hand in hand with the absence of threshing remains within the excavated sector (U. Thanheiser *pers. comm.*). Apart from regular tool-sets in the Late Neolithic (**Table 1**), based on different types of retouched and used blades, end, semi-circular and circular scrapers, drills and a few additional tool types, such as projectile points and backed bladelets appeared more regularly (see below).

Comparison with the regional site group

More broadly, a contemporaneous regional group of sites, including Ulucak, Yeşilova, Ege Gübre and Dedecik Heybelitepe belonging to the central Anatolian Aegean coast with Çukuriçi Höyük throughout the 7th millennium BC, forms a cluster in the Late Neolithic based on the similarities extending beyond the differences in material culture (Horejs 2016). Across the regional group, the lithic industry follows a very similar framework, where, after 6500 cal. BC, one sees homogeneity in the record with a tendency towards blade making, the use of pressure technique and uniform toolsets. Although details of chipped stone production for the sites in the Izmir region have not been extensively published thus far, previously-mentioned general characteristics can be outlined (see Herling *et al*. 2008; Derin *et al.* 2009; Çilingiroğlu *et al*. 2012; Derin 2012; Sağlamtimur 2012; Çevik & Abay 2016). The aforementioned contrasting ratios of obsidian to chert from these sites in relation to Çukuriçi Höyük likely influenced the internal variability regarding the involvement of certain techniques and tool types. As previously emphasised, the choice of raw materials played a crucial role in the formation of the local assemblage character through the accessibility, networks, procurement systems and economy enacted at each of these settlements (Milić 2018; Brandl in prep.). Similarly, the data for the Early Neolithic in this region, concerning the first half of the 7th millennium BC, is extremely scarce and more published data from Ulucak, the only site besides Çukuriçi with attested early dates, are needed for further correlation of lithic assemblages at the start of the Neolithic in central-west Anatolia. Though addressing the question of Neolithisation from the technological point of view regarding lithic assemblages is thus preliminary, it can provide significant insights for understanding the larger picture in which the western Anatolian Neolithic was embedded.

Specialisation in blade production

Because the production of regular blades by pressure technique took place at all contemporaneous sites in the Izmir region, there is a need to address the levels of lithic specialisation among the sites. The lithic assemblage from Neolithic Çukuriçi Höyük is ideal for tackling this question, given that obsidian blade blanks are far more numerous here than at other contemporaneous sites where flake blanks dominate. Specialisation, as referred to here, relates to production by highly skilled knappers. There are two important points that this section aims to address: 1) the degree of standardisation of blades and blade fragments, and 2) the production of long regular blanks using the pressure technique.

Blade standardisation

The differences in the primary production of blanks between obsidian and chert discussed above are supported by the approximate proportions of production techniques involved in blade making using these two raw materials (**Table 1**). The large number of pressure blades from the settlement has been detected using the established main features related to this technique (Pelegrin 2012). Other blades in the assemblage were knapped by direct percussion, more rarely indirect percussion and those for which detachment cannot be clearly determined. A small group of blades from phases XIII and XII shows that the pressure technique was employed in high proportions (56–62%) over direct percussion (not more than 4%) already from the Early Neolithic. Conversely, chert blades made with pressure in phase XIII (41%) decline in phase XII to 32%. In contrast, blades made using direct percussion (54%) represent over half of the blade assemblage in phase XIII, though direct percussion accounts for only 15% of blades in phase XII. During the Late Neolithic phases XI–VIII, a flake-oriented technology became characteristic of the chert assemblages, while the pressure technique still remains most frequent for the production of blades (up to 50%) over direct and indirect percussion (**Table 1**). Obsidian blade production is dominated by the pressure technique in the Late Neolithic technology, reaching 66% in the blade assemblages, with direct and indirect percussion far behind accounting for only 3% and 2% respectively (**Table 1**).

Complete blades are rarely preserved at Çukuriçi Höyük in both the Early and Late Neolithic with maximal recorded sizes of 160mm and 113mm in obsidian and chert respectively. On the other hand, intact blades are better represented in chert (14%) compared to obsidian (only 2%). The analysis of the length of blade fragments, produced by pressure, shows a dense grouping of blades between 3 and 4cm for obsidian blades, and somewhat smaller sizes for chert blades exhibiting the stigmata of pressure-flaking. Detailed analyses of the modes involved in pressure blade making by Pelegrin (2012) were based on the experimental replication of the technique by testing different body positions in correlation with applied body weight, and the use of different tools for the application of pressure. The distribution of blade widths for obsidian (3–27mm) and chert (3–22mm) pressure blades across the entire Neolithic sequence speaks in favour of the presence of all Pelegrins's modes (1–5), attesting to different levels of expertise used in the production of short and long blade(let)s at Çukuriçi Höyük. The information about pressure blade widths is still quite limited for the Early Neolithic phases XIII and XII; however, several regular blades in both obsidian and chert imply the use of standing pressure with a long crutch, alongside hand as well as shoulder pressure from the beginning of the sequence (Horejs *et al.* 2015). Nevertheless, the biggest concentration of widths related to larger assemblages in the Late Neolithic (10–14mm) speaks in favour of the dominant use of a short crutch in a sitting position during the pressure blade making process on the site. Organised knapping rhythms, attested by consecutive and non-consecutive detachments, with a repetition of the sequence '212' (although future analysis is needed to show the exact frequency of this sequence in comparison to others), illustrate a systematic order of core reduction (Milić & Horejs 2017: 35).

Pressure technique

Apart from the extreme standardisation in terms of blade sizes, the highest proportion of fragments consists of medial segments exhibiting trapezoidal and less frequently triangular and multifaceted sections. The analysis of fragmented obsidian blades (comprising 89% of the obsidian blade assemblage), especially following phase XIII, demonstrates that the large majority of fragments corresponds to old intentional breakages implying the sectioning of blades into standardised parts to obtain the regular, thin medial sections, free from thicker proximals containing the bulb of percussion. This is supported by two pit complexes in the latest Neolithic phase VIII at Çukuriçi Höyük, where large numbers of snapped, discarded proximal ends were recovered. The function of standardised pressure blade segments, scattered through all contexts of the settlement in both interior and exterior areas, remains unclear at Çukuriçi since most do not show any macroscopic traces of use. The previously proposed role of standardised blades as sickle elements (Horejs 2012) does not seem to be the solution at Çukuriçi due to the lack of traces (for example a matte surface) or characteristic patterns observed for chert blades recognised as sickles from the settlement (Milić 2018). These standardised obsidian blade segments, although not necessarily involving high knapping skills, might speak in favour of a certain specialised production on site, especially after 6500 cal. BC related to a constantly high supply of obsidian, not shown with the chert varieties.

The application of standing pressure with a long crutch was recognised on a significant number of blades, especially in later Neolithic phases (X–VIII) at Çukuriçi, showing blade widths over 12mm in obsidian and 10mm in chert on both fragmented and intact obsidian and chert regular blade(let)s. Additionally, the longest pressure blades (based on completely preserved specimens) from the site were recorded in obsidian from the Late Neolithic phase X reaching the maximum length of 160mm. The existence of large blades, produced with the support of a lever, fitting the complex mode 5 recognised by Pelegrin (2012), remains particular to Çukuriçi Höyük. According to Milić and Horejs (2017: 38), the widest regular blades made by the pressure technique for both obsidian and chert, which show widths of 23–27mm for obsidian and 20–22mm for chert, belong to the final Neolithic of the site, phase VIII, representing the products of highly skilled blade production. However, the widths of the Çukuriçi blades are just on the border between standing pressure with a long crutch and lever pressure according to experimental knapping criteria (Pelegrin 2012: 479; C. Perlès *pers. comm.*). More evidence is needed to rule out the regular use of lever pressure at the site. No matter how these blades were made, the ability to detach such large, highly standardised blades should be ascribed to specialist production. Similarly, the second question regarding the intentional breakage of long and large blades requires the understanding of fracture patterns, which need to be investigated in greater detail. Certain large blades seem to attest to the use of a direct blow from the dorsal side of the blank, observed on some of the proximal ends and thickest parts of the blades.

Though there is enough evidence to claim the knapping of pressure blades on-site, the preservation of particularly large cores is not attested thus far from Çukuriçi, which currently limits the understanding of large blade production. On the other hand, core preparation and rejuvenation elements (large crested and lateral blades), as well as blade cores with notched ends implying the immobilisation of the cores on the ground, speak in favour of the local application of pressure using a short and long crutch within the settlement. Core types related to the pressure technique from the Neolithic levels, especially spread throughout the Late Neolithic phases, include conical, semi-conical, rare wedge-shaped examples and finally bullet cores (Milić & Horejs 2017). The shape and size of the cores in their final stage (up to 55mm) are dependent on the organisation of the knapping production, where carefully-planned sequences of reduction are attested to by regular negative patterns in many examples of completely exhausted cores. However, it is interesting to observe that very few real bullet cores were recorded throughout the Neolithic occupation of the site. The latter might be related to the production of blade(let)s by modes 3 and 4, while successive core reshaping (for maximum raw material utilisation) resulted in the extraction of shorter blades towards the end of the reduction. Finally, the preliminary analysis which compares the total weight of obsidian from the settlement with the number of cores and regular pressure blades in the same material correlates with the idea of specialisation by local knappers, being able to produce a high number of regular blade(let)s and micro-blades from single cores in an organised system of knapping. This would also explain the abundance of blades related to relatively small amounts of obsidian brought to the site.

The cache of long obsidian blades

One of the most important *in situ* lithic finds from

Çukuriçi Höyük is a cache of long obsidian blades, excavated from a phase X house floor adjacent to the wall, dated to 6400–6300 cal. BC. The cache (**Fig. 3**), comprising 18 intact, unused blades, was buried with a shaft straightener, and most likely deposited in a bundle with the distal ends of the blades facing the ground. The preliminary analysis of the context, deposition and technological features of the blades from the cache suggested an interpretation of a possible offering to the building (Horejs *et al.* 2015: 318–319). Further study gives detailed information about the composition of the cache. Thirteen of the blades were securely ascribed to the pressure technique using detachment from a standing position with a long crutch (mode 4). Five additional blades from the cache were significantly wider and somewhat shorter (**Fig. 3**). The analysis of blade shapes and blade butts shows that the thicker blades were related to indirect percussion with an antler punch used to shape a large conical core with inclined knapping surfaces into one with a straighter form for further detachment using pressure. The longest pressure blade in the cache was 160mm and 22mm wide. Two groups of refitted pressure blades, one connecting three and the other four specimens, imply that the cache blades most likely come from the reduction of a single core. However,

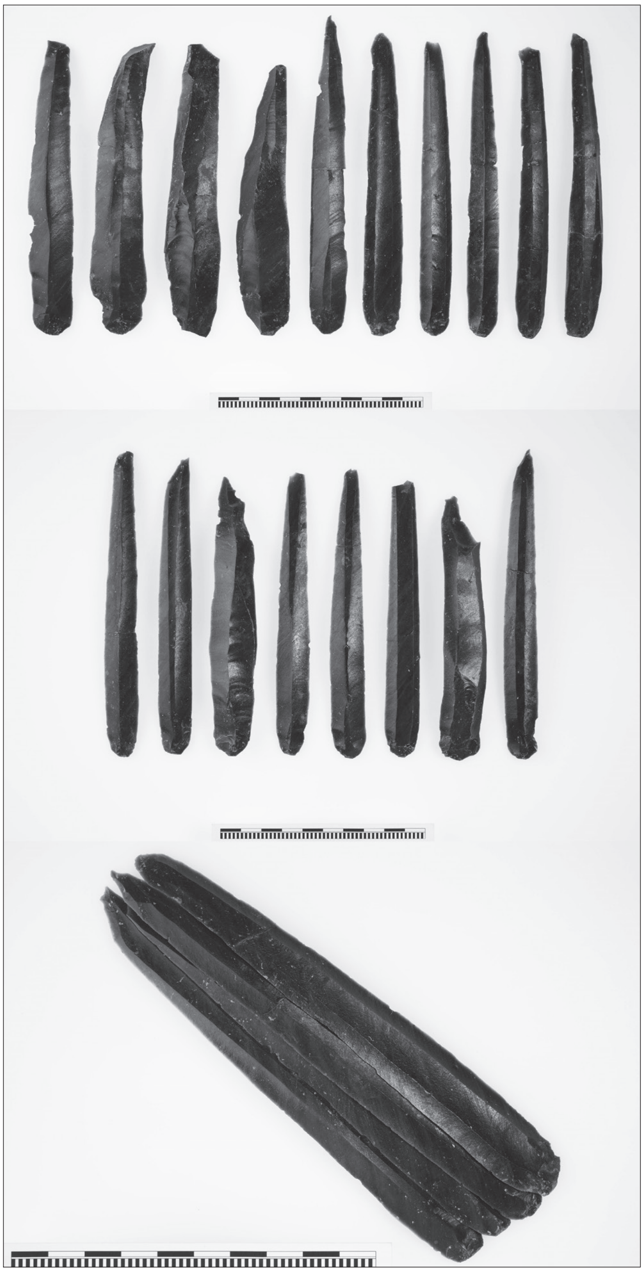


Figure 3. The content of the cache of obsidian blades (with 13 pressure and five indirect percussion blades) from Çukuriçi Höyük phase X (6400–6300 cal. BC) and the refitting of four of them (© ERC Prehistoric Anatolia. Photos by Niki Gail)

it is clear that not all the blades from the sequence, which must have included a greater number of blade blanks, ended up in the cache.

Further excavation of the same house provided four additional long blades with lengths of 110.3–143.5mm and widths of 19–20mm, excavated from two different floors in two groups of two blades (Milić & Horejs 2017: fig. 2.6). All four blades were broken, missing their distal ends. Technological details indicate that the same pressure mode 4 was used in the production of these blades. At the same time, the provenance studies identified the same source of obsidian (Adamas in the Melian outcrop) used for these four blades and for the 18 complete blades from the cache. The intended use of the four slender long blades outside of the cache is suggested by their segmentation by snapping the length into several parts and might be the reason for not depositing them in the cache. Two of the cached blades showed notches, but it is unlikely they were intended to be modified into retouched tools, given the extreme fragility of the complete blades. Alternatively, the notches might have been prepared for the purpose of dividing long blades into shorter medial segments possibly with a side-blow technique prior to the decision to place them in a special depot. Although it remains unclear whether these four blades belonged to the same reduction sequence with the cache blades, the house from phase X so far represents the most exceptional context regarding the deposition and preservation of obsidian blades at Çukuriçi Höyük.

The distribution of obsidian pressure blade widths and thicknesses from the Late Neolithic phases XI–VIII shows that a certain number of wide blades fit the width distribution pattern for obsidian blades from the cache (**Fig. 4**). However, the predominance of somewhat slender blade(let)s from the common assemblages makes the size of the cache blades unique. Additionally, apart from significantly wider blade fragments (with maximal widths of 27mm in obsidian) mentioned above, possibly speaking in favour of the presence of lever pressure at the end of the Neolithic on the site, there are several fragments with widths slightly below 30mm that should for the present be taken as outliers of possible pressure blades due to bad preservation and fragment size (**Fig. 4**).

Together the blades from the cache and the four other long blades from the same house support the idea that a high portion of blades from the Neolithic contexts could have been produced as long blades, and subsequently divided in a highly standardised way into shorter segments (3–4cm in length). In light of evidence for on-site production of pressure blades, the principal idea is that the specialisation regarding the production of long blades was carried out by local artisans. A small workshop area in the same house, linked to the floor foundation horizon, contained a large crested blade among other fragments of obsidian blades which hints at the size of the first long blades produced, though the corresponding core was not found in the same context. The deposition of the blade cache is not the sole example of burying special items. Another cache of numerous slingshot stones and a tool deposit consisting of oversized, large chert scrapers together with a few obsidian blades were found on the same floor and in a wall niche respectively. The entire structure, without doubt, testifies to the craftsmen connected to this Late Neolithic house at Çukuriçi and argues in favour of specialist individual knappers or households (Milić 2018).

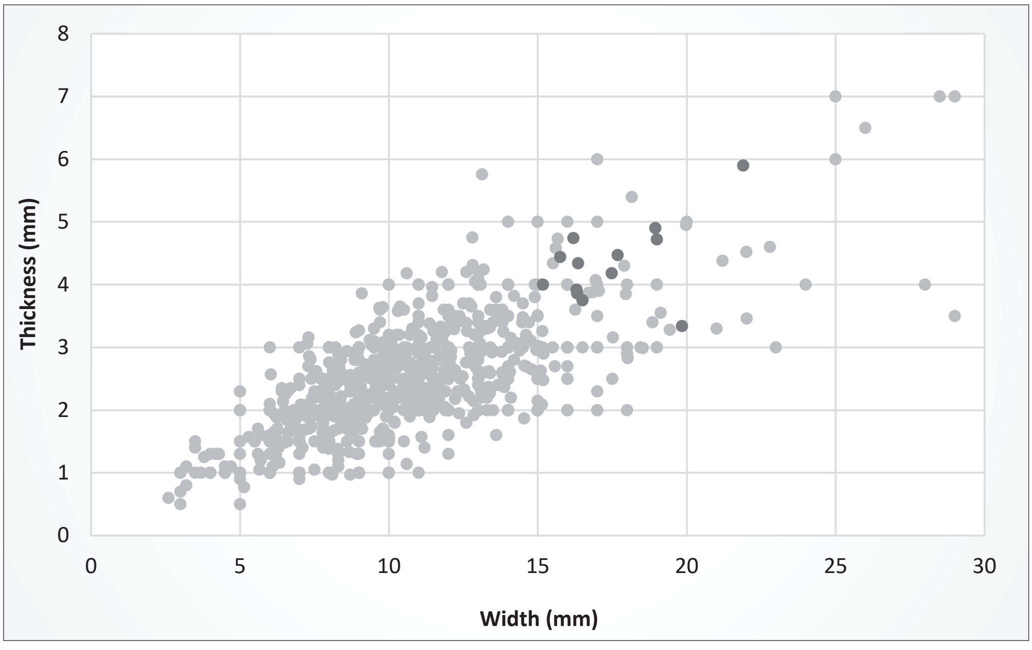


Figure 4. Distribution of widths and thicknesses for obsidian pressure blades: sample from the Late Neolithic (phases XI–VIII, 1499 items) Çukuriçi Höyük assemblage (light grey) and pressure blades from the cache of Çukuriçi phase X (dark grey)

Discussion—a lithic package from the east?

After the initial appearance of the pressure technique in Anatolia, in the 9th millennium BC, limited to the southeast region and Cappadocia (Binder 2007), its penetration into the other regions of Anatolia took place after only two millennia (see Milić & Horejs 2017: 29–30). Given the fact that the pre-Neolithic horizon in the Izmir region is closely related to the Aegean and that the newly recognised western Anatolian Mesolithic (9th–8th millennia BC) is flake-based, the appearance of a new, advantageous technique for blade production, i.e. pressure technique, must derive from elsewhere. It is very unlikely that the pressure technique, which involves significant know-how and skill, could arise in a place without this background of technological skill.

Supra-regional influences

The following text aims to address potential supra-regional influences in terms of the introduction of the pressure technique into western Anatolia, already discussed elsewhere (Milić & Horejs 2017), by only briefly depicting the technological trends during the PPNB in the broader area of interest with the focus on the period just preceding the onset of the Neolithic on the western Anatolian coast in the 7th millennium BC. Apart from the Cappadocian evidence, post 9th and pre-7th millennium BC in central Anatolia attested to a bidirectional blade technology (e.g. Binder 2007). The research shows that, after the interruption of the Kaletepe-Kömürcü workshop in the 9th millennium BC, pressure blade making re-appeared in central Anatolia not earlier than 6500 cal. BC based on the Çatalhöyük case study (Carter & Milić 2013). At the same time, western Anatolia and the case study of this paper demonstrate that pressure-flaking was introduced in the centre of the Anatolian Aegean already in the first part of the 7th millennium BC (around 6700 cal. BC), which puts it at least 200 years before the introduction in central Anatolia. This further speaks against the evidence that the knapping traditions just prior to 7th millennium BC in central Anatolia could be understood as the place of origin for the diffusion of the pressure technique to the west. Additionally, entirely different subsistence patterns suggest that the origin of the Neolithic in western Anatolia cannot be traced to central Anatolia (Horejs *et al.* 2015; Milić 2018).

Similarly, the region of the eastern Mediterranean including Cyprus, the Northern and the Southern Levant also relied on bidirectional and naviform knapping systems during the PPNB. This tradition remained in use especially along the Levantine coast for a very long time extending into the early Pottery Neolithic in the mid-7th millennium BC (Quintero & Wilke 1995; Abbès 2003; Barzilai 2010; Borrell & Khalaily 2016). Thus, this region provides negative evidence for the direction of the spread of the pressure technique westwards, although some of the major cultural elements and subsistence strategies of the Levantine corridor have been recognised as crucial for the emergence of the Neolithic in the Aegean Basin (Perlès 2001; Horejs *et al.* 2015).

Finally, Upper Mesopotamia, seen here as the large area including the Upper Euphrates and Tigris Valleys in southeastern Turkey and northern Iraq, the Middle Euphrates and additionally the Khabur and Balikh Valleys in Syria, speaks in favour of different knapping methods throughout the 9th, 8th and the beginning of the 7th millennium BC, where blade making by the pressure technique has been attested at a significant number of sites. Conical, wedge-shaped and bullet cores remained in use for a long time, until the 4th–3rd millennia BC, so by the end of the PPNB (Kozlowski & Aurenche 2005; Borrell 2007; Maeda 2009) the continuation of the pressure technique is observed after the PPN into the PN, especially in the eastern parts of this region (e.g. Wilke 1996; Binder 2007; Inizan 2012). This continuous pressure blade making, with the crucial influence in shaping the Neolithic blade technologies of the Upper Mesopotamia just after the PPNB, has, therefore, been suggested as a plausible origin for pressure blade making in the west.

This evidence goes alongside the production of long regular blades. Additionally, Guilbeau and Perlès (this volume) have addressed the very important question regarding the use of lever pressure and the origins of large blade production in Neolithic Greece and Italy during the 7th and early 6th millennia BC, again showing that the only comparative data comes from Upper Mesopotamia (southeast Anatolia and northern Syria) in the 8th and 7th millennia BC, bearing in mind the long chronological and geographical distance from this source to western Anatolia and the Aegean. In parallel with the Greek Early Neolithic data, the possible appearance of lever pressure blades, along with the use of pressure technique in mode 4 from western Anatolia dated to the 7th millennium BC, provides new evidence for the diffusion of blade production involving significant technological skills in production, while this phenomenon to date remains quite invisible in central Anatolia (Altınbilek-Algül *et al.* 2012). The evidence from Çukuriçi Höyük adds another point in the vast area between Upper Mesopotamia and the western Mediterranean, linking networks that rested on the exchange of the technological know-how (Perlès 2001; Binder *et al.* 2012; Milić & Horejs 2017).

Caches, depots and reserves (Astruc *et al.* 2003) are an element shown by PPN and rarely PN communities in the core area of Neolithisation (including the Near East and central Anatolia) that for the longest time remained absent from our knowledge of the western Anatolian Neolithic record. The cache of obsidian blades from Çukuriçi Höyük sheds new light on the special deposition of valuable items likely related to specialised knappers in the context of the mid-7th millennium BC. Caches from PPNB contexts in the Southern and Northern Levant and Cyprus consist exclusively of blades made using bidirectional knapping and the highly skilled naviform method characterising this period (Barzilai & Goring-Morris 2007; Briois 2007; Karnes & Quintero 2007; Khalaily *et al.* 2007, 2013). So far, the only cache that contains blades produced by the pressure technique relates to obsidian found at Sabi Abyad II in Upper Mesopotamia (Astruc *et al.* 2007). Finally, post-PPNB, i.e. 7th millennium BC blade caches were documented in western Syria and central Anatolia (Carter 2007; Rokitta-Krumnow 2013), still made employing bidirectional technology. Despite the chronological discrepancies, similar patterns regarding depositing items within the background of potential specialised production in western Anatolia could have been done in relation with the Near Eastern, i.e. Upper Mesopotamian evidence. This correlates with the preservation of a certain PPNB element in later contexts (Horejs *et al.* 2015: 319), involved in the spread of technical know-how and knowledge alongside the migration of farmers from east to west.

Toolsets

Following the suggestion that technological innovations spread towards western regions, another question of whether the technology comes alone or was accompanied by other elements is raised here. This issue can be investigated through the typological details of the Çukuriçi Höyük tools, which appear distinct relative to other Near Eastern evidence. As noted, the western Anatolian Neolithic assemblages share quite homogenous toolsets, especially in the central part of the coast during the period after 6500 cal. BC. The Çukuriçi toolset from the Early Neolithic (first half of the 7th millennium BC) is not particularly elaborate in terms of formal tools. This contrasts with Near Eastern toolsets assigned to the final PPNB/ beginning of the PN (end of the 8th and beginning of the 7th millennium BC), which exhibit a variety of formal tools such as projectile points, sickle blades and burins, and a greater variability of non-formal tool types including retouched blades and flakes, corner-thinned blades and SBBFs amongst others (Nishiaki 2000; Caneva *et al.* 2001; Coşkunsu & Lemorini 2001; Kozłowski & Aurenche 2005; Khalaily 2009; Vardi & Gilead 2011; Maeda 2013). The analysis of Late Neolithic (post 6500 cal. BC) chipped stone tools provided much more data for the understanding of the variety of tools in central-west Anatolia, which based on the Çukuriçi Höyük case study informed about use of blade(let)s and flakes with formal retouch, but also about the expedient manner of modifying blanks for the use of sickle blades and drills for instance.

However, there are certain tool types at Çukuriçi which can be classified as rare or exclusive in the context of western Anatolia, including its northwest and southwest parts. Backed bladelets are one such tool type. They were recorded at Çukuriçi from different Late Neolithic phases and were made mainly from obsidian with abrupt retouch applied exclusively on tiny micro-blades (**Fig. 5.6**–**7**). Based on the literature, backed bladelets are not reported from other sites in western Anatolia, but are very common in the Upper Mesopotamian and Zagros regions from the 10th to the 7th millennia BC (Kozłowski & Aurenche 2005: 128–129). Although this tool type can be another point of comparison between western Anatolia and these eastern regions, the functional aspect might be as well the reason for their production apart from the cultural tradition.

The most widely-debated tool type is related to hunting activities. To date, arrowheads are completely absent from the Marmara region in northwestern Anatolia during the Neolithic and are only occasionally reported from the Izmir region as single finds (e.g. Kolankaya-Bostancı 2014). Instead, excavated deposits of multiple slingshot stones at western Anatolian sites dated after 6500 cal. BC (Çilingiroğlu *et al.* 2012; Horejs 2016) support the suggestion that they replaced arrowheads in the role of projectiles in this region (Özdoğan 2002). However, projectile points were recovered at Çukuriçi Höyük, where they appear rather rarely in the beginning of the Neolithic (phases XIII and XII) and become regularly attested from phase XI onwards (in the Late Neolithic). They appear simultaneously at four of the five sites from the Izmir region (Milić 2018). Points from Çukuriçi Höyük do not represent uniform types, exhibiting variability in terms of raw material selection and size (ranging from 2–5cm). Features that connect them are the type of blank selected (primarily blades) and retouch which is almost always on the ventral side on both basal and distal ends (**Fig. 5.1**–**5**). These points do not have distinct tangs, but occasionally show notches, most likely related to hafting. A few exceptional examples from Çukuriçi look like shouldered points. Points from other sites in the Izmir region date primarily after 6500 cal. BC and in terms of size and forms can be understood as the same tool types. The only point known from the first half of the 7th millennium BC was found at Çukuriçi Höyük in the initial Neolithic occupation of the site, referring to phase XIII dated around 6700 cal. BC. It is a form of foliate point that is unique for the period (Horejs *et al.* 2015). The major significance of these points is their resemblance to examples from PPNA contexts in the Tigris basin, on sites such as Hasankeyf or Demirköy (Rosenberg & Peasnall 1998: 205; Miyake *et al*. 2012: 6), a very unlikely direct relationship considering the long chronological distance. At present it appears we are dealing here with a unique group of sites where distinctive points were produced and used in the 7th millennium BC in western Anatolia, contradicting the idea that arrowheads did not go west during the Neolithic expansion following the PPNB collapse

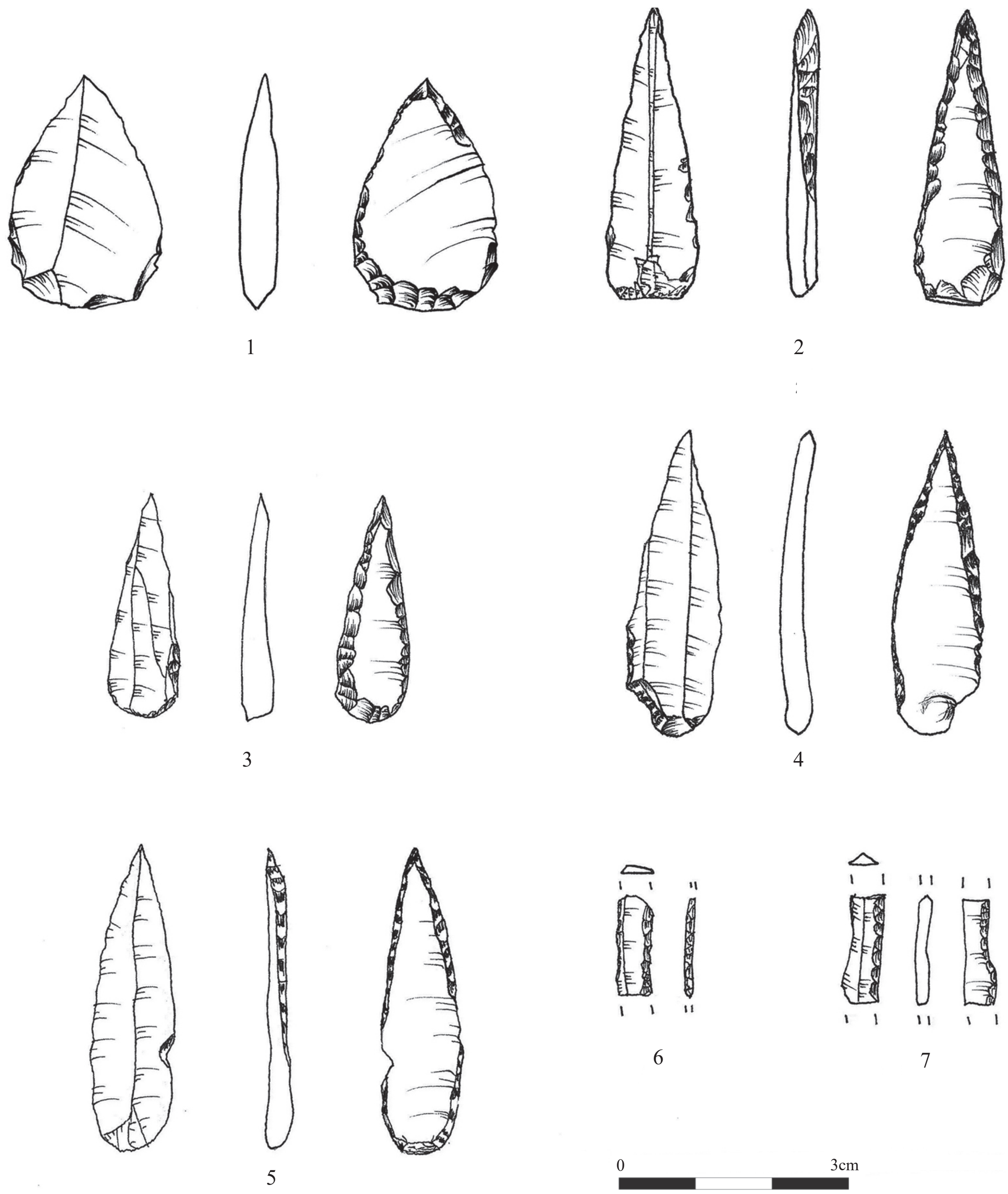


Figure 5. Points and backed bladelets from different Neolithic phases at Çukuriçi Höyük: XIII, jasper (1), X, obsidian (2), X, chert (3), IX, chert (4), VIII, chert (5), X, obsidian (6–7)

(Özdoğan 2002). Mersin Yumuktepe appears to be the westernmost point on the map where the PPN–PN Near Eastern arrowhead types (particularly the most widely distributed Amuq type) existed (Altınbilek-Algül 2011), although the extension all the way to the Lakes District could be debated in future (see Mortensen 1970; Duru 2012: figs 26, 50).

Conclusion

The attempt to draw a wider picture and reconstruct the diffusion of influences based on typological resemblance is difficult if one expects to uncover perfectly corresponding evidence that indicates direct connections between distant areas across a large span of time. The situation is made difficult because the Early Neolithic phases (prior to 6500 cal. BC) on the western sites are frequently limited in terms of artefact variability, while the significant features that define the Neolithisation processes were already ubiquitous throughout the Near East during the 7th millennium BC. However, these later contexts should not be overlooked. Neolithisation should be seen as a process not a single event, which finally led to the formation of fully developed Neolithic characteristics. Two key elements define the Neolithic character of the Çukuriçi Höyük lithic assemblage and undoubtedly relate it to eastern areas. These include 1) a new technology seen in the use of pressure technique, and 2) the absence of a direct pre-Neolithic sequence with the potential to provide an autochthonous development, requiring the spread of the pressure innovation from elsewhere. The origin of the pressure technique is likely to be seen in Upper Mesopotamia. Once incorporated into the production of lithic tools this technology spread to western Anatolia and on to the Aegean at the beginning of the 7th millennium BC.

The production of long blades and the appearance of caches at Çukuriçi Höyük correspond with the spread of technological know-how and skill from certain regions of the Near East. The western evidence not only informs us about the craftsmanship being transferred, but by repeating practices from the 8th millennium BC may also hint at similarities of social perspective. However, because the toolset of Çukuriçi Höyük exhibited tool types not reported elsewhere in western Anatolia, this transfer seems to have been of a conceptual nature rather than directly copying some of tool types from the east. The continuation of arrowhead/point production, for instance, was bounded strictly within the region at the centre of the western Anatolian coast not the larger region of the Aegean Basin and Marmara area. All the ideas addressed so far speak in favour of the Çukuriçi Höyük lithic assemblage being strongly related to the eastern fringes of the Near East, and Upper Mesopotamia in particular. These elements seem to have arrived alongside the migration of the first farmers to western Anatolia, with the pathways of the Neolithic spread not being the same everywhere from east to west. Based on the Çukuriçi case study, a maritime route used by colonisers on their way to the Aegean has been suggested (Horejs *et al*. 2015). The transfer of technological skills involving the spread of the pressure technique most likely relates to the movement of specialists from the Near East in the westward expansion of the Neolithic. However, it is not yet entirely clear what the nature of the movement via maritime routes was, especially during the centuries just prior to settling western Anatolia around 6700 cal. BC. Some of the areas in between, such as the southern coast of Anatolia, remained virtually empty in terms of Early Neolithic sites and should be investigated in detail in that regard.

Although the material culture of contemporaneous settlements in the centre of the Aegean Anatolian coast supports the idea of a cluster of sites, there are distinct aspects of production observed in the lithic record, mainly based on different use of raw materials, that influenced the technological and typological features of the assemblages. An apparent connection between these sites was most likely involvement with the obsidian exchange network running through the 7th millennium BC in this region. It is possible that through this exchange additional elements beyond obsidian were shared, namely, ideas, concepts and technological knowledge. All sites around Çukuriçi from the Izmir group show very similar patterns regarding chipped stone technology and typology, and therefore testify to the existence of an industry with shared elements, some of which initially arrived from the east. These elements seem to have been adopted, shaped and developed in the local western Anatolian environment through networks and the wider regional framework of the economy leading to the formation of a specific lithic package. In many regards, this package rests on the concepts of interaction developed for the PPNB sphere (Bar-Yosef & Belfer-Cohen 1989), though belonging in the case discussed here applies to a different Neolithic world of the 'west'. Finally, the question of the mutual influences between the Early Neolithic pioneer sites in the west (in the post-Mesolithic period of the early 7th millennium BC) remains open at the moment as technological innovations appear simultaneously on the both sides of the Aegean in Greece and western Anatolia.

Acknowledgments

I would like to thank to B. Horejs, the excavator of Çukuriçi Höyük and my PhD supervisor for the support and help along the way and the excavation team members for their assistance during the work on lithic datasets. I wish to thank Carole McCartney for getting me involved in this workshop in the first place, and both her and Laurence Astruc for their efforts and patience in editing this contribution. Discussions during the PPN8 meeting on Cyprus itself triggered many new ideas and new collaborations, and amongst others I am thankful in particular to Denis Guilbeau, Omry Barzilai, Jacob Vardi, Hamoudi Khalaily, Catherine Perlès, Ferran Borrell, Osamu Maeda, Juan José Ibáñez, Hanna Sosnowska, Antoine Muller, Bastien Varoutsikos, Frédéric Abbès, Alice Vinet and Denis Štefanisko. I want to thank Carole McCartney for kindly proofreading the final version of the English manuscript, and two anonymous reviewers for their useful comments on the details of chipped stone production techniques and overall context of the paper. Last but not least, special thanks go to my colleagues Maxime Brami, Stephanie Emra and Michael Brandl for giving other language suggestions for the initial version of the text, and Mario Börner for the original map layout. This research was a part of my PhD study on the BEAN project 'Bridging the European and Anatolian Neolithic' at Istanbul University (project no. 289966), within the Marie Curie Initial Training Networks Theme, funded by the European Commission FP7 program, and further financially supported by the Austrian Science Fund (FWF) project 'Interaction of Prehistoric Pyrotechnological Crafts and Industries' at the OREA institute in Vienna (project no. P 25825).

Bibliography

Abbès, F. 2003: *Les outillages néolithiques en Syrie du nord. Méthode de débitage et gestion laminaire durant le PPNB (British Archaeological Reports International Series* 1150*)*, Oxford

Altınbilek-Algül, Ç. 2011: Chipped stone industry of Yumuktepe. Preliminary results from "The Early Neolithic" phase, *Anatolia Antiqua* 19, 13–25

Altınbilek-Algül, Ç., L. Astruc, D. Binder & J. Pelegrin 2012: Pressure blade production with a lever in the Early and Late Neolithic of the Near East, in P.M. Desrosiers (ed), *The Emergence of Pressure Blade Making. From Origin to Modern Experimentation*, 157–179, New York

Astruc, L., F. Abbés, J.J. Ibáñez Estévez & J.E. González Urquijo 2003: "Dépôts", "réserves" et "caches" de matériel lithique taillé au Néolithique précéramique au Proche-Orient : quelle gestion de l'outillage? *Paléorient* 29.1, 59–78

Astruc, L., B. Gratuze, J. Pelegrin & P. Akkermans 2007: From production to use: a parcel of obsidian bladelets at Sabi Abyad II, in L. Astruc, D. Binder & F. Briois (eds), *Technical Systems and Near Eastern PPN Communities. Proceedings of the* 5*th International Workshop on PPN Chipped Lithic Industries, Fréjus 2004*, 343–355, Antibes

Balcı, S. 2011: The chipped stone industry of Aktopraklık C (Bursa). Preliminary results, *Anatolia Antiqua* 19, 1–11

Balcı, S. 2013: Naviform technology at Göllüdağ, Central Anatolia. Some remarks, in F. Borrell, J.J. Ibáñez & M. Molist (eds), *Stone Tools in Transition: From Hunter-Gatherers to Farming Societies in the Near Eas*t. *Proceedings of the 7th Workshop on PPN Chipped and Ground Stone Industries of the Fertile Crescent*, 277–288, Barcelona

Bar-Yosef, O. & A. Belfer-Cohen 1989: The Levantine ''PPNB'' interaction sphere, in I. Hershkovitz (ed), *People and Culture in Change. Proceedings of the 2nd Symposium on Upper Paleolithic, Mesolithic and Neolithic Populations of Europe and the Mediterranean Basin* (*British Archaeological Reports International Series* 508), 59–72, Oxford

Barzilai, O. 2010: *Social Complexity in the Southern Levantine PPNB as Reflected through Lithic Studies* (*British Archaeological Reports International Series* 2180), Oxford

Barzilai, O. 2013: The bidirectional blade industries of the Southern Levant, in F. Borrell, J.J. Ibáñez & M. Molist (eds), *Stone Tools in Transition: From Hunter-Gatherers to Farming Societies in the Near Eas*t. *Proceedings of the 7th Workshop on PPN Chipped and Ground Stone Industries of the Fertile Crescent*, 59–72, Barcelona

Barzilai, O. & A.N. Goring-Morris 2007: Bidirectional blade and tool caches and stocks in the PPNB of the Southern Levant, in L. Astruc, D. Binder & F. Briois (eds), *Technical Systems and Near Eastern PPN Communities. Proceedings of the 5th International Workshop on PPN Chipped Lithic Industries, Fréjus 2004*, 277–294, Antibes

Binder, D. 2007: PPN pressure technology. Views from Anatolia, in L. Astruc, D. Binder & F. Briois (eds), *Technical Systems and Near Eastern PPN Communities. Proceedings of the 5th International Workshop on PPN Chipped Lithic Industries, Fréjus 2004*, 235–244, Antibes

Binder, D., C. Collina, R. Guilbert, T. Perrin & O. Garcia-Puchol 2012: Pressure-knapping blade production in the north-eastern Mediterranean region during the seventh millennium cal. B.C., in P.M. Desrosiers (ed), *The Emergence of Pressure Blade Making. From Origin to Modern Experimentation*, 199–217, New York

Borrell, F. 2007: Single-platform blade knapping in the Middle Euphrates Valley during the mid VIII millennium cal. B.C., *Anatolia Antiqua* XV, 1–16

Borrell, F. & H. Khalaily 2016: Reconstructing the last stages of bidirectional blade technology in the Levant. North and South (dis)connections, *Paléorient* 42.2, 73–95

Brami, M., B. Horejs & F. Ostmann 2016: The ground beneath their feet. Building continuity at Neolithic Çukuriçi Höyük, *Anatolian Studies* 66, 1–16

Brandl, M. 2016: The multi layered chert sourcing approach (MLA). Analytical provenance studies of silicite raw materials, *Archeometriai Műhely* 13.3, 145–156

Brandl, M. in preparation: *Neolithic Çukuriçi Höyük Chert. Characterisation, provenance studies and economy* (*Institute for Oriental and European Archaeology*), Vienna

Briois, F. 2007: Les caches de lames de Shillourokambos (Chypre), in L. Astuc, D. Binder & F. Briois (eds), *Technical Systems and Near Eastern PPN Communities. Proceedings of the 5th International Workshop on PPN Chipped Lithic Industries, Fréjus 2004*, 317–326, Antibes

Burger, J. & M.G. Thomas 2011: The palaeo-population genetics of humans, cattle and dairying in Neolithic Europe, in R. Pinhasi & J. Stock (eds), *The Bio-archaeology of the Transition to Agriculture*, 371–384, Chichester

Caneva, I., M.R. Iovino, C. Lemorini, A. Özdogan & D. Zampetti 2001: A combined analysis of lithic assemblages from Çayönü, in I. Caneva, C. Lemorini, D. Zampeti & P. Biagi (eds), *Beyond Tools: Redefining the PPN Lithic Assemblages of the Levant. Proceedings of the 3rd Workshop on PPN Chipped Lithic Industries in the Near East* (*Studies in Early Near Eastern Production, Subsistence, and Environment* 9), 165–181, Berlin

Carter, T. 2007: Of blanks and burials. Hoarding obsidian at Neolithic Çatalhöyük, in L. Astruc, D. Binder & F. Briois (eds), *Technical Systems and Near Eastern PPN Communities. Proceedings of the 5th International Workshop on PPN Chipped Lithic Industries, Fréjus 2004*, 343–355, Antibes

Carter, T. & M. Milić 2013: The consumption of obsidian at Neolithic Çatalhöyük. A long-term perspective, in F. Borrell, J.J. Ibáñez & M. Molist (eds), *Stone Tools in Transition: From Hunter-Gatherers to Farming Societies in the Near Eas*t. *Proceedings of the 7th Workshop on PPN Chipped and Ground Stone Industries of the Fertile Crescent*, 495–508, Barcelona

Carter, T., D.D. Mihailović, Y. Papadatos & C. Sofianou 2016: The Cretan Mesolithic in context. New data from Livari Skiadi (SE Crete), *Documenta Praehistorica* 43, 87–101

Carter, T., T.F. Strasser, E. Panagopoulou, K. Campeau & D.D. Mihailović 2018: Obsidian circulation in the early Holocene Aegean. A case study from Mesolithic Damnoni (SW Crete), *Journal of Archaeological Science Reports* 17, 173–183

Clare, L. & B. Weninger 2014: The dispersal of Neolithic lifeways. Absolute chronology and rapid climate change, in M. Özdoğan, N. Başgelen & P. Kuniholm (eds), *The Neolithic in Turkey.* Volume 6. *10,500–5200 BC. Environment, Settlement, Flora, Fauna, Dating, Symbols of Belief, with Views from North, South, East, and West*, 1–65, Istanbul

Çevik, Ö. & E. Abay 2016: Neolithisation in Aegean Turkey. Towards a more realistic reading, in Ü. Yalçin (ed), *Anatolian Metal* 7. *Anatolia and Neighbours 10.000 Years Ago. Volume in Honour of Mehmet Özdoğan*, 187–197, Herne

Çilingiroğlu, Ç. 2017: The Aegean before and after 7000 BC dispersal. Defining patterning and variability, *Neo-Lithics* 1.16, 32–41

Çilingiroğlu, A., Ö. Çevik & Ç. Çilingiroğlu 2012: Ulucak Höyük. Towards understanding the early farming communities of middle west Anatolia. The contribution of Ulucak, in M. Özdoğan, N. Başgelen & P. Kuniholm (eds), *The Neolithic in Turkey. New Excavations & New Research*. Volume 4. *Western Turkey*, 139–175, Istanbul

Çilingiroğlu, Ç., B. Dinçer, A. Uhri, C. Gürbiyik, I. Baykara & C. Çakirlar 2016: New Palaeolithic and Mesolithic sites in the eastern Aegean. Karaburun Archaeologial Survey Project, *Antiquity Project Gallery*, 90.353, 1–6

Coşkunsu, G. & C. Lemorini 2001: The function of Pre-Pottery Neolithic projectile points. The limits of morphological analogy, in I. Caneva, C. Lemorini, D. Zampeti & P. Biagi (eds), *Beyond Tools: Redefining the PPN Lithic Assemblages of the Levant. Proceedings of the 3rd Workshop on PPN Chipped Lithic Industries in the Near East* (*Studies in Early Near Eastern Production, Subsistence, and Environment* 9), 145–159, Berlin

Derin, Z. 2012: Yeşilova Höyük, in M. Özdoğan, N. Başgelen & P. Kuniholm (eds), *The Neolithic in Turkey. New Excavations & New Research* Volume 4. *Western Turkey*, 177–195, Istanbul

Derin, Z., F. Ay & T. Caymaz 2009: İzmir'in Prehistorik Yerleşimi—Yeşilova Höyüğü 2005–2006 Yılı Çalışmaları, *Arkeoloji Dergisi* 13, 7–58

Duru, R. 2012: The Neolithic of the Lakes Region. Hacılar – Kuruçay Höyük – Höyücek – Bademağacı Höyük, in M. Özdoğan, N. Başgelen & P. Kuniholm (eds), *The Neolithic in Turkey. New Excavations & New Research* Volume 4. *Western Turkey*, 1–65, Istanbul

Galanidou, N. & C. Perlès (eds) 2003: *The Greek Mesolithic. Problems and Perspectives* (*British School at Athens Studies* 10), London

Gatsov, I. 2001: Epi-Palaeolithic/Mesolithic and Neolithic periods chipped stone assemblages from southern Bulgaria and northwest Turkey. Similarities and differences, *TÜBA–AR* 4, 101–112

Gatsov, I. 2003: The latest results from the technological and typological analysis of chipped stone assemblages from Ilıpinar, Pendik, Fikir Tepe and Menteşe, NW Turkey, *Documenta Praehistorica* 30, 153–158

Gatsov, I. 2009: *Prehistoric Chipped Stone Assemblages from Eastern Thrace and the South Marmara Region 7th–5th mill. B.C.* (*British Archaeological Reports International Series* 1904), Oxford

Gatsov, I. & P. Nedelcheva 2011: Neolithic chipped stone assemblages in north-western Anatolia, Turkey, *Eurasian Prehistory* 8.1–2, 89–95

Gatsov, I. & M. Özdoğan 1994: Some Epi-Palaeolithic sites from NW Turkey. Ağaçlı, Domalı and Gümüşdere, *Anatolica* 20, 97–120

Gerritsen, F.A. & R. Özbal 2016: Barcın Höyük and the pre-Fikirtepe Neolithization of the eastern Marmara region, in Ü. Yalçin (ed), *Anatolian Metal* 7. *Anatolia and Neighbours 10.000 Years Ago. Volume in Honour of Mehmet Özdoğan*, 199–208, Herne

Herling, L., K. Kasper, C. Lichter & R. Meriç 2008: Im

Westen nichts Neues? Ergebnisse der Grabungen 2003 und 2004 in Dedecik-Heybelitepe, *Istanbuler Mitteilungen* 58, 15–65

Horejs, B. 2012: Çukuriçi Höyük. A Neolithic and Bronze Age settlement in the region of Ephesos, in M. Özdoğan, N. Başgelen & P. Kuniholm (eds), *The Neolithic in Turkey. New Excavations & New Research* Volume 4. *Western Turkey*, 117–131, Istanbul

Horejs, B. 2016: Aspects of connectivity on the centre of the Anatolian Aegean coast in the 7th millennium BC, in B. Molley (ed), *Of Odysseys and Oddities. Scales and Models of Interaction between Prehistoric Aegean Societies and their Neighbours* (*Sheffield Studies in Aegean Archaeology* 10), 143–167, Oxford

Horejs, B. 2017: The Çukuriçi Höyük research project, in B. Horejs (ed), *Çukuriçi Höyük* 1. *Anatolia and the Aegean from the 7th to the 3rd Millennium BC* (*Oriental and European Archaeology* 5), 11–26, Vienna

Horejs, B., B. Milić, F. Ostmann, U. Thanheiser, B. Weninger & A. Galik 2015: The Aegean in the early 7th millennium BC. Maritime networks and colonization, *Journal of World Prehistory* 28, 289–330

Inizan, M.L. 2012: Pressure debitage in the Old World. Forerunners, researchers, geopolithics, handing on the baton, in P.M. Desrosiers (ed), *The Emergence of Pressure Blade Making. From Origin to Modern Experimentation*, 11–42, New York

Karnes, J.D. & L.A. Quintero 2007: A MPPNB blade cache from 'Ain Ghazal, Jordan, in L. Astruc, D. Binder & F. Briois (eds), *Technical Systems and Near Eastern PPN Communities. Proceedings of the 5th International Workshop on PPN Chipped Lithic Industries, Fréjus 2004*, 311–316, Antibes

Kartal, M. 2011: Epi-Palaeolithic–Early Neolithic findings in northern and midwestern Turkey and knapped stone comparisons with southwest Anatolia, in H. Taşkiran, M. Kartal, K. Özçelik, M.B. Köşem & G. Kartal (eds), *Işın Yalçınkaya'ya Armağan/Studies in Honour of Isin Yalcinkaya*, 153–166, Ankara

Khalaily, H. 2009: The "Ghazalian culture", transitional phase from Pre-Pottery to the Early Pottery Neolithic periods. Technological innovation and economic adaptation, in S.A. Rosen & V. Roux (eds), *Techniques and People*, 179–191, Paris

Khalaily, H., O. Marder & O. Barzilai 2007: An Early Pre-Pottery Neolithic B blade cache from Motza, west of Jerusalem, Israel, in L. Astruc, D. Binder & F. Briois (eds), *Technical Systems and Near Eastern PPN Communities. Proceedings of the 5th International Workshop on PPN Chipped Lithic Industries, Fréjus 2004*, 269–276, Antibes

Khalaily, H., I. Milevski & O. Barzilai 2013: Caching and depositing in the Pre-Pottery Neolithic B of Yiftahel, Israel, in F. Borrell, J.J. Ibáñez & M. Molist (eds), *Stone Tools in Transition: From Hunter-Gatherers to Farming Societies in the Near East. Proceedings of the 7th Workshop on PPN Chipped and Ground Stone Industries of the Fertile Crescent*, 219–230, Barcelona

Kolankaya-Bostancı, N. 2014: What happened to projectile points in the Izmir region during the Neolithic period? [Neolitik dönemde İzmir bölgesi'nde uçlara ne oldu?], *Arkeoloji Dergisi* 19, 127–136

Kozłowski, J.K. 2016: The Mesolithic of the Aegean basin. Cultural variability, subsistence economy, interregional links and seafaring, in R. Krauss & H. Floss (eds), *Southeast Europe Before Neolithisation. Proceedings of the International Workshop within the Collaborative Research Centres SFB* 1070 *"RessourcenKulturen", Schloss Hohentübingen, 9th of May 2014*, 41–64, Tübingen

Kozłowski, S.K. & O. Aurenche 2005: *Territories, Boundaries and Cultures in the Neolithic Near East* (*British Archaeological Reports International Series* 1362), Oxford

Maeda, O. 2009: The Materiality of Obsidian and the Practice of Obsidian Use in the Neolithic Near East. Manchester. PhD Dissertation, University of Manchester

Maeda, O. 2013: Cultural affinities and the use of lithics during the 8th to 7th millennia cal. BCE in the Northern Levant and Northern Mesopotamia, in O.P. Nieuwenhuyse, R. Bernbeck, P.M.M.G. Akkermans & J. Rogasch (eds), *Interpreting the Late Neolithic of Upper Mesopotamia* (*PALMA Series* 9), 267–276, Turnhout

Milić, B. 2018: Lithics and Neolithisation—Çukuriçi Höyük in Anatolia and the Aegean. PhD Dissertation, University of Tübingen

Milić, B. & B. Horejs 2017: The onset of pressure blade making in western Anatolia in the 7th millennium BC. A case study from Neolithic Çukuriçi Höyük, in B. Horejs, *Çukuriçi Höyük* 1. *Anatolia and the Aegean from the 7th to the 3rd Millennium BC* (*Oriental and European Archaeology* 5), 27–52, Vienna

Milić, M. 2014: PXRF characterisation of obsidian from central Anatolia, the Aegean and central Europe, *Journal of Archaeological Science* 41, 285–296

Miyake, Y., O. Maeda, K. Tanno, H. Hongo & C.Y. Gündem 2012: New excavations at Hasankeyf Höyük. A 10th millennium cal. BC site on the Upper Tigris, southeast Anatolia, *Neo-Lithics* 1.12, 3–7

Mortensen, P. 1970: Chipped stone industry, in J. Mellaart, *Excavations at Hacılar*, 153–157, Edinburgh

Nishiaki, Y. 2000: *Lithic Technology of Neolithic Syria* (*British Archaeological Reports International Series* 840), Oxford

Otte, M., I. Yalçinkaya, J.M. Leotard, M. Kartal, O. Bar-Yosef, J. Kozlowski, I. Lopez-Bayon & A. Marshack 1995: The Epi-Palaeolithic of Öküzini Cave (SW Anatolia) and its mobiliary art, *Antiquity* 69, 931–944

Özbaşaran, M. & H. Buitenhuis 2002: Proposal for a regional terminology for central Anatolia, in F. Gérard & L. Thissen (eds), *The Neolithic of Central Anatolia. Internal Developments and External Relations During the 9th–6th Millennia cal. BC* (*Proceedings of the CANeW Table Ronde*), 67–77, Istanbul

Özdoğan, M. 2002: On arrows and sling missiles. What happened to the arrows?, in R. Aslan (ed), *Mauerschau. Festschrift für Manfred Korfmann*, 437–444, Stuttgart

Özdoğan, M. 2008: An alternative approach in tracing changes in demographic composition. The westward expansion of the Neolithic way of life, in J.P. Bocquet-Appel & O. Bar-Yosef (eds), *The Neolithic Demographic Transition and its Consequences*, 139–178, Heidelberg

Özdoğan, M. 2010: Westward expansion of the Neolithic way of life. Sorting the Neolithic package into distinct packages, in P. Matthiae, F. Pinnock L. Nigro & N. Marchetti (eds), *Proceedings of the 6th International Congress on the Archaeology of the Ancient Near East, May 5th–10th 2008*, 883–897, Wiesbaden

Özdoğan, M. & I. Gatsov 1998: The Aceramic Neolithic period in western Turkey and in the Aegean, *Anatolica* 24, 209–232

Pelegrin, J. 2012: New experimental observations for the characterization of pressure blade production techniques, in P.M. Desrosiers (ed), *The Emergence of Pressure Blade Making. From Origin to Modern Experimentation*, 465–500, New York

Perlès, C. 2001: *The Early Neolithic in Greece. The First Farming Communities in Europe*, Cambridge

Rosenberg, M. & B.L. Peasnall 1998: Report on soundings at Demirköy Höyük. An aceramic Neolithic site in eastern Anatolia, *Anatolica* 24, 195–207

Quintero, L.A. & P.J. Wilke 1995: Evolution and economic significance of naviform core-and-blade technology in the Southern Levant, *Paléorient* 21.1, 17–33

Rokitta-Krumnow, D. 2013: The significance of long blade caches and deposits at Late Neolithic Shir, Syria, in F. Borrell, J.J. Ibáñez & M. Molist (eds), *Stone Tools in Transition: From Hunter-Gatherers to Farming Societies in the Near East. Proceedings of the 7th Workshop on PPN Chipped and Ground Stone Industries of the Fertile Crescent*, 231–245, Barcelona

Runnels, C.N. 1995: Review of Aegean prehistory. The Stone Age of Greece from the Palaeolithic to the advent of the Neolithic, *American Journal of Archaeology* 99, 699–728

Sağlamtimur, H. 2012: The Neolithic settlement of Ege Gübre, in M. Özdoğan, N. Başgelen & P. Kuniholm (eds), *The Neolithic in Turkey. New Excavations & New Research* Volume 4. *Western Turkey*, 197–225, Istanbul

Sampson, A. 2010: *Mesolithic Greece 9000–6500 BC. Palaeo-environment, Palaeo-economy, Technology*, Athens

Sampson, A. 2014: The Aegean Mesolithic. Environment, economy and seafaring, *Eurasian Prehistory* 11. 1–2, 63–74

Schwall, C., M. Brandl, T.M. Gluhak, B. Milić, L. Peloschek, L. Sørensen, D. Wolf & B. Horejs in press: From near and far. Stone procurement and exchange at Çukuriçi Höyük in Western Anatolia, *Journal of Lithic Studies*

Stock, F., L. Ehlers, B. Horejs, M. Knipping, S. Ladstätter, S. Seren & H. Brückner 2015: Neolithic settlement sites in western Turkey. Palaeo-geographic studies at Çukuriçi Höyük and Arvalya Höyük, *Journal of Archaeological Sciences Reports* 4, 565–577

Storch, G., W. Schoch, W. Rähle, J. Moser, D. Burger, H. Berke, B. Albrecht, G. Albrecht & H.P. Uerpmann 1992: Late Pleistocene and Early Holocene finds from Öküzini. A contribution to the settlement history of the Bay of Antalya, Turkey, *Paléorient* 18.2, 123–141

Takaoğlu, T., T. Korkut, B. Erdoğu & G. Işin 2014: Archaeological evidence for 9th and 8th millennia BC at Girmeler Cave near Tlos in SW Turkey, *Documenta Praehistorica* 41, 111–118

Vardi, J. & I. Gilead 2011: Side-blow blade-flakes from the Ghassulian sickle blade workshop of Beit Eshel. A Chalcolithic solution to a Neolithic riddle, in E. Healey, S. Campbell & O. Maeda (eds), *The State of the Stone: Terminologies, Continuities and Contexts in Near Eastern Lithics. Proceedings of the 6th Workshop on PPN Chipped and Ground Stone Industries in the Near East* (*Studies in Early Near Eastern Production, Subsistence, and Environment* 13), 257–263, Berlin

Wilke, P.J. 1996: Bullet-shaped microblade cores of the Near Eastern Neolithic. Experimental replicative studies, in S.K. Kozłowski & H.G.K. Gebel (eds), *Neolithic Chipped Stone Industries of the Fertile Crescent and Their Contemporaries in Adjacent Regions. Proceedings of the 2nd Workshop on PPN Chipped Lithic Industries* (*Studies in Early Near Eastern Production, Subsistence, and Environment* 3), 289–310, Berlin