

Interpreting Chipped Stone Assemblages of the Neolithic in Western Anatolia – A Conceptual View

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Abstract: The publications of chipped stones from the Neolithic in western Anatolia offer an understanding of the synchronised development of the material in the 7th mill. BC, within the three main proposed cultural groups in the north-western, central-west and south-western part of Anatolia. Although the perspectives in the studies seem to be similar, there are certain aspects related to methodology and conceptual framework, which differ both in the approaches to and the final results and interpretation of the Neolithic assemblages. This paper aims to offer definitions and address some of the main concepts which seem to be crucial for dealing with this chipped stone material, in order to overcome possible barriers in the understanding of a bigger picture. For this reason, the general ideas are shared from the perspective of the author and the experience from the study of a particular site located in the centre of the Anatolian Aegean coast, and comparison of the results at a supra-regional level.

Introduction

The material culture of the Neolithic in western Anatolia rests upon the understanding of three major regions – north-west, south-west and central-west, which are framed on cultural unity and shared geographical location of sites within these regions. Thus, the north-western part mainly refers to the Marmara region, while the south-west is primarily represented by the sites known from the Lakes District. Finally, the central-west is defined as the so-called centre of the Anatolian Aegean coast, with the sites grouping around the modern city of Izmir. In many regards, these groups result from the targeted investigations in those particular areas over past decades. Yet, there is difficulty in the determination of several sites (of which some were found recently) that do not seem to fit into existing frameworks, given that there are no clearly defined borders between the regions. Some of these include the north-west Anatolian Aegean coast, Lycia Bay, or the island of Gökçeada, however in general they do correlate better with one part than another. On the other hand, within the main geographical regions there are micro-regions, which also differ amongst themselves. The results of chipped stone studies significantly contribute to the interpretation of the character of regional groups, for instance with suggested technological traditions and trends of production and circulation of obsidian from particular sources. Looking from the outside, it seems that there is a general uniformity of assemblages, which can be seen through the basic characteristics, which are, broadly speaking, a strong blade component, followed by a similar set of retouched tools, which are typical for the settled village life of farming communities. This ‘uniformity’ is mainly observed in the second half of the 7th mill. BC, when most of the known sites in

western Anatolia emerged. On the other hand, certain differences are claimed in the Early Neolithic (prior to 6500 or 6600 BC), which is poorly understood due to the small number of settlements with early dates.

In addition, general differences proposed for the material culture (built environment, pottery, small finds) of the Neolithic in the three regional groups seem also to be the outcome of different cultural backgrounds, which presumably influenced the formation of the Neolithic in these regions, as suggested by M. Özdoğan (2006), as well as the westward expansion of the Neolithic happening at that time (Özdoğan, 2010). The cultural background – meaning here the pre-Neolithic sequence – is one of the key factors in understanding the early lithic assemblages, especially due to the fact that lithics often represent the main artefactual evidence in the pre-Neolithic of this area (mainly known from the surveys, and only a handful of excavations). Therefore, the information about the presence or absence of the pre-Neolithic sequence is equally important for interpretation. Furthermore, following the changes during the process of Neolithization, which refers to the formation and development of the Neolithic in a particular area, it seems to be the right approach to look at the assemblages and spot the differences in chipped stone production, which are often not very apparent.

Nevertheless, this paper’s focus is not on details of the early and late assemblages, but rather on addressing the interpretation(s) offered for chipped stones in the larger area in question, by looking at how much research has been done, in what way, and what could be future directions for a continuing discussion about Neolithic chipped stones. The main observations come from the author’s first hand analysis of lithics from Neolithic Çukuriçi Höyük, a 7th mill. BC coastal site in the Izmir

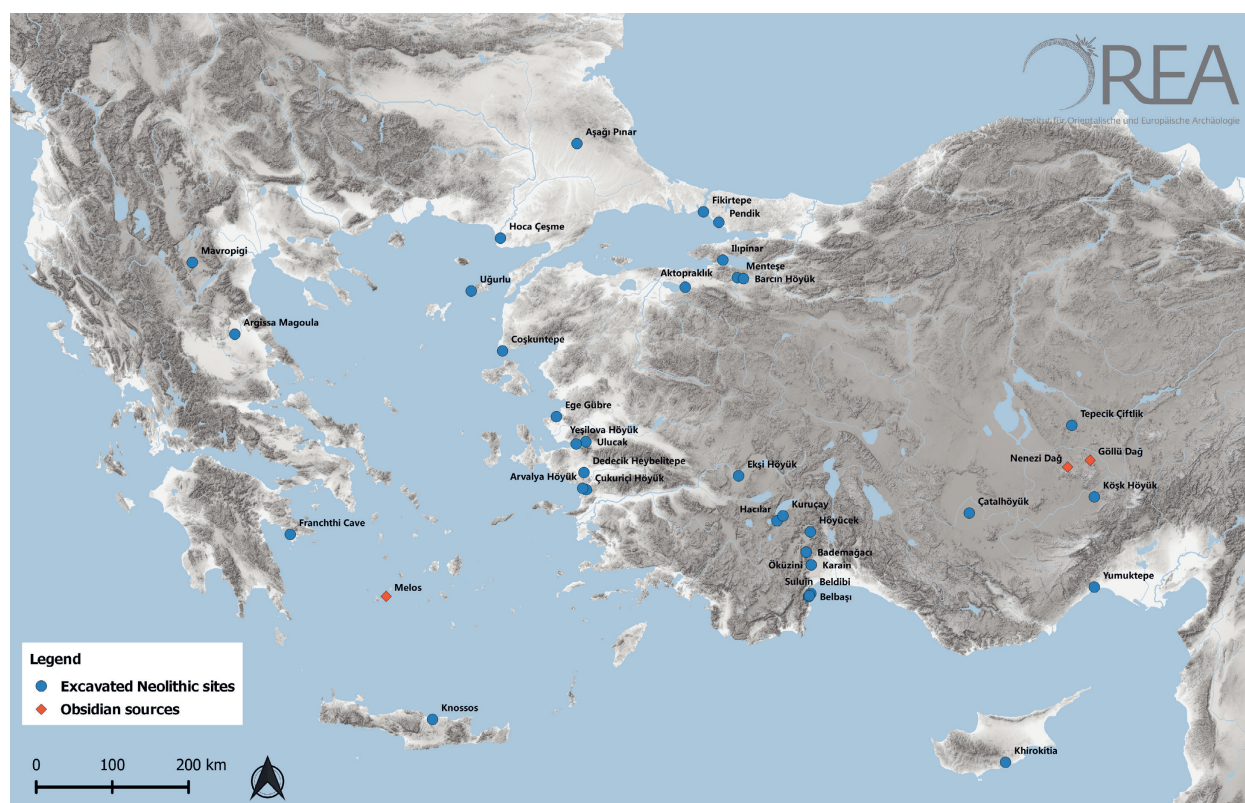


Figure 1: Map with excavated Neolithic sites in western Anatolia with other major sites from neighboring regions (7th millennium BC).

region (Horejs, 2012, 2016, 2017; Horejs *et al.*, 2015), and the need to contextualise the site's assemblage in the broader Anatolian Neolithic (Figure 1).

As the history of investigation of the Neolithic in the west is somewhat younger than in other parts of Anatolia, there appear to be many gaps in understanding the general context, but at the same time, there are also many new data becoming available. It is quite clear that this part of Anatolia still lacks the big publication outcomes that are available for other regions (central and southeast Anatolia for instance), however, there is already a solid base for discussion. The best overview of the Neolithic chipped stone assemblages comes from the north-west, as given by Gatsov and Nedelcheva (Gatsov, 2003; Gatsov and Nedelcheva, 2007, 2009, 2011), and is continually updated (Gatsov and Nedelcheva, 2016; Gatsov *et al.*, 2017; Balcı, 2011). On the other hand, the publication of the data from the Lakes District is still very limited, yet with some important references, which should not be overlooked (see Baykal-Seeher, 1994 for Kuruçay, Balkan-Athi, 2005 for Höyücek). Similarly, there are several shorter occupations, related to small-scale excavations, which give further insights into the end of the Neolithic sequence (see Perlès *et al.*, 2011 for Coşkuntepe, Herling *et al.*, 2008 for Dedecik-Heybelitepe). Finally, the ongoing studies on the Early Neolithic assemblages (from Ulucak, Barçın and Uğurlu)

are very much awaited, as this part of the Neolithic still lacks its major interpretation.

Main goals

The main aim of this paper is to offer the conceptual outline of chipped stone studies by pointing to some crucial elements embedded in the analysis of the material on one hand, and in dealing with this material in the Neolithic of western Anatolia on the other. In order to do so, there will be a discussion of the definitions and concepts, with an intention to bring one broader methodological perspective dealing with chipped stones in this particular geo-chronological, but also socio-cultural framework. The paper does not aim to refer to a certain assemblage studied by the author as this has been done elsewhere (Milić, 2018 and 2019), but rather to look at ways of dealing with a bigger picture, which rests on the understanding of the published data.

Definitions and their implications for the interpretation of assemblages

There are many ways to deal with the interpretation of data when it comes to Neolithic chipped stones, depending on the scope and aims of the research. Thus, different approaches are employed to address micro or macro levels of analysis. Due to different schools of

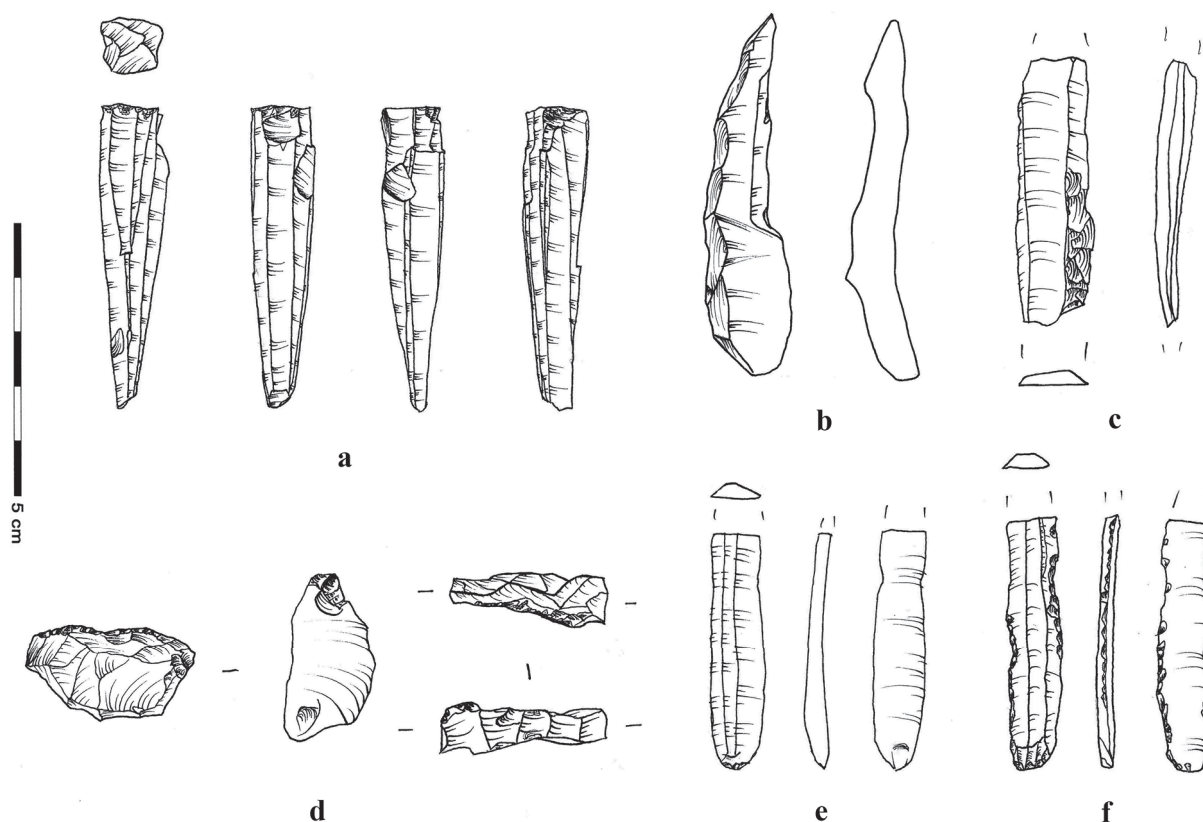


Figure 2: An example of various blade reduction sequence components from the Late Neolithic contexts at Çukuriçi Höyük (a – bullet-like core, b – core preparation element/lateral crested blade, c – rejuvenation element/neo-crested blade, d – platform rejuvenation/tablet, e – proximal blade fragment/unused blade blank, f – proximal fragment of a retouched blade (artefacts here not belonging to the same reduction sequence)).

research, results can often be ambiguous, if previously not well defined. For this reason, I would like to briefly address, and to some extent repeat, certain definitions that have been outlined previously.

Industry

The term industry is used in many different manners, most broadly relating to the aim of production. However, the major difference is in whether industry is used to describe the assemblage(s) of a single context (site), or at the supra-level by looking at shared features of more than one site. Thus, the French definition covers a rather broad meaning applied to prehistoric societies, which combines the modification of raw materials with certain techniques to meet the aims of consumption (see the discussion on definitions in Inizan *et al.*, 1999: 143). Some of the authors used the term industry to define modes of production on single sites based on different knapping traditions (see e.g. Carter *et al.*, 2005: 222 after Newcomer, 1975). This approach, referring to the interpretation of single-site production(s) is also very common in publications of Neolithic chipped stones in western Anatolia (e.g. Balci, 2011). Finally, some of the Near Eastern specialists use the definition of industry

to illustrate the common elements of assemblages on a broader level, based on ‘technological and typological resemblances’ of different assemblages (Barzilai, 2013: 67). In this regard, the industry is classified differently from other concepts, such as ‘complex’ and ‘phase’ or ‘facies’ (see further discussion in Barzilai, 2013: 67, after Clarke, 1968). This approach is indeed very welcome in western Anatolia for the description of knapping trends and traditions for the regional groups and their affinities in chipped stone production during the Neolithic, where the general blade industries could be used to properly illustrate contrast with the previous Aegean Mesolithic flake industries, for instance.

Blade-based and flake-based

One of the problematic issues encountered while dealing with western Anatolian chipped stones comes from the interpretation of blade-based and flake-based assemblages (or technologies, industries, etc. depending on the level of analysis). As previously mentioned, the Aegean Mesolithic can be best defined with the flake-based industries mainly known from the islands and some mainland evidence of the 9th and 8th mill. BC (Runnels, 1995; Galanidou and Perlès,

2003; Sampson, 2010, 2014; Carter *et al.*, 2016; Kozłowski, 2016). This technological aspect of production is also used in searching for the cultural background of the western Anatolian Neolithic with a focus on the origin of lithic technologies, as there are principal differences between the Mesolithic and Neolithic production aims (Milić, 2019). The dominant blade-based industries of the Late Neolithic in western Anatolia however do not exclude the existence of a flake component on certain sites, yet the production purposes must be clearly evaluated.

In my understanding, the blade- or flake-based assemblage (or technology, or industry) can be characterized with blades or flakes respectively being the major aim of production. This means that in the blade-based assemblage the main elements are blades, while, the accompanying flakes (if they properly correlate in production) represent by-products of the reduction sequence, and usually come from the (p)reparation of the core. Vice versa, flake-based assemblages have the flakes as the desired blanks, which are used for further modification, and are commonly transformed into retouched tools (which makes it obvious that they are real aim of production). In contrast, it is not common that flake-based assemblages have blades as by-products, which is an additional marker in the definition of assemblages one way or the other. However, this definition also strongly relates to the raw material used in production, despite the clear and predetermined aims and needs for blade or flake blanks. Thus, the analysis of particular assemblages strongly relying on obsidian (such as Çukuriçi Höyük) has demonstrated that the flake component is usually visible from the chert group of artefacts, due to the availability of the raw material, need for heavier tools, and the fact that obsidian would not be 'spent' for the production of flakes, but rather carefully knapped with the purpose of using as much of the material as possible to gain the maximum number of blanks. However, the Çukuriçi Höyük obsidian assemblages also strongly relate to a blade production tradition, which should be borne in mind. On the other hand, the existence of a high number of flakes (in blade-based production) on other sites, which do not have abundant obsidian, would be expected if the raw material is locally available and can be fully reduced on-site. From everything stated previously, it is clear that the number of flakes is much less important than the understanding of the aim of production, which is manifested differently depending on which raw materials are used.

Stages of the chaîne opératoire

This section does not have the intention to define the concept of the chaîne opératoire, as proposed by Leroi-Gourhan (1964). Instead, it has the purpose

to remind the reader that in the interpretation of assemblages one should not exclusively focus on the main part of the chaîne opératoire – which is the reduction sequence related to the main production of blanks and tool making, but should try to address the concept as a whole. In other words, although we are often limited to understanding the central part of the chaîne opératoire, there is much information which can be retrieved from the first and the last stages of the operational sequence, which are significant to the interpretation of chipped stone assemblages. From a literature review of assemblages in western Anatolia, it seems that the reconstruction of acquisition of the raw materials has been left to the specialists in this field (e.g. geologists), while many of the crucial strategies of procurement depend on our own ideas based on the presently available material. Similarly, there is often a lack of understanding of the refuse deriving from tools (and artefacts in general), referring to the last stage of the chaîne opératoire. Thus, there are many critical issues in the interpretation of assemblages that are often completely scattered in settlement areas without necessarily being deliberately discarded as obvious waste. Given the fact that the final place of the artefacts in different domestic contexts does not necessarily represent the remnants of everyday life in the settlements, attempts to interpret the refuse of chipped stone working is very much needed and valuable in many different respects.

Know-how and knowledge

Without going into the detail of the definitions, I would like to mention here know-how and knowledge, which often go together as important elements when the concept of new techniques is addressed, as it is in the case of the western Anatolian Neolithic. The extensive definitions from Pelegrin (1990) cannot be better formulated and rephrased. In my understanding, in the publication 'know-how' refers to the ability to perform an action, which is in line with 'knowledge', which is the previous action of learning and memorising the concept. Both are crucial in perceiving the reasons why certain elaborate techniques cannot be simply transmitted in the form of ideas but are often related to direct contacts between individuals in the past.

Concepts and current perspectives

Chronology matters!

One of the main points in contextualising an assemblage is to follow the right chronological framework. As we are not dealing with the same start and end of the Neolithic in all micro-regions of western Anatolia, it is crucial to correlate the finds with radiocarbon dates, so they are suitable for comparative studies.

The Neolithic in western Anatolia, as in the Aegean, seems to have a starting point around 6700 BC (Weninger *et al.*, 2014; Clare and Weninger, 2014), although some authors speak in favour of an earlier start, moving it back to 6800 BC (see e.g. Çevik and Abay, 2016 for Ulucak). However, without talking in more detail about the reasons why, we are not able to accurately define the occupations between 7000-6700 BC because of the existence of a plateau in the calibration curve at that time (see Weninger *et al.*, 2014). It is worth noting that the Early Neolithic in western Anatolia is defined differently than that in the adjacent regions.

First, the Neolithic in western Anatolia is a Pottery Neolithic, so far the entire coast seems to be void of the Aceramic or Pre-Pottery (PPN) horizon, although it became clear recently that pottery was not extensively used (if at all) at the very beginning of the period (Horejs *et al.*, 2015; Çevik and Abay, 2016; Gerritsen and Özbal, 2016). The main difference is in the determination of the Early Neolithic in western Anatolia when contrasting it to the Aegean, i.e. Greece. In other words, the Early Neolithic in Greece chronologically corresponds to the entire Neolithic sequence in western Anatolia, covering the 7th mill. BC. The Greek periodisation defines further Neolithic occupation (Middle and Late), with a long continuation after 6000 BC, during which time many regions in western Anatolia have already entered the Chalcolithic (Schoop, 2005). From the other side, central Anatolia has a much earlier start of the Neolithic, similar to that evidenced in the Near East, due to the presence of Aceramic or PPN sequences. Further, in western Anatolia we differentiate Early and Late Neolithic, with 6600/6500 BC being the border between the two (Clare and Weninger, 2014). Finally, according to published data, there seem to be also differently defined ends of the Neolithic in micro-regions of western Anatolia. Thus, some sites have a slightly later end of the Neolithic than the conventionally accepted date of around 6000 BC. For all of these reasons, direct comparisons between the assemblages can be tricky, especially if different relative chronologies are addressed at the broader level.

As already mentioned, published data for the Early Neolithic in western Anatolia concerning chipped stones is currently lacking. However, from the small available assemblage of Çukuriçi Höyük (Horejs *et al.*, 2015; Milić, 2019), there seem to be differences in production and raw material use between the Early and Late Neolithic. Further, a diversification and intensification related to production techniques and role of raw materials can be observed in the Late Neolithic when directly compared with the Early (Milić, 2018). The first impression, based on comparisons with other contemporaneous sites (although mainly based on the Late Neolithic), is that the entire region of western Anatolia likely had more elaborate assemblages towards the end of the Neolithic

sequence, in particular regarding the set of retouched tools. This diachronic Neolithic perspective, although short (with a time span of around 700 and a maximum of 1000 years), should be further followed for defining other trends in chipped stone production.

Finally, the recent discoveries of pre-Neolithic contexts in western Anatolia again inspired discussion about the arrival of the Neolithic in already settled areas, with the potential influences of those early activities on the formation of the Neolithic in certain micro-regions. The pre-Neolithic sequence is now present in the Black Sea coast (with Ağacli group of sites), in the regions of Balıkesir and Çanakkale (Musluçesme and Çalça), in the regions of Eskişehir (with Keçiçayırı and Asarkaya), in Antalya and Lycia Bay (with Karain, Öküzini, and Girmeler), in the Istanbul area (isolated finds from Küçükçekmece), and finally in the Karaburun peninsula (with new surveyed sites). Given the fact that the majority of these sites and their early proposed dating (Mesolithic, Epipaleolithic and even PPN), mainly based on chipped stone collections, have been defined only within the course of surface surveys, one has to be very cautious when relating them to later Neolithic occupations in the same regions. Thus, detailed discussion of similar knapping traditions between some of the early and late assemblages, for instance flake-based in Karaburun (Çilingiroğlu *et al.*, 2016) and blade-based from the Ağacli group (Gatsov and Özdoğan, 1994) and their influence on much later 7th mill. BC sites in the Izmir and Marmara region respectively must be based within clear chronological frameworks.

Innovations and innovative techniques

Apart from crucial innovations that appeared during the Neolithic in western Anatolia in contrast to earlier contexts, such as farming and herding and settled village life, the chipped stone production in this period is characterised by the onset of new production techniques. An overall tendency towards blade making and the introduction of the pressure technique seen from almost all assemblages of the 7th mill. BC contrasts with the knapping traditions of the previous pre-Neolithic sequence, known from the broader Aegean region. The novel approach to production during the Neolithic in Greece, as described by Perlès (1988) can also be applied to the chipped stones in the western Anatolian Neolithic. This encompasses much more care dedicated to the preparation of cores and standardisation in knapping defined in the Neolithic assemblages, in contrast to the Mesolithic general 'ad hoc' production employed for the immediate need for tools (Perlès, 1988: 484), and the involvement of the new pressure technique, which in particular contexts is incorporated in some of the old traditions (Perlès, 2001).

Apart from the general blade-based technologies, a clear blade component in the Neolithic assemblages in Western Anatolia seems to be primarily related to the application of pressure technique, which, as in the case of Greece, most likely arrived with other elements of village life from elsewhere. Following the chronological order of the appearance of pressure in the broader region of western, but also central Anatolia in the 7th mill. BC, possible routes of the spread can be proposed (Milić and Horejs, 2017). One of the questions raised in this framework is whether the pressure technique spread in a synchronised way with each of the groups of farmers in different micro-regions and different pathways of the Neolithic spread to the west, or it gradually reached settlements within the new connections established during the Neolithic. To go into more detail one should follow the intra-site chronologies and define the networks operating at that time.

Exchange networks and exchange of ideas

The most evident exchange networks regarding the chipped stones in western Anatolian Neolithic are related to obsidian. The characterisation of trace elements in obsidian artefacts from provenance studies has demonstrated that the western Anatolian communities were involved in procurement and exchange of obsidian from two main sources – Melos and Cappadocia. Thanks to the exhaustive analysis of M. Milić, the pattern of use of the two sources is available for many of the 7th mill. BC sites in western Anatolia (Milić, 2014). This further shows the affinities for particular materials in different micro-regions, but also their closer relations to one or another region (Aegean or central Anatolia sources). However, we are still currently lacking the full interpretation of the exchange network models, given that the ‘down the line’ model proposed by Renfrew *et al.* (1968) does not seem to fit a good part of the area due to uneven ratios of obsidian at the sites and their distance from the sources.

Although the obsidian networks are primarily based on the exchange of obsidian artefacts or the raw material itself, they are likely to also have involved the exchange and circulation of ideas embedded in the networks. This aspect does not seem to be exploited to its full in the literature about the western Anatolian Neolithic, and it has great potential to address the movement of other elements that was triggered by already established obsidian exchange. From the example of Çatalhöyük, and the detailed study of the raw materials and technology from the site, we know now that the appearance of several important new elements in central Anatolia, such as the pressure technique and a particular type of retouched tool (Çayönü tool) coincides with the involvement of obsidian from the

eastern Anatolian sources (Carter and Milić, 2013). Although such examples might be rare in western Anatolia, there is a whole new area to explore in this respect. The case study of Neolithic Çukuriçi Höyük has already given an insight about obsidian and blade-based technology being in strong correlation, which is apparent from the difference in technology between the Early and Late Neolithic on the site followed by different use of this raw material. Furthermore, the comparisons to the Ulucak Early Neolithic assemblage (although only briefly addressed in Çevik and Abay, 2016) could imply that the exchange of obsidian at the regional level during the first half of the 7th mill. BC also influenced the circulation of the know-how and knowledge about production of blades using the pressure technique at that time.

Form and function (and cultural determination)

The last concept regards outlining several ideas and examples dealing with certain tools, which have implications for the interpretation of chipped stone assemblages in the Neolithic. Although here one can name many significant Neolithic tool types, which attest to the activities of everyday life, I will only focus on a few examples.

Apart from technology, the production and use of sickle elements (sickle blades, sickle implements) in the 7th mill. BC can be also addressed as a new component in the Neolithic chipped stone assemblages in western Anatolia in contrast to earlier contexts in the Aegean (Mesolithic in particular). As indicators for cereal farming in the Neolithic, sickle elements are usually defined through the visible gloss (mainly by naked eye) on one or both edges of the tool, and this is where the discussion in western Anatolia about these tools stops (with only a few exceptions where more details are given). An overview of the use of sickle elements in the sickle or handle itself has not been extensively discussed for the assemblages, although the position of the gloss, either being parallel or oblique to the edge, could give more insights into the reconstruction of possible hafting methods, but also into the efficiency of harvesting. This basic understanding of the use, reuse and discard of sickle elements here is contrasted to the big publication outcome from the Near East (e.g. Borrell, 2008; Maeda *et al.*, 2016) or western Mediterranean (e.g. Mazzucco *et al.*, 2017), where the contribution to the interpretation has been outstanding. One of the reasons why we are lacking such results stems from the lack of use-wear analysis on chipped stones in western Anatolia.

Meanwhile, the lack of use-wear analysis has also led to a possible misrepresentation and misinterpretation of other tools in western Anatolian assemblages – such as points, drills and geometric microliths, which have been

largely defined according to the form of the artefacts. Until recently, the absence of points in western Anatolia (in types known from central and southeastern Anatolia) has been interpreted through the presence of sling missiles that completely replacing the role of arrowheads in western Anatolia (Özdoğan, 2002). The new data from Çukuriçi Höyük and contemporaneous sites in the Izmir region has demonstrated that, although not in great numbers, points appear during the whole 7th mill. BC, and are different in form and use (according to first basic microscopic observation) from the drills present at these sites. Although this does not necessarily mean that the same types of chipped stone weapons should appear in all micro-regions of western Anatolia, an alternative shape, and the use of points in general, should not be *a priori* excluded. In line with this, some of the northwestern Anatolian assemblages show the use of geometric microliths (with trapezes being the most common among them) in the Neolithic assemblages (Balci, 2011; Gatsov and Nedelcheva, 2011), which can contribute to the discussion of these tools being used as points, as defined at some of the Aegean sites (see e.g. Perlès, 2001). However, the clear use of trapezes as transversal arrowheads or assault weapons is only clearly demonstrated with the later Chalcolithic finds in the Marmara region, with an example of a trapeze found embedded in a human skeleton from Aktopraklık (Alpaslan-Roodenberg, 2011). At the same time, the appearance of geometrics in the Neolithic 'does not seem to be expected' due to traditional opinions that these tool types have a Mesolithic character. In contrast, several studies discuss the use of microliths in the later context and base the evidence on functional analysis. Thus, the use-wear results from the lunates of Drama, a later Neolithic site in Bulgaria (Lichardus *et al.*, 2000) and other evidence from the Syrian PPN-PN at Tell Damishliyya (Nishiaki, 2000), attests to the use of wider geometric microliths (mainly lunates) as sickle elements. With these examples it became clear that some geometrics were produced and used as a result of their suitable form for certain activities and should not be necessarily culturally attributed to older periods only due to form which conventionally affiliates a certain type to a certain chronological context.

Potential future directions

This last section does not intend to finally adhere to any particular methodological approach in chipped stone study, but to conclude by offering some future directions, based on the weak points and gaps in our current interpretations of lithics in the western Anatolian Neolithic.

Based on the sections above it is apparent that one of the main directions of the author is to look at the bigger picture, in order to develop conclusions that do not exclusively concern isolated assemblages but

relate to a broader context understandable for those dealing with the Neolithic in general. Several fields which seem not to have been completely explored for the western Anatolian Neolithic regarding chipped stone studies correspond to new analysis on one hand and interpretations based on comparative studies at a supra-regional level on the other.

First, although this paper has made an attempt to provide some definitions, which are employed in the methodology, much more still needs to be done in this direction. Therefore, discussions about terminology used in chipped stone analysis (as provided for instance by Altınbilek-Algül, 2015 for the chipped stones of southeastern Turkey) should take place also in written form. Following the methodological concepts, it is clear that there cannot be only one methodology for the analysis of technological and typological aspects of production, simply because specialists follow and belong to different research schools. However, there should be a way to synchronise and make it understandable among specialists, which can be best done with clear definitions of methods and objectives within the studies.

There are three main study fields to address while dealing with chipped stone assemblages – raw material study, technological and typological analysis. As mentioned before, use-wear analysis should be employed more often as a significant part of the typological study (or as its own field related to typology), which could in this particular area contribute to the understanding of many ambiguous results related to the use of certain tools during the Neolithic.

The interpretation of the context of finds is also very relevant to our studies and should therefore not be omitted. Apart from some examples of special deposits of blanks and tools (e.g. Astruc *et al.*, 2003; Carter, 2007; Horejs *et al.*, 2015), chipped stones as remnants of domestic activities should also be better contextualised with other parts of material culture in publications.

Despite the work done on obsidian provenance studies, there is a big gap in non-obsidian, i.e. chert studies related to the use of raw materials for chipped stone production in western Anatolia. However, there is in general very little research done on this aspect of the Anatolian Neolithic (see Nazaroff *et al.*, 2013 for the study of cherts from Çatalhöyük or Schwall *et al.*, 2018; Brandl, in prep. for Çukuriçi Höyük), and it is understandable due to the involvement of different methods than the ones conventionally used. Nevertheless, the work on non-obsidian knappable materials certainly brings much potential for the interpretation of the use of local and exotic origins for raw materials, and significantly helps our understanding of exchange networks (Nazaroff *et al.*, 2015). Last but not least, the

exchange networks, mainly those based on obsidian circulation, do not seem to have been analysed in depth for the western Anatolian Neolithic. As already mentioned above, the old proposed models of obsidian long distance exchange do not find good standing in the interpretation of exchange networks. Instead, new complex models need to be evaluated in order to understand the modes of exchange in this region. To do so, one can focus on what already has been tested for the Near Eastern Neolithic assemblages, with the innovative methods employed in collaboration with computer simulations and mathematical modelling which contributed to a better understanding and definition of complex networks (see e.g. Ibáñez *et al.*, 2015).

Finally, for the understanding of technological details, which are important for the possibility of relating the Neolithic with the pre-Neolithic sequence in western Anatolia, it seems necessary to have some of the older assemblages re-evaluated and even re-analysed. Therefore, the integration of new assemblages, alongside a full understanding of old assemblages can bring fruitful discussion of the cultural context of the Neolithic in western Anatolia and the important role of chipped stones within it.

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