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Photo on the cover: Excavations at the Early Neolithic settlement of Mavropigi-*Filotsairi* (photo G. Karamitrou-Mentessidi)

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NEOLITHIZATION BETWEEN THE ADRIATIC AND THE BLACK SEA

Edited by

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INTRODUCTION: TRANS-AEGEAN VS. TRANS-ADRIATIC CONTACTS IN THE MESOLITHIC AND EARLY NEOLITHIC

Despite ongoing discussions, the Neolithisation of the Balkans, an issue of fundamental importance for understanding the rise of farming-herding societies in Europe, is still far from resolved. A number of studies addressing this issue have been published in recent years (e.g. Reingruber *et al.* eds., 2017; Krauss, Floss eds., 2016). This study is another attempt to present current views on the transition from the Mesolithic to the Neolithic in the territories between the eastern coast of the Adriatic Sea and the Black Sea. Important contributions to the issue of Neolithisation have come from research in the Marmara Sea basin and north-western Anatolia. Particular papers examine northern Greece (N. Efstratiou), northern Greece and western Anatolia (B. Milić), the Adriatic basin (J. Guilaine, G. Radi, L. Angeli, A. Bunguri, S. Forenbaher, L. Fidanoski, M. Kaczanowska, J.K. Kozłowski, I. Jovanović, M. Vander Linden), and the Black Sea and Marmara Sea basins (D. Kiosak, I. Gatsov, P. Nedelcheva).

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Małgorzata Kaczanowska, Janusz K. Kozłowski

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UNDERSTANDING (EARLY) NEOLITHIC CHIPPED STONE PRODUCTION IN NORTH-WESTERN AEGEAN FROM AN EASTERN AEGEAN PERSPECTIVE

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Abstract

This paper aims to outline the major points and current issues in understanding the chipped stone production in the Aegean area during the 7th millennium BC. Not often, western and eastern Aegean have been studied within the same framework, although similar trends related to the process of Neolithisation in this broad area, i.e., the Aegean basin, could be proposed. Some of the major issues may relate to the unsynchronized chronology, which can be the first obstacle when it comes to the correlation of the Neolithic developments between Greece and the Aegean islands on one side and western Turkey on the other side. First-hand studies of lithic assemblages from the centre of the Aegean Anatolian coast will be used here to address shared features with the northern Greek Early Pottery Neolithic and to offer insights related to possibly different cultural backgrounds which could have enabled and shaped different patterns of production and use of lithics. This study employs the analyses of raw materials used in the production of chipped stone assemblages and their technological and typological features to gauge the north-western Aegean context from the eastern Aegean perspective.

Keywords: Neolithic, 7th millennium BC, northern Greece, western Anatolia, technology, typology, obsidian, pressure flaking technique

INTRODUCTION

The onset of the Neolithic in the Aegean basin, early in the first half of the 7th millennium BC, reflected the introduction of farming from the Near East accompanied by the appearance of new features of material culture embedded in village lifestyles. The emergence of new techniques regarding the production of artefacts used for everyday life, such as pottery manufacture, innovations in chipped stone and polished stone production, amongst others, have been understood as part of the new Neolithic agenda (e.g. Perlès, 2001; Özdoğan, 2010; 2011). The focus on the Neolithisation processes in both Greece and Turkey in the past decades yielded a large output of new data, enabling us to discuss different regional perspectives of the formation and development of the Neolithic, as well as in regard to the pre-Neolithic sequences. Although similar trends have been proposed for the introduction of the Neolithic on both sides of the Aegean basin (e.g. Horejs *et al*., 2015; Douka *et al*., 2017), not very often the western and eastern Aegean have been studied within the same framework. It is only recently that certain aspects of the material culture have been discussed within the framework of the so-called "circum-Aegean perspective" (Reingruber, 2017) given the connectivities, exchange networks and mutual influences observed trough comparative studies and network analyses encompassing a larger investigation area (Reingruber, 2011; 2017; Gatsov *et al*., 2017; De Groot, 2019). Possible reasons for a certain lack of investigations which would have brought the two sides of the Aegean together are the

unsynchronized Neolithic chronology in Greece and Anatolia, the presumably different cultural backgrounds, as well as the different natural habitats in the various local micro-regions.

Adding to the solid evidence conerning chipped stone industries in the Argolid, Thessaly, and Crete (for the overview see Perlès, 2001; Kaczanowska and Kozłowski, 2011), northern Greece (Thessaloniki bay in particular) has provided fresh evidence of great potential towards the understanding of the northwest Aegean in a more synthetic way, based on excavations and studies of new sites (e.g., Karamitrou-Mentessidi *et al*., 2015; Dogiama, 2017, for later phases see Kakavakis, 2017). This paper therefore does not aim to present a synthesis of previous Greek Neolithic research, but to offer a basis for further discussion on the chipped stone production in one chosen region – northern Greece, from the perspective of contemporaneous developments in lithic industries in the eastern Aegean, i.e., western Anatolia. The ongoing study by the author of the Early Neolithic assemblage from Paliambela Kolindros intends to provide more data pertinent to questions concerning lithic elements involved in the Neolithisation process of this region. The present contribution represents but a first step of the author's involvement in the area.

CHRONOLOGICAL ISSUES

The Neolithic period in western Anatolia has been so far explored from its three major regions – northwest, southwest and central-west Anatolia (Fig.1), defined based on site clustering sites and shared cultural elements. The occupation of the settlements in all three regions in the Neolithic period continues throughout the 7th millennium BC, and only occasionally venturing into the first centuries of the 6th millennium BC (Özdoğan *et al*., 2012). Different relative chronologies concerning the Early and Late Neolithic in Anatolia in general (including west, central, southeast) have been used based on regional scales, especially in those areas with the presence of Pre-Pottery or Aceramic Neolithic (considered as part of the core zone of the Neolithisation). However,

Fig. 1. Map with most important 7th millennium BC sites and obsidian sources in the Aegean basin and Anatolia

focusing on radiocarbon dates, the Early and Late Pottery Neolithic refer to periods from 7,000-6,600/6,500 cal BC and 6,600/6,500-6,000 cal BC respectively (Clare and Weninger, 2014), with an arbitrary cutting line at around 6500 cal BC between the two. The major break between what is called Neolithic and Chalcolithic in Anatolia is based on the results of pottery studies, known initially from the Lakes District in the southwest, and Marmara region in the northwest (Mellaart, 1970, see also Seeher, 1990; Özdoğan, 2007). These results have been supported by new interpretations involving radiocarbon dates for the start of the Chalcolithic in Anatolia around 6,000 cal BC (Schoop, 2005; Clare and Weninger, 2014). However, new investigations search for explanations of more complex systems embedded in the Neolithic-Chalcolithic transition in western Anatolia, assuming a prolonged Late Neolithic occupation at the beginning of the 6th millenium, up until ca. 5,700 cal BC in some regions (Erdoğu and Çevik, 2015:45, table 1). Finally, based on the excavations of more than 25 settlements in western Anatolia (Özdoğan, 2011), there is a consensus concerning the absence of true Pre-Pottery Neolithic (hereafter PPN) in the region, known from the southeast and central Anatolia, although some surveys in this wide area speak in favour of potential earlier intrusions of people from the neighbouring PPN areas (Özdoğan, 2008:150).

Similar assumptions concerning the possible existence of an Aceramic horizon in western Aegean are based on the evidence from Thessaly (Milojčić, 1962). However, if we look at western Anatolia, it seems now that the ceramic production might not be the crucial element for recognising the beginning of the "Pottery" Neolithic, rather, it is suggested that the start of the Neolithic rather denotes a very minor ceramic impact, confirmed by the findings from a couple of early dated sites such as Çukuriçi, Ulucak and Barcın Höyük (Horejs *et al*., 2015; Çevik and Abay, 2016; Gerritsen and Özbal, 2016). Similar rare occurrences of pottery in the first stages of the Neolithic are observed in Greece as well (see Reingruber, 2015; 2017; Perlès, 2001).Therefore, this scarcity of pottery should be considered as one of the features of Early Pottery Neolithic alongside the absence of PPN characteristics in the material culture of western Aegean, characteristics known primarily from the core area of the Neolithisation in Western Asia (for the core area see e.g. Özdoğan, 2011).

Due to a plateau in the calibration curve between ca. 7,000 and 6,700/6,600 BC known from the modelling of the radiocarbon data for the broader Mediterranean area, there are limitations in recognizing the first centuries of the 7th millennium BC. Thus, in western Anatolia, the C14 evidence from Çukuriçi, Ulucak and Barcın Höyük inform about the start of the Neolithic at around 6,700 cal BC (Weninger *et al*., 2014; Horejs *et al*., 2015). The earliest Neolithic dates in western Aegean are from Franchthi and Knossos, where the onset of the Neolithic goes back to 7,000 cal BC or just afterwards (Perlès *et al*., 2013; Douka *et al*., 2017). Based on that, the dates from northern Greece attest to a slightly later start of the Neolithic in comparison with the Argolid and Crete (Maniatis, 2014; Karamitrou-Mentessidi *et al*., 2015), and a more detailed outline for Thessaly was discussed in detail just recently by Reingruber *et al*. (2017). It appears that the modelled data of Weninger *et al*. (2014) suggested an "in parallel start" of the Neolithic in Greece with western Anatolia around 6,600/6,700 cal BC, yet more data-correlation is needed to form a complete picture for the Aegean basin (updates by Reingruber and Thissen, 2017; see also Brami, 2015).

Despite a possibly similar start of the Neolithic in the entire Aegean basin, the major chronological and terminological difference between the western and eastern Aegean rests on the uneven end of the Neolithic in both regions. As stated above, western Anatolian Neolithic had lasted throughout the 7th millennium BC, while the Greek Neolithic was significantly longer, continuing almost until the end of the 4th millennium BC. Thus, the western Aegean 7th millennium BC is represented exclusively by the Early Neolithic phase (EN), while the Middle Neolithic (MN) and Late Neolithic (LN) in Greek terms refer to period only after 6,000 BC (see e.g. Alram-Stern, 1995; Reingruber *et al.*, 2017). For that reason, comparing western and eastern Aegean requires careful consideration of dating, as the (Pottery) Neolithic in western Anatolia, i.e. eastern Aegean (including both Early and Late

Pottery Neolithic in this region) in duration equals only with so called Early (Pottery) Neolithic in Greece, as a part of the long Neolithic sequence mentioned above.

CULTURAL BACKGROUND

The Neolithisation process in the Aegean basin has been addressed through two major scenarios – an autochthonous development of the Neolithic from the local Mesolithic on spot (with or without external influences on shaping the formation of the Neolithic), and the complete introduction of new Neolithic way of life especially in places where the pre-Neolithic sequence is unknown or virtually absent. At the same time, different routes of the spread of the Neolithic (involving demic diffusion) have been proposed based on investigation of subsistence strategies and awareness of large networks incorporating exchange of ideas, technologies, objects and finally people (e.g. Perlès, 2001; Özdoğan, 2011; Horejs *et al*., 2015). Thus, understanding of the pre-Neolithic horizon is crucial for the discussion of the nature of first Neolithic communities in one area, especially when chipped stones are concerned, as this part of the material culture was of great importance in the preceding periods.

Although western Aegean with the islands provided a much clearer picture of the occupations in the 9th and 8th millennia BC in contrast to the eastern Aegean (Runnels, 1995; Demoule and Perlès, 1993; Galanidou and Perlès, 2003; Kaczanowska and Kozłowski, 2014; Sampson, 2010; 2014; Sampson *et al*., 2012; Carter *et al*., 2016; Kozłowski, 2016), the record from the end of the 8th and beginning of the 7th millennia. BC, i.e., from the period just prior to the onset of the Neolithic, remains quite poorly understood on both sides of the basin. Meanwhile, obsidian artefacts were confirmed from the majority of the known Mesolithic sites, testifying about the existence of a large Aegean network related to raw material sources on the island of Melos circulating well before the Neolithic (Carter *et al*., 2018).

Franchthi cave in the Argolid is one of the unique cases in the Aegean basin with evidence on the continuation from the Mesolithic to the Neolithic (comprising a Final Mesolithic occupation at ca. 7,200-7,000 BC), where Perlès discussed elements which underwent changes with the arrival of the Neolithic on the site (Perlès, 1990; 2001). This pre-Neolithic horizon demonstrates "crude flake tools" and the use of trapezes as transverse arrowheads, alongside scrapers and backed pieces (Perlès, 1990:84-93). On the other hand, Kozłowski and Kaczanowska argued for the period after mid-8th millennium BC to be represented by a flake-based industry and splintered technologies, accompanied retouched flakes, denticulates, notches and end-scrapers (Kaczanowska and Kozłowski, 2014:46; Kozłowski, 2016). Based on the evidence from the Aegean islands where similar technologies were attested, they coined the term "Early Holocene Aegean Island Tradition" (Sampson *et al*., 2010), which has been used extensively ever since to support the new data (e.g. Carter *et al*., 2016:181; Çilingiroğlu, 2017: 33). According to similar finds from the new survey in the Karaburun peninsula, Çilingiroğlu suggested that a part of the central-west Anatolia in the period prior to the Neolithic can be seen as an extension of the Aegean Mesolithic, also represented through the flake-based industry, though still without any obsidian. These findings are currently the only example of the period likely dating to the 9th and 8th millennia BC, in a region previously considered as "empty" (Çilingiroğlu *et al*., 2016; Çilingiroğlu, 2017:33). Despite the fact that we still lack more sturdy evidence for a continuation between the pre-Neolithic and Neolithic sequences in central-west and southwest Anatolia (where Epipaleolithic presence was found mainly in cave sites), in the northwest a direct influence of a pre-Neolithic horizon has been claimed for the Neolithic chipped stone industries in the Marmara region, based on the presence of different blade-based technologies, observed at the possible Epipaleolithic or Mesolithic Ağaçlı group of sites (Gatsov and Özdoğan, 1994; Gatsov, 2003; Gatsov and Nedelcheva, 2011). Although the relation between terminology, chronology and specific cultural determination is discussed elsewhere in more details (Milić, 2018), it is noteworthy to mention that occasionally both terms, Epipaleolithic and Mesolithic, are used to address the pre-Neolithic sequence in

western Anatolia, and in more particular 9th and 8th millennium BC. However, Epipaleolithic, as known from southwest Anatolia for instance, concerns Pleistocene occupation and should be clearly regarded in this context. Mesolithic, from another side remained as a term consistently used in western Aegean and on the islands to denote the presence of hunter-gatherers and fishers at the beginning of the Holocene, and should be as such more carefully used in parallel with another term, i.e. Epipaleolithic for the Aegean basin and Anatolia.

CHIPPED STONE INDUSTRIES IN WESTERN ANATOLIAN NEOLITHIC

Chipped stone assemblages in previously mentioned three major regions of western Anatolia in the 7th millennium BC share several common features regarding the technological and typological aspects of production. However, regional developments of chipped stone industries also point out differences in the use of raw materials and details of the production techniques, which might stem from different networks of single micro-regions during the Early and Late Pottery Neolithic. The first half of the 7th millennium BC in western Anatolia is still poorly understood regarding lithics, due to the lack of published data and a general scarcity of sites dating to the Early Pottery Neolithic in the broader area. Nonetheless, some issues related to chipped stone datasets can be outlined based on the assemblages comprising 517 artefacts from the first two phases (XIII and XII) of Çukuriçi Höyük, dated to ca. 6,700-6,500 cal BC (for the site's chronology see Horejs, 2017:17). In the earliest occupation of the site, phase XIII, 33% of the tools (or is it artefacts? please clarify) are made on obsidian, in parallel with chert and rock crystal (clear quartz) representing 54% and 13% respectively, while in the later phase XII obsidian artefacts comprise 68% of the assemblages (with 32% made of chert). This shift in raw materials is also mirrored in the technological and typological aspects of production. Clearly, a blade-based technology with pressure flaking predominates once the obsidian amounts had increased. According to Neutron Activation Analyses (NAA) and pXRF study conducted on the material from the site, it appears that the obsidian can be traced exclusively to the Melian sources (Milić, 2018). In-depth study implies that the first settlers of Çukuriçi already arrived with a package of technological know-how including the knowledge of pressure technique for blade making, which had directed the orientation towards the major production of blades throughout the Neolithic sequence, particularly relying on obsidian until the end of the millennium. The rather small proportion of obsidian at the start of the occupation, in contrast to its later significant increase at Çukuriçi (reaching up to 86% around 6,400 cal BC) suggested that the first farmer settlers were forming the paths in the Aegean networks gradually from the time of their arrival from elsewhere, most likely from the east using the maritime routes alongside the southern Anatolian coast (Horejs *et al*., 2015). Core reduction on chert and rock crystal (Fig.2 and Fig.3), the latter being used exclusively in this first phase (XIII) of the Early Pottery Neolithic, attested to on-site production of bladelets by direct percussion and pressure (Fig.4 and Fig.5), as well as the manufacture of small flakes – judged by the small unidirectional and those with changed direction cores attesting to complete exploitation of the material (Fig.4 and Fig.5). There are also some core preparation and rejuvenation elements, and a small amount of debris. The tools include retouched blades and flakes, notches, end-scrapers, rare sickle

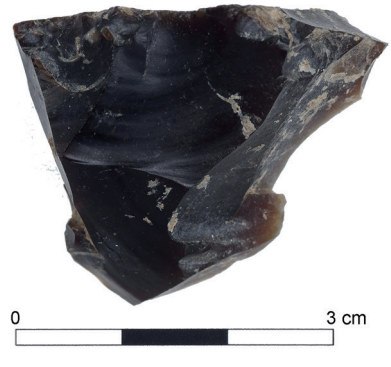

Fig. 2. Unidirectional chert core from the Early Pottery Neolithic phase XIII at Çukuriçi Höyük (6,700-6,600 cal BC) (© ERC Prehistoric Anatolia, photo Niki Gail)

Fig. 3. Rock crystal (clear quartz) flakes and core with changed direction from the Early Pottery Neolithic phase XIII at Çukuriçi Höyük (6,700-6,600 cal BC) (© ERC Prehistoric Anatolia, photo Mario Börner)

Fig. 4. A set of retouched tools (end-scraper on flake) and unretouched blade(let)s produced by direct percussion and pressure technique from the Early Pottery Neolithic phase XII at Çukuriçi Höyük (6,600-6,500 cal BC) (© ERC Prehistoric Anatolia, photo Niki Gail)

Fig. 5. A set of retouched and unretouched blades from the Early PotteryNeolithic phase XIII at Çukuriçi Höyük (6,700-6,600 cal BC) (© ERC Prehistoric Anatolia, photo Niki Gail)

blades and drills, alongside single appearances of geometric microliths (lunates) and specific types of projectile points (foliates) (Milić, 2018; Horejs *et al*., 2015). Although only single mentions of the material from the contemporaneous assemblages are available from other sites such as Ulucak in the central-west, and Barcın Höyük in the northwest Anatolia, it seems that Çukuriçi Höyük appears to be unique in the region in terms of the obsidian use, with a negligible percentage of this material recognised from the Early Pottery Neolithic at Ulucak Höyük (Çevik and Abay, 2016:187). On the other hand, more details in the ongoing studies on Ulucak and Barcın are needed to clarify the technological aspects of lithic production, but so far it seems plausible that Ulucak early technology relates to the production of flakes over blades (Çevik and Abay, 2016:188), attesting therefore to a different pattern than at the neighbouring Çukuriçi Höyük. Finally, it seems that Barcın in the northwest of Anatolia represents a similar image to Çukuriçi, with the likely use of pressure technique for blade production already from the beginning of the settlement's occupation in the first half of the 7th millennium BC (Gatsov *et al*., 2017:60). This implies that there existed different regional technologies concerning in particular blade and flake-based industries at the onset of the Neolithic, reflecting to some extent different technological packages of the first farmers arriving in these regions at around the same time.

In a similar way, much better evidence from the Late Pottery Neolithic, known from the significantly higher number of sites dating to the period of 6,500-6,000/5,700 cal BC (Fig.1),

speak in favour for different processes of Neolithisation in three mentioned regions of western Anatolia, concerning different directions of the development of the Neolithic way of life relating to the second half of the 7th millennium BC. In general, a strong tendency towards blade production in parallel with flake-oriented technologies has been recognised at the majority of western Anatolian Late Pottery Neolithic sites. Local chert varieties were used in parallel with obsidian, present in much lower amounts. In most cases both raw materials attested to an on-site core reduction for the purposes of tool making. The origins and proportions of obsidian testify for different use of Melian, i.e., Aegean and Cappadocian sources during the Late Neolithic on micro-regional scales (Milić, 2014:288, fig. 2), which could further imply connections of the western Anatolian coast with the Aegean world on the one hand, and central Anatolia, on the other hand.

Different regional patterns regarding chipped stone production in western Anatolian micro-regions during the Late Pottery Neolithic are briefly summarised in the following text. The results of the study on chipped stones from eastern Marmara and northwest Anatolian Aegean coast, mostly published by I. Gatsov and P. Nedelcheva, provide a good basis for understanding the trends of production in northwest Anatolia. Sites of eastern Marmara after 6,500 cal BC provide evidence for an extensive on-site production of (micro)-blade(let)s by pressure technique, alongside the use of direct percussion and punch, and less frequent flake production (Gatsov and Nedelcheva, 2011). It seems that in this particular region, despite the existing evidence for the use of different pressure modes, among which are also more advanced ones aiming the production of longer blade(let)s, a higher specialisation in reduction of small cores was employed. This is emerging from the abundance of bullet cores, which were presumably initially reduced from conical cores following strictly defined knapping methods (Gatsov, 2005; Balcı, 2011; Gatsov *et al*., 2017). This differs significantly from central-west Anatolia, where, based on the Çukuriçi datasets, core reduction systems rely more frequently on blade detachment from conical, semi-conical and wedge-shaped cores (Fig.6:b-c), in a different mode of exploitation related to pressure flaking, only rarely leading to the shape of bullet cores. This might be explained by the different goals of the blade production, which at Çukuriçi rested largely on the pressure flaking with the use of short and long crutchs, aiming for manufacture of longer or medium-sized blade(let)s. On the other hand, the Lakes District record depicts a mixture of the two, with the presence of both high number of bullet cores and pressure flaked larger blades with less standardised reduction patterns based on conical cores (Balkan-Atlı, 2005; Milić, 2018). Conversely, sites in eastern Thrace demonstrate surprisingly small amount of chipped stone artefacts in the Late Pottery Neolithic in general, as well as different patterns of production with the virtual absence of pressure technique, replaced by the presence of macro-blade technologies with punch technique alongside flake technology (Gatsov, 2009; Gatsov and Nedelcheva, 2011). Finally, datasets from the site of Uğurlu show a rather mixed evidence for the presence of both macro-blades produced by punch and on-site pressure flaking (Erdoğu, 2013:7; Guilbeau and Erdoğu, 2011). At the end, the majority of studied assemblages imply the on-site reduction of obsidian to a certain extent, being extra-local to all of the settlements in western Anatolia. Only rare sites, such as Coşkuntepe dispute this evidence, with some imported obsidian pressure blades to the site from elsewhere next to an on-site production on local raw materials (Perlès *et al*., 2011:44). First-hand studies on chipped stone technology from Çukuriçi Höyük provided further insights in potential levels of specialisation in pressure flaking by local artisans during the Late Pottery Neolithic, where a high standardisation in production of blade(let) (Fig.6:a,g), the intentional sectioning aiming for medial fragments, and rather unique depositions, such as caches of obsidian blades produced by standing pressure technique have been documented (Horejs *et al*., 2015; Milić and Horejs, 2017; Milić, 2018). Besides, the rich site's assemblage and long continuous occupation offered a basis for recognising different knapping methods in obsidian and chert, with distinct production aims, i.e., blades on obsidian and flakes and blades on chert, suggesting a slightly different use of tools of the two raw materials accordingly. Apart from

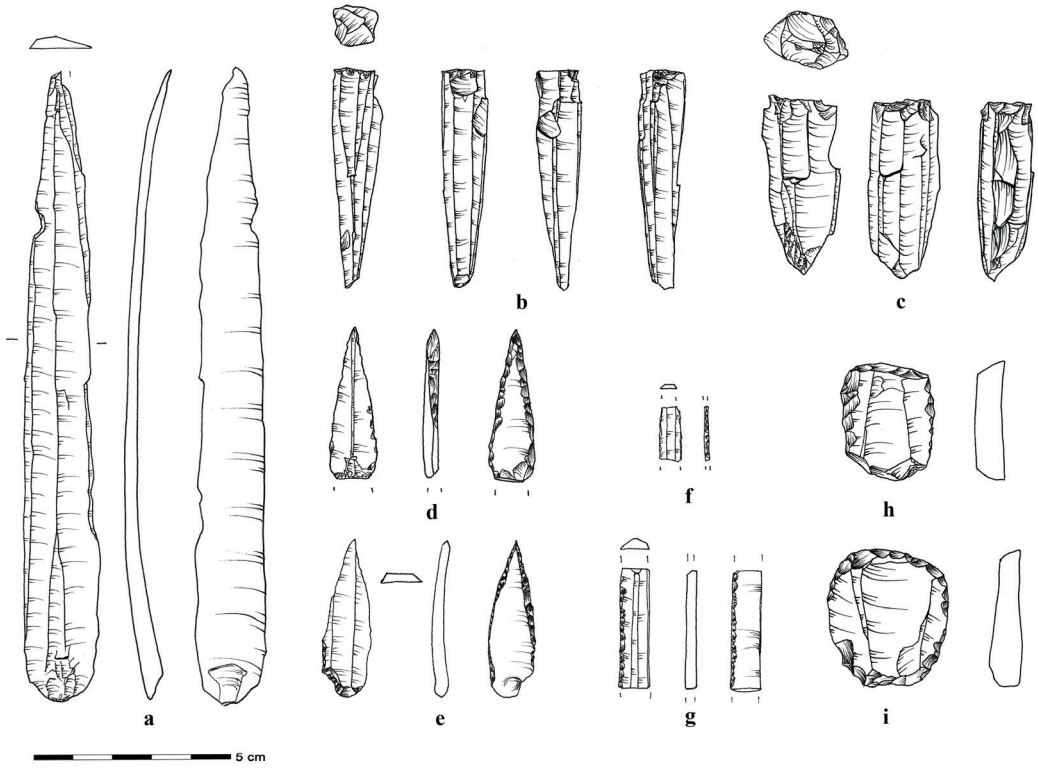

Fig. 6. A set of cores, blanks and retouched tools (points, backed and retouched bladelets, circular scrapers) from the Late Pottery Neolithic (6,500-5,970 cal BC) at Çukuriçi Höyük (drawings B. Milić)

the technological skill, it is evident that there is a mutual relationship between the strong focus on pressure blade production and the abundance of obsidian at Çukuriçi Höyük, which, with its proportions up to 86% in the Late Pottery Neolithic assemblages completely contrasts the evidence from other contemporaneous sites in western Anatolia, despite the fact that the raw material source was almost 300km away from the site (Milić, 2018).

Typological analysis of the Late Pottery Neolithic chipped stones outlines certain homogeneity in the evidence for the entire area of western Anatolia, however, there are several elements which are attesting to a different use of some of the tools in the aforementioned regions. Common tool types at the majority of the settlements occupied between 6,500 and 6,000/5,700 cal BC are retouched blades and flakes, sickle blades, end-scrapers, perforators and drills, notches, truncations and denticulates, and occasionally semi- and circular scrapers (e.g. Gatsov and Nedelcheva, 2011; Baykal-Seeher, 1994; Milić, 2018). On the contrary, tool types such as burins, geometric microliths, projectile points and backed bladelets On the contrary, tool types such as burins, geometric microliths, projectile points and backed bladelets are appearing only rarely, and are not distributed in all micro-regions of the eastern Aegean (northwest, central-west, southwest Anatolia), which can point out to different traditions in tool making and tool consumption in the developed phase of the Neolithic here. While geometric microliths, most commonly trapezes, have been found at several sites in the eastern Marmara region (Gatsov, 2009; Gatsov and Nedelcheva, 2011; Balcı, 2011), the central-west and southwest Anatolia are so far completely devoid of this tool types during the Late Pottery Neolithic. A single lunate, i.e.,

segment was documented from Çukuriçi Höyük, however, it derives from the first Neolithic phase on the site, dating back to the first half of the 7th millennium. BC (Horejs *et al*., 2015:306, fig. 7a). In parallel, projectile points have been so far absent in the northwest of Anatolia (Gatsov and Nedelcheva, 2011:91), though they were reported recently for the entire Neolithic sequence in central-west Anatolia, based on the findings from sites in the Izmir region, Çukuriçi Höyük amongst them (Fig.6:d-e) (Milić, 2018; Kolankaya-Bostancı, 2014). A few projectiles appeared also in the Neolithic sequences in the southwest Anatolia, i.e. Lakes District, yet in a possibly different cultural context due to their morphology and possibly earlier dating, prior to 6,500 cal BC (Mortensen, 1970:448; Balkan-Atlı, 2005:196). At the same time, there are a couple of obsidian backed bladelets in the Late Pottery Neolithic of Çukuriçi Höyük, which are absent in other regions of western Anatolia. Burins are so far reported only at Aktopraklık in the northwest (Balcı, 2011:5), though in single numbers and additionally at some of the Lakes District sites in the southwest (Balkan-Atlı, 2005:196; Baykal-Seeher, 1994:106). As mentioned above, they are virtually absent from other sites in the northwest and central-west Anatolia (Gatsov and Nedelcheva, 2011; Milić, 2018). Finally, tools made on macro-blades of the so-called Karanovo type are restricted to certain sites such as Hoca Çeşme and Uğurlu, located in the northwest Anatolian Aegean coast and on the island of Gökçeada (Gatsov, 2009; Guilbeau and Erdoğu, 2011), and can indicate yet another techno-typological variant present in western Anatolia.

To sum up, the Late Pottery Neolithic period in western Anatolia exhibits a higher variety of tools on single site-, micro-regional and regional levels in comparison to the local Early Pottery Neolithic record. Indeed, this is suggested based only on the local, scarce Early Neolithic evidence, as previously emphasized both regarding the small sizes of known assemblages and current lack of published data from the first half of the 7th millennium BC. Nevertheless, what emerges from the general picture speaks in favour of minor, but likely culturally significant differences between the Early and Late Pottery Neolithic of western Anatolia in all three aspects of chipped stone production – the use of raw materials, production techniques and composition of toolsets.

NORTHERN GREECE IN FOCUS

As this article intends to discuss the chipped stone production in the northwest Aegean based on the author's experience from the eastern Aegean, i.e. western Anatolia, lately published materials from the sites such as Mavropigi and Revenia will be outlined briefly in this sub-chapter.

The purpose to include only a single micro-region here (northern Greece with mentioned sites Mavropigi and Revenia) for representing the northwest Aegean rests on the idea to test the comparison with the eastern Aegean, i.e. western Anatolia based on fully dated and published contemporaneous assemblages in order to provide a starting point for more detailed discussions in future, including other regions in the Aegean, such as Thessaly, Argolid and Crete for instance. Without the intention to repeat the outcomes of the in-depth studies, this section aims to provide the data peretinent to the first and second half of the 7th millennium BC so to be able to approach the three aspects of chipped stone production discussed above for western Anatolia.

From all Early Pottery Neolithic sites in the northwest Aegean, Mavropigi provides the best sequence with fully studied chipped stone assemblages, supported by specific radiocarbon dates enabling to address the material culture in more detail (Karamitrou-Mentessidi *et al*., 2015:58). In total 3000 artefacts were excavated throughout the occupation in the 7th millennium BC. The first occupation phase (I), representing the first half of the 7th millennium had provided a limited number of artefacts, attesting to the on-site production of quartz items, splintered technique and cores with double platforms, and a small amount of extra-local materials such as obsidian and flint, as finished blades, which according to Kaczanowska and Kozłowski likely attest to exchange with the region of Thessaly (Karamitrou-Mentessidi *et al*., 2015:89). Tool types from this earliest phase on the site comprise burins, retouched blades and sickle implements (Karamitrou-Mentessidi *et al*., 2015:91). Two successive settlement phases (II and III), dating

to after 6,500 cal BC inform about a gradual increase in chipped stone production on-site, as well as the introduction of presumably new local materials, which influenced the broader spectrum of production techniques in parallel with a higher typological variety. It seems that in phase II the on-site production strongly relyed on quartz knapping. This is attested by through the presence of quartz cores, flakes and debris. Quartz flake production by the splintered technique coincided with a blade component on other raw materials (radiolarite, obsidian and different flint varieties). Blades were mainly produced by pressure and punch techniques and are manufactured from both local and non-local raw materials (Karamitrou-Mentessidi *et al*., 2015:73-76). Previously documented burins and other tool types were enriched in this phase with a modest presence of end-scrapers, trapezes, perforators, truncations, notches, and other types retouched and used blades (Karamitrou-Mentessidi *et al*., 2015:73-78). Finally, towards the end of the sequence and the end of the 7th millennium BC, a significantly larger assemblage yielded information as regards a reduction in the use of quartz (still very well represented) in favour of the on-site knapping of radiolarite, representing another local raw material presumably brought in from the close vicinity of the site, resulting in a higher visibility of the blade element in the assemblage (produced mainly from unidirectional and changed-direction cores), nonetheless, still retaining the tradition of quartz knapping, splintered technique and a dominant quartz flake component (Karamitrou-Mentessidi *et al*., 2015:79-82). Maximal variety of tools was reached in phase III, comprising a large number of retouched blades, burins (and burin spalls), sickle blades, trapezes, truncations, notches and denticulates, end- and side-scrapers, and rare retouched flakes and backed pieces. Besides, a cache of finds with almost 100 radiolarite debitage products has been found in a pit in the same phase, which seems to represent a cache of a symbolic value (Karamitrou-Mentessidi *et al*., 2015:83-88). Despite the fact that production orientation changed in the last Early Pottery Neolithic phase, there were still no cores of exotic flint varieties and obsidian present on the site. In phases II and III at Mavropigi the on-site pressure blade making was portrayed through the high number of radiolarite blades although pressure technique seems to be present in the region, including the areas further south from the very beginning of the Early Neolithic sequence (Karamitrou-Mentessidi *et al*., 2015:82; Perlès, 2001). Kaczanowska and Kozłowski argue that the blanks of extra-local raw material were modified in workshops, most likely located close by the sources and further modified into retouched tools on-site once they were distributed by middle-men (Karamitrou-Mentessidi *et al*., 2015:93). Additionally, alongside obsidian, some of the non-local raw materials found on this site, especially the so-called "silex blond", significant for the Early Pottery Neolithic in Greece seem to either be distributed by highly specialised itinerant knappers (Perlès, 2001) or exchanged via long distances, reaching northern Greece through exchange of goods via Thessaly since the first half of the 7th millennium BC (Karamitrou-Mentessidi *et al*., 2015:72).

While the earlier publications of the Early Pottery Neolithic Nea Nikomedea inform about the significant use of quartz (Karamitrou-Mentessidi *et al*., 2015:93; Elster, 1977), and presence of flint blade caches (Rodden, 1964), similar to what was observed in Mavropigi contemporaneous assemblages of Revenia recently provided an insight into a possibly different pattern for the use of raw materials in northwest Aegean, although the author of the study pointed out that so far only 11% of the total chipped stone material (entire 100% assemblage comprised of 2600 pieces) recovered from the Early Pottery Neolithic at the site has been analysed (Dogiama, 2017). First results from Revenia speak in favour for the major use of flint (local and non-local) and obsidian (non-local), almost reaching 50% each, besides tiny amounts of quartz and opal (Dogiama, 2017:448), entirely contrasting the evidence from Mavropigi with the minor role of obsidian with maximal proportions of 7% in the phase III (post 6,500 cal BC) on the site (Karamitrou-Mentessidi *et al*., 2015:77). The major argument for the difference in the character of chipped stones between these two sites is the on-site knapping of obsidian at Revenia, based on the presence of core rejuvenation elements and some debris, alongside with an exhausted pièce esquillée obsidian core (Dogiama, 2017:449-450).

Briefly summarised, pressure technique, presumably used in parallel with punch technique, direct percussion, and splintered technology (i.e., the presence of pièces esquillées) seems to be aimed at modifying obsidian raw material. The author (Dogiama, 2017:449) compares the chaîne opératoire of obsidian and non-obsidian raw materials (different varieties of flint and minor quartz and opal), mainly based on similar technological details recorded and an on-site core reduction. Clearly, the pressure technique was considered as the most appropriate for the production of obsidian blades and micro-blades (Dogiama, 2017:448-457). Thus, an introduction of semi-prepared or prepared nodules of obsidian and flint to the site has been proposed for Revenia, where knapping of blanks and modification of tools occurred in direct relation to excavated pits (Dogiama, 2017:457). The tools types recovered at Revenia comprise retouched, blades, sickle blades, scrapers, burins, drills, denticulates, and a significant number of geometrics - trapezes, triangles and rectangles (Dogiama, 2017:454-457).

Although the studied material is still small in comparison to Mavropigi and more precise dating of the sequence is needed to get a diachronic perspective of chipped stone production at Revenia, similar toolsets and the presence of non-local raw materials imply that the sites in northern Greece were incorporated within the north-western Aegean network during the Early Neolithic, with a certain orientation towards Thessalian sites as suggested by both Kaczanowska and Kozłowski (Karamitrou-Mentessidi *et al*., 2015) and Dogiama (2017).

DISCUSSION

Contextual analysis of chipped stone assemblages, taking into consideration the different cultural contexts given the location, modified and natural environment and other elements of material culture as well as the micro-regional developments of the Neolithic in the 7th millennium BC provided a great potential to discuss and accordingly bridge the evidence from two different sides of the Aegean. The first impression that is striking for someone who deals with the western Anatolian assemblages is actually the amount of artefacts recovered in the northwest Aegean (northern Greece) during the 7th millennium (e.g., the highest number of artefacts claimed at Mavropigi, n=3000) in contrast with the contemporaneous sites in the eastern Aegean, where assemblages easily reach 18.000-20.000 pieces or more during the same Neolithic time span, as known from the central-west Anatolia (Izmir region) for instance. This can be due to the difference in the extent of the excavated areas in Greece and Turkey, still, it seems that has more to do with differences in the built environment (pits in the west versus more permanent domestic architecture in the east) and other aspects of production.

One of the most crucial differences between the northern Greek and western Anatolian assemblages lies in the details of the on-site production patterns. In the northern Greek assemblages and Mavropigi especially, one can observe that the knapping of non-local raw materials on site is quite restricted and there is a fully developed exchange network ensuring the introduction of ready-made blades on obsidian and non-local flint varieties (Karamitrou-Mentessidi *et al*., 2015). Although the preliminary results from Revenia speak in favour of an in-situ knapping of obsidian (Dogiama, 2017), more data is needed, based on a complete study of the whole assemblage in order to understand in depht the production systems of this assemblage, which would indeed go more in line with what is currently known from the majority of western Anatolian assemblages.

The first half of the 7th millennium BC remains unclear as regards micro-regional developments of chipped stone industries on both sides of the Aegean. The present paper addresses in detail two assemblages – Çukuriçi in western Anatolia and Mavropigi in northern Greece where the short occupations prior to 6,500 cal BC provide important insights on aspects of production. It seems plausible that pressure technique is present from the onset of the Neolithic in both cases. The focus on its application for blade production is observed in Çukuriçi's earliest assemblage, comprising obsidian, chert varieties and rock crystal (clear quartz), alongside other production techniques including direct percussion. Meanwhile, the small assemblage from Mavropigi phase I demonstrated a very

different on-site production pattern of splintered technology primarily on quartz, along with a gradual introduction of ready-made blades from elsewhere, indicating the existence of pressure technique somewhere in the wider area of north-western Aegean (Karamitrou-Mentessidi *et al*., 2015). Both the presence of quartz and the use of a particular knapping mode using the so-called anvil technology of bipolar cores on the site, was prominent in this area throughout the complete sequence of the Early Pottery Neolithic in Greece until the end of the 7th millennium BC, indicating a significant difference in production modes compared with western Anatolian datasets. Similarly, the constant presence of burins in northern Greece from the start of the Neolithic stands in contrast to their absence from the early toolsets in western Anatolia, in particular prior to 6,500 cal BC, and very limited presence later on. On the other hand, there seems to be an extensive use of quartz in the Mavropigi assemblage, northern Greece from the beginning of the Neolithic sequence, which is very peculiar given the fact that other local raw materials with better knapping properties were available in the vicinity (as confirmed from the later stages of the Early Pottery Neolithic). Even if it is possibly too early to discuss potential cultural choices reflected in the determined use of quartz at the onset of the Neolithic, it is worth noting that a similar picture has been outlined for the central Balkans based on the Early Neolithic assemblages from Serbia, though of much later radiocarbon dating (Bogosavljević-Petrović and Starović, 2016). The aforementioned presence of clear quartz, i.e., rock crystal at Çukuriçi Höyük (Horejs *et al*., 2015), limited only to the settlement foundation phase is also worth mentioning in this context. Finally, contrary to the northwest Aegean assemblages, the first half of the 7th millennium BC, in theeastern Aegean, particularly known from Çukuriçi Höyük, is marked by the presence of peculiar types of projectile points, present specifically in this region in western Anatolia in the later phases as well.

The second half of the 7th millennium BC provides much more data for a solid, detailed discussion of production aspects regarding northern Greece and western Anatolia (Table 1). There was continuation in presence of pièces esquillées as tools and as a part of bipolar production of artefacts by anvil, or splintered technology (mainly in quartz, but also on obsidian) observed at Mavropigi and Revenia is accompanied by the presence of other production techniques attesting to a flake and blade manufacture on-site with a concommitant introduction of blades from elsewhere in northern Greece (Karamitrou-Mentessidi *et al*., 2015; Dogiama, 2017). Pièces esquillées, mainly used as splinter tools have been recognised in western Anatolia as well, though through a very minor representation in the Late Pottery Neolithic assemblages in the eastern Aegean (post 6,500 cal BC) (Milić, 2018). However, the main feature of western Anatolian assemblages concerns blade production by the use of pressure, direct percussion and less frequently punch technique, with regional differences reflected in an extensive presence of various core types, knapped primarily on-site on both local and non-local raw materials. While in western Aegean distinct exchange networks were employed in the circulation of blades made of obsidian and specific flint varieties, such as "silex blond" (Perlès, 2001; Karamitrou-Mentessidi *et al*., 2015), similar networks involving macro-blade technology incorporating the use of punch related to the white dotted honey flints are know from northeast Aegean Anatolia, in Turkey and on the Gökçeada island only in the very late centuries of the 7th millennium BC. At the moment, no bullet (and regular conical) cores, attested at many sites in western Anatolia have been documented in northern Greece. On the other hand, various toolsets known from micro-regions of western Anatolia could potentially speak in favour of some shared traditions in the use of retouched tools with northern Aegean. This in particular concerns the appearance of geometric microlithic, mainly trapezes (primarily used as transverse arrowheads) in parallel in eastern Marmara region and northern Greece, where they seem to be intensively and continuously used. Further, the presence of projectile points so far remains limited exclusively to central-west Anatolia, where similar types of such tools seem to denote a certain specificity of a lithic industry observed in the sites in the Izmir region (Milić, 2018). In the end, only rare sites in western Anatolia offered

Table 1. Main features of the chipped stone industries in the 7th mill. BC in the regions discussed in this paper

Aegean Chipped stone industries of the 7th mill. BC		Northern Greece (Mavropigi)	Northern Greece (Revenia)	Turkish Thrace	Gökçeada (Uğurlu)	Eastern Marmara	Central-west Anatolia	Southwest Anatolia
Raw materials	Obsidian	✓	✓	✓	✓	✓	✓	✓
	Quartz	✓	✓	✗	✗	✗	✓	✗
	Chert/Flint/Radiolarite	✓	✓	✓	✓	✓	✓	✓
	"Silex blond"	✓	?	✗	✗	✗	✗	✗
	White spotted honey flint	✗	✗	✓	✓	✗	✗	✗
Chipped Stone Technology	On-site production of local rm	✓	✓	✓	✓	✓	✓	✓
	On-site production of non-local rm	✗	✓	✓	✓	✓	✓	✓
	Bipolar anvil, splintered technology	✓	✓	✗	✗	✗	✗	✗
	Pressure technique	✓	✓	✗	✓	✓	✓	✓
	Direct percussion & punch	✓	✓	✓	✓	✓	✓	✓
	Bullet cores	✗	✗	✗	✓	✓	✓	✓
	Flake-based technology	✓	✓	?	?	✓	✓	✓
	"Macro-blade" technology	✓	✓	✓	✓	✗	✗	✗
	"Micro-blade" technology	?	✓	✗	?	✓	✓	?
Toolset	Retouched blades & flakes	✓	✓	✓	✓	✓	✓	✓
	Scrapers	✓	✓	✓	✓	✓	✓	✓
	Drills & perforators	✓	✓	✓	✓	✓	✓	✓
	Sickle blades	✓	✓	✓	✓	✓	✓	✓
	Backed blade(let)s	✓	✗	✗	?	✗	✓	✗
	Burins	✓	✓	✗	?	✗	✗	✓
	Trapezes	✓	✓	✗	✗	✓	✗	✗
	Lunates (segments)	✗	✗	✗	✗	✗	✓	✗
	Projectile points	✗	✗	✗	✗	✗	✓	✓
	Pièces esquillées (tools)	✓	✓	✗	?	✓	✓	✗
Special finds	Depots/caches	✓	✗	✗	✗	✗	✓	✗

evidence of intensified networks of obsidian exchange and use of this raw material in the second half of the 7th millennium BC. So far, Çukuriçi remains an exception of this statement with the dominant use of obsidian preferred over other local chert varieties, taking into consideration the distance between the site and the Melian sources on the Aegean island. However, similar patterns concerening the introduction of obsidian in forms of already prepared nodules to settlements can be recognised in both northern Greece (as proposed by Dogiama, 2017 for Revenia), and

western Anatolia, whereas the intensity of this phenomenon reflects the involvement of single settlements in the networks. Finally, there was a broadening of the networks in both regions, with other obsidian sources from central Anatolia circulating in western Aegean, and in parallel more flint varieties presumably from the north and south circulating in the northern Greece, which likely mirrored different network catchments during the second half of the 7th millennium BC. At the end, new investigations are bringing to light also aspects of symbolic behaviour for instance finds of special depositions and caches of chipped stones overall offering the possibility to address and discuss regional identities in this period.

CONCLUSION

Evidence bridging eastern and western Aegean, focusing here on northern Greece to address western Aegean in particular, has been tested trough a comparative study of major chipped stone elements related to three main production aspects – the use of raw materials, and technological and typological features related to the primary and secondary production of blanks and tools respectively. Although datasets from the first half of the 7th millennium BC remain quite unclear from these regions, there are two major points to address for western Anatolia and northern Greece. The first is that there was a spread of pressure technique at the same time as the first farmers spread into the Aegean, presumably originating in the Near East based on the Anatolian evidence, as the pre-Neolithic sequence in the Aegean basin was devoid of this technique prior to the 7th millennium BC. Furthermore, the pressure technique could have been brought directly by the newcomers and used on-site in these early instances, which is supported by the western Anatolian evidence, or distributed through bade(let)s exchange within already established networks of raw materials circulation obsereved in both northern Greece and western Anatolia. The second point relates to quartz and bipolar anvil technologies involving splintered pieces, characteristic for the northern Aegean, likely to be related to the local development of lithic industries potentially having to do with the pre-Neolithic, i.e., Mesolithic background. On both sides of the Aegean, there is evidence for the use of blade-based and flake-based industries, indicating sporadic interrelations between the Neolithic farmers and Mesolithic foragers, although this idea has to be supported and elaborated by new data from sites preceding the first half of the 7th millennium BC.

An overall intensification and diversification in the use of raw materials, production techniques and toolsets can be suggested for the second half of the 7th millennium BC in both eastern and western Aegean, based on the case studies from western Anatolia and northern Greece given accordingly in this paper. In contrast to the earlier Mesolithic industries, there is a large variety of production and use of tools in the different micro-regions with the emergence of the Neolithic, which in a great portion shaped the process of Neolithisation on both sides of the Aegean. Outlining detailed features of chipped stone production is a welcomed approach which offers a good basis for understanding the regional formations and developments of the Neolithic, and brings new data for bridging the regions, which in many regards seem to be culturally and geographically distanced from each other. Thus, new datasets regarding micro-regional contexts are necessary in order to address a wider picture, which is at the end of the day the main goal of our studies of chipped stone industries, which are produced, used and shared between people of often different cultural backgrounds.

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