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The flaked stone assemblages

Catherine Perlès, Lygeri Papagiannaki

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PLATIA MAGOULA ZARKOU
THE NEOLITHIC PERIOD

ENVIRONMENT, STRATIGRAPHY AND ARCHITECTURE,
CHRONOLOGY, TOOLS, FIGURINES AND ORNAMENTS

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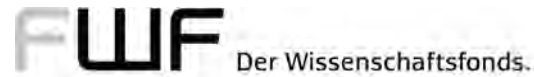
The Neolithic Period

**Environment, Stratigraphy and Architecture,
Chronology, Tools, Figurines and Ornaments**

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V. The Tools

V.1. The Flaked Stone Assemblages

Catherine Perlès – Lygeri Papagiannaki

V.1.1. Introduction

Despite the abundance of Middle Neolithic sites in Thessaly, the flaked stone tools remain insufficiently documented, especially when compared with the pottery. Several sites yielded very small collections, and aside from Achilleion, the most comprehensive studies have remained unpublished.²³³ Consequently, regional and diachronic variation in characteristic tool types, raw material procurement, techniques and methods of production remain difficult to establish. PMZ will be one of the few assemblages to be fully published²³⁴ and should constitute an important reference collection to define the characteristics of Middle Neolithic and early Late Neolithic Thessalian flaked stones assemblages.

The Potential for Refined Diachronic Approaches

The several metres-deep Middle Neolithic sequence at PMZ will allow us to define not only the main features of the Middle Neolithic flaked stone assemblages as a whole, but also to investigate for the first time in Thessaly, diachronic variation within the Middle Neolithic. In particular, a late Middle Neolithic phase, called the ‘Zarko phase’, was defined in the original publication on the basis of the pottery assemblages.²³⁵ Can we document parallel transformations in the flaked stone assemblages and individualise this phase? PMZ is also one of the very few sites where the Middle Neolithic/Late Neolithic transition can be observed, and this was originally presented as an instance of local, gradual transformation. Is the transition to the Late Neolithic also gradual with the lithics, or, as occurs in other regions,²³⁶ do we witness breaks in raw material procurement, flaking techniques and tool typology? Defining the technological and typological characteristics of the flaked stone assemblages, their transformation throughout the sequence, the lithic phases and their correlation – or absence thereof – with the pottery phases will thus be a major goal of the present analysis.

²³³ Moundrea-Agrafioti 1981; Karimali 1994.

²³⁴ The flaked stone assemblages from PMZ were initially entrusted to Ernestine Elster, who published two short reports (Elster – Duricic 1982; Elster 1994). Catherine Perlès studied the collection at Larissa in 1984–1986 in the framework of the French ‘Mission Néolithique de Thessalie’ with Jean-Paul Demoule (Perlès 1994a). They were later also studied by Evangelia Karimali for her dissertation (Karimali 1994) and referred to in several important papers on lithic trade networks (Karimali 2000; Karimali 2009).

²³⁵ Demoule et al. 1988. The final results of the reanalysis of the pottery by Areti Pentedeka were not available at the time of writing.

²³⁶ At Franchthi, for instance, see Perlès 2004. Antikleia Moundrea-Agrafioti also notes important differences between the Middle and Late Neolithic assemblages in Thessaly, but her sample only included the LN II subphase from Dimini and no early Late Neolithic: Moundrea-Agrafioti 1981, 159–163.

Phasing the Flaked Stone Assemblages

The samples from each excavation unit being too small for valid comparisons, our unit of analysis has been the ‘building phase’ or ‘building subphase’, as defined by G. Toufexis and C. Batzelas.²³⁷ The earliest two phases (BPh I and II) refer to the basal ditch and the overlying sediments. The later building phases were defined by the presence of ‘surfaces’ (F33 to F20), usually associated with architectural remains, hearths, postholes or pits. BPh and BSpH III to IX thus consists of a ‘surface’, its associated features and the sediments interstratified between this surface and the overlying one (possibly destruction strata). Ideally, the lithic chronostratigraphy should have been established solely on the basis of the most secure contexts with in situ deposition (‘surfaces’, ‘floors’, ‘pits’). Unfortunately, the number of significant artefacts from these secure contexts is far too small to do this. Consequently, we had to take into consideration all the artefacts from each architectural phase, including those coming from the deposits between two surfaces, and possibly redeposited.

From the base of the excavation on the sterile soil, up to the uppermost Neolithic deposits, we defined five ‘lithic phases’ on the basis of the stratigraphy and intrinsic characters of the flaked stone assemblages: raw materials, products, techniques of production and tool types.

Two important points must be made concerning this phasing:

i) Each lithic phase differs from the others by *statistically* significant variation in the proportion of raw materials, and/or of blades and flakes, and/or of retouched tools. Nevertheless, considering the very small size of each sample, random spatial variation must be expected. Consequently, these variations may not all be *archaeologically* significant, especially when the tool types show no differences. This will lead us to suggest an alternate chronostratigraphic scheme based on tool types only, and restricted to three lithic phases.²³⁸

ii) The fact that the material from the deposits overlying each ‘surface’ was included in the samples for each building phase may create artificial continuity between the lithic phases. Indeed, most of this material, as we shall argue below, is redeposited rather than in its original use or discard context. Some, at least, of this material may come from earlier contexts. There is therefore a distinct possibility that regular reworking of earlier material and its incorporation into later assemblages create spurious continuity. This point will be discussed in the conclusion, on the basis of the more securely dated subsamples.

Technology and Traceology: An Integrated Approach

The PMZ assemblages are also the first in Thessaly to be studied simultaneously from a technological perspective (Catherine Perlès = C. P.) and a functional perspective (Lygeri Papagianaki = L. P.). The initial aim of the technological approach was to reconstruct the major characteristics of the *chaînes opératoires*, from the acquisition of the raw material to the discarding of the tools, and to address questions about the techno-economic organisation of raw material acquisition and tool production. In particular, we sought to establish whether the raw materials were procured from primary or secondary sources, whether they were obtained through direct procurement or exchange, at what stage of exploitation they were introduced into the settlement, which techniques of production were implemented, and the degree of specialisation this required. All the artefacts were individually recorded, sketched and described. Most were also photographed with a Lumix TZ6 camera. Michèle Ballinger produced the publication drawings of the most significant artefacts.

As a complement and prolongation of the technological studies, the functional analyses investigated the nature of the activities involving flaked stone tools at or around PMZ, their relative

²³⁷ Toufexis – Batzelas, this volume, chapter III.

²³⁸ Below, 269.

importance, the choice of blanks for specific activities and the conception of the tool as a whole. In this perspective, we hoped that a comparison between tool conception and use in the Middle and Late Neolithic would contribute to the debate on continuity and discontinuities between the two periods.

L. P. examined 45 pieces – roughly half of the retouched tools and some unretouched blanks – in order to specify the mode of hafting of the tools, the materials worked, the gestures, and the life history of each tool.²³⁹ Systematic macroscopic and microscopic observation of the blunting, removals, polishes, striations and residues²⁴⁰ were conducted under a Euromex StereoBlue binocular and an Olympus BH2-Umex microscope, fitted with a Tucson TSview camera. Additionally, Niccolò Mazzucco examined all the sickle inserts within the framework of a large comparative study of Neolithic Mediterranean sickle elements.²⁴¹ His observations will be included in the present study to complement Papagiannaki's.²⁴²

Besides insights on the use of flaked stone tools at PMZ, the joint technological and functional approaches will allow us to test the validity of the traditional pseudo-functional typological denominations (e.g. 'end-scraper', 'borer', 'point'). It will clearly reveal, in particular, the difficulty for the technologist in differentiating a retouch meant to shape the handhold or hafted part of the tool from a retouch meant to modify the working edge of the tool.

Spatial Analyses

PMZ is also one of the few sites excavated decades ago where the three-dimensional position of each flaked stone artefact was recorded. This proved essential in order to discriminate between artefacts more securely associated with a stratified surface, and artefacts found in intermediary deposits and potentially redeposited. We also hoped to find a significant association of tools on identified 'surfaces' so as to define activity areas. As mentioned above, however, the majority of the artefacts come from the deposits interstratified between the 'surfaces', and these analyses turned out to be rather disappointing.

Platia Magoula Zarkou and Thessalian Lithic Trade Networks

Finally, the position of PMZ on the main axis that links the Western and Eastern Thessalian Plains sets it a priori in an ideal nodal position in exchange networks. Areti Pentedeka has already shown the site to be a 'source' for three exchange networks in pottery, in both the Middle Neolithic and the Late Neolithic, and, to a lesser extent, a recipient site in two other networks linking it to eastern Thessaly.²⁴³ On the other hand, Evangelia Karimali underlined that PMZ was characterised by a massive dominance of 'chocolate flint' and a low proportion of obsidian that clearly aligned it with the settlements of the Western Thessalian Plain.²⁴⁴ With more detailed technological and functional analyses and a refined chronostratigraphic framework, can we now shed more light on the position of PMZ within these lithic networks and document, as is the case with pottery, diachronic changes in raw material procurement strategies and participation in trade networks?

²³⁹ The functional analyses were the subject of an M2 thesis at the University of Nice by Lygeri Papagiannaki. The documentation and interpretation of each artefact studied was discussed at the Larissa Museum with Sylvie Beyries, Directeur de Recherches, CEPAM (Cultures et Environnements – Préhistoire, Antiquité, Moyen Âge), CNRS-University of Nice, and supervisor of the master. The interpretation of the traces was based on the reference collection of the CEPAM.

²⁴⁰ Semenov 1964; Mansur 1982; González Urquijo – Ibáñez Estevez 1994.

²⁴¹ Project 'Nea-Innova: The diffusion of Neolithic in the central-west Mediterranean: agriculture, innovations and radiocarbon dating', PI: J. F. Gibaja (HAR2016-75201-P).

²⁴² We warmly thank Niccolò Mazzucco for sharing his observations and for fruitful discussions on the material.

²⁴³ Pentedeka 2011.

²⁴⁴ Karimali 2009.

These questions drove our analyses of the material and defined the main axes of enquiry. However, archaeology is not a predictive science, and the study of the material led to some frustration: for the most part, the *chaînes opératoires* are so patchily represented that it is impossible to reconstruct them in their entirety, and often likewise impossible to assess the extent of local manufacturing versus the importation of finished blanks or tools. On the other hand, these analyses also led us to unexpected and interesting results: compared with other sites,²⁴⁵ PMZ presents many idiosyncratic features, absent or only rarely documented elsewhere in Thessaly and in southern Greece. For instance, the density of flaked stones is particularly low, the position of PMZ within trade networks appears singular, and several technical choices and tool types are unique.

Significantly, one of the most conspicuous idiosyncratic traits, the scarcity of flaked stone artefacts, holds true in both the Middle Neolithic and the Late Neolithic and has immediate bearing on all subsequent analyses. We shall therefore discuss this problem and the related issue of raw material procurement before embracing a diachronic perspective.

Why Are There So Few Flaked Stone Tools at Platia Magoula Zarkou?

A total of 270 artefacts (including debris) were attributed to the Neolithic deposits from Platia Magoula Zarkou for a volume of sediment estimated at 119m³.²⁴⁶ The overall ratio is thus 2.3 artefacts per m³. Although it varies somewhat from phase to phase, it always remains low. By comparison, the Neolithic trenches FAN and FAS at Franchthi yielded a total of 1916 artefacts for a volume of ca. 20 m³,²⁴⁷ i.e. a ratio of 96 flaked stones per m³.

Obviously, the two sites differ in two major respects. First, the majority of excavation units in the two Franchthi trenches were water-sieved, and the remaining were dry-sieved down to a mesh of 5mm. By contrast, no sieving was undertaken at PMZ. Recovery procedures must therefore have played a role and led to losses at PMZ. There are, however, reasons to argue that this is only part of the problem. The excavation was indeed careful and recovered very small chips of 10mm or less. Even more significantly, obsidian, although the most conspicuous and ‘precious’ raw material for the excavator in view of its exogenous origin, is always scarce.

We could consequently attribute the scarcity of flaked stones to an uneven spatial distribution of flaking remains: the excavation would have concerned sectors where flaking activities rarely took place, and where tools were occasionally utilised, but not produced. Such sampling biases are always possible on large tell settlements that were only very partially excavated, and it must account in part for the very fragmented aspects of the *chaînes opératoires*. However, the nature of the excavated areas and deposits varies through time,²⁴⁸ whereas the scarcity of flaked stones is a constant. It thus seems unlikely that excavation at PMZ systematically concerned areas devoid of flaking activities and where there was little use for flaked stone tools.

The second major difference between Franchthi and PMZ is the scarcity of obsidian. Franchthi is a southern coastal site, and clearly had easier access to obsidian exchange networks than did PMZ. Antikleia Moundrea-Agrafioti specifically noted that Thessalian sites with restricted access to obsidian tended to be altogether poor in flaked stone tools.²⁴⁹ At PMZ, no locally available raw

²⁴⁵ Data on flaked stone assemblages contemporaneous with PMZ are available for the following Thessalian sites: Achilleion, dated to the Early Neolithic/Middle Neolithic transition, MN I and MN III (Elster 1989); Sesklo B, dated to the MN II and III and Magoula Karamourlar (Moundrea-Agrafioti 1981); Otzaki (Mottier 1981) and Ag. Petros in the nearby Sporades dated to the MN II (Moundrea-Agrafioti 1981). Unfortunately, neither the Middle Neolithic nor the early Late Neolithic at Magoula Visviki yielded any retouched tool (Bergner 2015a). The assemblages from Magoula Koutroulou and Magoula Imvrou Pigadi are currently being studied and little information is available. The attribution of these sites to subphases of the Middle Neolithic is based on Reingruber et al. 2017.

²⁴⁶ Toufexis – Batzelas, this volume, 83.

²⁴⁷ Farrand 2000.

²⁴⁸ Souvatzi, this volume, chapter IX; Toufexis – Batzelas, this volume, 137.

²⁴⁹ Oral communication 7/16.

materials could replace obsidian, and our technological and functional analyses suggest that the settlement had only limited access to regional raw materials, such as radiolarite. The proportion of retouched tools is indeed unusually high, and the tools, especially in the earlier Middle Neolithic, show an equally unusual degree of curation. It appears that, if the flaked stone are so scarce at PMZ, it is mainly because the settlement had no easy access to sources of raw materials. More generally, and probably for the same reasons, the scarcity of flaked stone tools appears to be characteristic of many Thessalian settlements: Karimali provides even lower figures for Dimini, Ag. Sophia and Pefkakia.²⁵⁰

V.1.2. An Overview of Raw Materials Exploitation

The raw materials from PMZ were initially identified according to criteria commonly used by lithic technologists, and, in the present case, a lithic technologist of French training: texture, inclusions, and translucency. Most were initially identified as radiolarites and diagenetically transformed radiolarites, i.e. ‘jaspers’. Both raw materials are also commonly found in the literature under the name of ‘chocolate flint’.²⁵¹ The identification of ‘radiolarites’ and derived ‘jaspers’ was based on comparative samples collected from the Portaikos River and at primary sources in the Pindos (Koziakas Range), which were identified in the 1980s by the French specialist of radiolarites in Greece, P. de Wever.

For the present publication, raw material determinations within the ‘chert group’ (or silicites) were revised by mineralogist Michael Brandl, according to the recommendations of the 2010 International Mineralogical Association in Budapest.²⁵² As shown by Tab. V.1.1 (‘original determination’), this nomenclature differs significantly from the nomenclatures used by flaked stone specialists. In particular, within this new system of classification, jaspers are considered completely unrelated, by their formation, to radiolarites.

The problems, however, are not only terminological. The samples sent to Brandl for petrographic determination and geochemical analyses revealed important discrepancies between the original, macroscopic identification, and the microscopic identification. On the whole, the identification of light-coloured translucent raw materials as ‘chert’ was confirmed. By contrast, several specimens identified as ‘jasper’ or ‘radiolarite’ on the basis of their fine grain, texture and absence of translucency, contained too few radiolarians to be considered as radiolarite and were therefore reclassified as cherts (Tab. V.1.1). Their geochemical composition is nevertheless identical to that of true radiolarites and indicates a similar source area.²⁵³ Since it was not possible for the entire collection to be re-examined by a specialist, we shall thus group all the brown-red, non-translucent specimens initially classified as radiolarites or ‘jaspers’ under the heading of ‘radiolarite/chocolate chert’ (henceforth R/CC).

Another difficulty pertains to the fact that the group of ‘cherts’ now contains both the dark-coloured, non-translucent material similar to radiolarites, and the light-coloured, translucent materials, most probably of different origins. In order to distinguish the two varieties, we shall call the second group ‘translucent chert’, with a special mention for the well-known ‘honey flint’, here called ‘honey chert’.

Radiolarites/Chocolate Cherts are by far the most abundant in the PMZ Neolithic collection (72%), as already noted by Karimali.²⁵⁴ They can be divided into very fine-grained ones (51% of total) and the coarser ones (20.6%). Despite the fineness of the grain of the majority of the radiolarites, their flaking qualities are not always optimal: besides the small size of the pebbles,

²⁵⁰ Karimali 1994, 291.

²⁵¹ The Greek ‘chocolate flint’ is completely unrelated to the Polish ‘chocolate flint’ (or ‘chocolate silicites’) from the Holy Cross Mountains: Brandl et al. 2016.

²⁵² See Brandl 2013/2014; Brandl et al., this volume, 291–292.

²⁵³ Brandl et al., this volume, 302.

²⁵⁴ See ‘chocolate flint’ in Karimali 2009.

when they were collected as such, they often present inner faults that render the control of flaking hazardous or react to percussion with marked undulations.

Some R/CC are extremely lustrous and evoke heat-treated raw materials, as was also the case at Achilleion.²⁵⁵ In some cases small thermal cracks confirmed the presence of heat alteration, but we found no definite evidence for intentional heat treatment, such as lustrous retouch negatives contrasting with the matte original flaked surfaces.²⁵⁶ Most pieces must have accidentally come into contact with a fire, but natural processes, such as heating during a metamorphic process, could also be envisioned.

Obsidian amounts to 11.4% of the raw materials.²⁵⁷ It has not been analysed, but its texture and colour is entirely compatible with a Melian origin.²⁵⁸

Translucent cherts, of various textures and colours but always somehow translucent, amount to 11.7% of the raw materials. This group is anything but homogeneous and the flaking qualities vary. Included in this category are eight specimens (3% of total) of the diagnostic ‘honey cherts’, here mostly honey or rose in colour, translucent and homogeneous. As with radiolarites, the pink hue made us suspect heat treatment, but this could not be established. Noteworthy is the absence of a green-brown very homogeneous chert, well represented at Achilleion by pressure-flaked blades, imported as finished blanks. This high-quality raw material was seemingly unavailable to the inhabitants of PMZ.

Quartz flakes are scarce: eight specimens, or 3% of the total. Some are clearly intentional, non-cortical flakes. Others consist of cortical flakes and debris that may be unrelated to the flaked stone industry and may have been accidentally produced during the percussive use of a quartz pebble.

Acquisition of the Raw Materials

The presence of cortical and neocortical flakes demonstrates that some of the R/CC were picked up as river pebbles and not at the original sources. However, according to Riccardo Caputo, the flysch and marble hills on each side of the valley near PMZ do not contain radiolarites and could not have provided local pebbles.²⁵⁹ Consequently, all the R/CC derived from the Pindos Mountains, more precisely the Koziakas Range, where these materials are common. It is easy to find large and good-quality pebbles in the Peneios near the foot of the mountains,²⁶⁰ but the Peneios could not have had the carrying capacity to transport pebbles down to PMZ through the flat Trikala Basin. The surveys undertaken in the framework of the present project confirmed that R/CC pebbles were virtually absent in the riverbeds a few kilometres from the mountains and that the nearest exploitable sources were located 40km away from the settlement, as the crow flies.²⁶¹ With one exception, the ten Neolithic samples analysed all corresponded to locations sampled along the Portaikos and the Peneios, up to 50km from the site: PMZ 2, 4, 5 and 8. With five specimens identified, location PMZ 8, on the Peneios,²⁶² appears to have been favoured, but the sample is small. It is clear, anyway, that R/CC pebbles must be considered as a regional, not a local resource, either collected during specific expeditions, or exchanged with groups living nearer to the mountains.

Most of the pebbles flaked at PMZ were too small to produce the good-quality and often wide R/CC blades and other sources must have been exploited. Some artefacts indeed present a fresh

²⁵⁵ Personal observation C. P.

²⁵⁶ Inizan et al. 1976; Domanski – Webb 2007; Schmidt et al. 2012.

²⁵⁷ The figure given by Karimali (8.4%) was clearly based on a subsample of the collection since she quotes six pieces whereas we have 31 obsidian artefacts for the Neolithic strata: Karimali 2009, fig. 1.

²⁵⁸ With one possible exception: the flake PM0567 in Lithic Phase 4.

²⁵⁹ Caputo et al., this volume, chapter II.1.

²⁶⁰ Personal observation 1986.

²⁶¹ Brandl et al., this volume, 294.

²⁶² See Brandl et al., this volume, Fig. V.1.21.

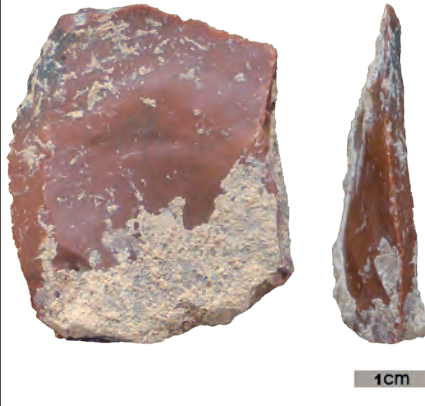
cortex that indicates a collection of raw material at or near the sources, in the Pindos. One of them was analysed and does correspond, by its geochemical composition, to source PMZ 5, characterised as a primary/residual outcrop. Core-shaping flakes and under-crest bladelets suggest that some of the laminar were produced at the site, either from traded cores or by itinerant specialists. It seems probable, however, that the best-quality blades, each unique as regards the characteristics of its raw material, were imported as already flaked blanks.²⁶³

This also applies to the honey chert blades: the only honey chert flake found at PMZ is a secondary flake extracted from a blade, and honey chert (or ‘honey flint’) blades always circulate as such in eastern and southern Greece. Their precise origins remain unknown.²⁶⁴ Bulgaria can be excluded for the vast majority of honey chert blades south of Macedonia and a western origin, in Greece or Albania, appears the most plausible.

Obsidian was imported from Melos. The assemblage comprises both flakes and bladelets. Some, but not all bladelets were pressure flaked. The presence of rejuvenation flakes and irregular bladelets suggests in situ flaking of already prepared or already partially flaked cores, a usual pattern with obsidian.²⁶⁵ However, the low proportion of obsidian and small absolute number of pieces clearly shows that PMZ had limited access to obsidian trade networks.

The only raw material that can be considered potentially local is quartz, but its use at PMZ is anecdotal. While the procurement of R/CC pebbles remains debatable since both direct procurement and exchange can be envisioned, there is no doubt that most of the sources of raw materials, in particular the raw materials related to the production of blades, were too far away for direct procurement at the sources. The PMZ inhabitants were thus largely, or perhaps entirely, dependant on exchange for their flaked stone tools. The dependence upon traded raw materials and blanks is frequent in central and southern Greece during the Neolithic, even when local raw materials were available. What is more unusual is that all the trade networks appear to have provided PMZ with very limited quantities of nodules and blanks.

Tab. V.1.1 Raw materials used at PMZ and results of microscopic and geochemical analyses. Microscopic and geochemical groups, see Brandl et al., this volume (C. Perlès)






PMZ number	Description	Original determination	Petrographic determination	Photograph
PM0078 Unretouched flake (Helladic)	Medium-grained, matte, non-translucent, red with dark spots	Matt red jasper (= chocolate flint)	Radiolarite (radiolarians) Microscopic group 1 Geochemical group 1, Source 8	

²⁶³ Below, e.g. 207.







²⁶⁴ There are indeed many varieties in the group of ‘honey flints’ and certainly multiple sources: Perlès in preparation.

²⁶⁵ Perlès 1990; Karimali 2009.


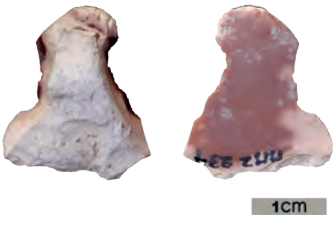



Tab. V.1.1 (continued)

PMZ number	Description	Original determination	Petrographic determination	Photograph
PM0108 Unretouched flake (Helladic)	Fine-grained, homogeneous, lustrous, non- translucent, pale chocolate colour	Lustrous chocolate jasper (= chocolate flint)	Radiolarite (radiolarians) Pebble Microscopic group 1 Geochemical group 1, Source 8	 1cm
PM0380 Unretouched flake (Lithic Phase 5)	Fine-grained, homogeneous, non-translucent, chocolate and beige colour	Chocolate and beige jasper (= chocolate flint)	Radiolarite (radiolarians) Microscopic group 1 Geochemical group 1, Source 8	 1cm
PM0404 Unretouched flake (Lithic Phase 5)	Medium- grained, non- translucent, dark brown colour	Dark-brown radiolarite	Radiolarite (radiolarians) Microscopic group 2 Geochemical group 1, Source 2	 1cm
PM0449 Unretouched flake (Lithic Phase 5)	Fine-grained, homogeneous, non-translucent, brown to olive- green with blue passes	Brown-olive- green jasper	Olive-green radiolarite (dissolved radiolarians) Pebble Microscopic group 3 Geochemical group 1, Source 8	 1cm
PM0448 Unretouched flake (Lithic Phase 5)	Fine-grained, homogeneous, non-translucent, chocolate colour with dark pink stain and a translucent band	Chocolate jasper (= chocolate flint)	Radiolarite (radiolarians) Slight fire influence Microscopic group 1 Geochemical group 1, Source 8	 1cm







Tab. V.1.1 (continued)

PMZ number	Description	Original determination	Petrographic determination	Photograph
PM0568 Unretouched flake, cortical (Lithic Phase 4)	Fine-grained, homogeneous, non-translucent, brown-red with pink cortex	Red-brown jasper with cortex (= chocolate flint)	Radiolarite (dissolved radiolarians) with sub-cortex Microscopic group 1 Geochemical group 1, Source 2	
PM0868 Waste (Lithic Phase 1)	Very lustrous, brown-red with darker spots, rolled outer surface	Brown-red jasper, lustrous (= chocolate flint)	Radiolarite Medium fire influence Gravel Microscopic group 5 Geochemical group undetermined	
PM0884 Unretouched flake (Lithic Phase 1)	Medium- grained olive- green jasper passing to brown	Medium- grained radiolarite	Radiolarite (radiolarians) Microscopic group 2 Geochemical group 1, Source 8	
PM0461 Unretouched flake (Lithic Phase 4)	Fine-grained, slightly translucent on edges, texture of a radiolarite, green with white fresh cortex	Cortical radiolarite or chert?	Radiolarite (heavily dissolved radiolarians) Primary source Microscopic group 3 Geochemical group 1, Source 2	
PM0248 Unretouched flake (Helladic)	Fine-grained, homogeneous, lustrous, non- translucent, chocolate colour	Jasper (= chocolate flint)	Chert (very few radiolarians) Microscopic group 6 Geochemical group 1, Source 8	
PM0299 Unretouched flake (Helladic)	Fine-grained, homogeneous, lustrous, non- translucent, chocolate colour	Very lustrous red jasper	Chert (very few radiolarians) Microscopic group 6 Geochemical group 1, Source 5	

Tab. V.1.1 (continued)

PMZ number	Description	Original determination	Petrographic determination	Photograph
PM0870 Unretouched flake (Lithic Phase 1)	Very lustrous dark-brown flake, with thermal removal on dorsal face and a matter surface, heated	Lustrous radiolarite, heated (heat-treatment?)	Chert (very few radiolarians) Burnt Microscopic group 6 Geochemical group 1	
PM0471 Primary flake (Lithic Phase 4)	Fine-grained, homogeneous, non-translucent, red with light spots, white fresh cortex	Cortical radiolarite from primary source	Chert (very few radiolarians) Primary source Microscopic group 6 Geochemical group 1, Source 5	
PM0252 Unretouched laminar flake (Helladic)	Fine-grained, translucent, beige-pink with lighter passes	Chert (= silex)	Pelmicritic Chert (peloids) Possibly heated Microscopic group 8 Geochemical group 3, Source undetermined	
PM0580 Unretouched flake (Lithic Phase 3)	Fine-grained, translucent, very small white spots	Chert (flint) or calcedony	Chert Few intraclasts, some marine detritus Microscopic group 7 Geochemical group 2, Source 4	
PM0811 Unretouched flake (Lithic Phase 1)	Fine-grained, red with grey veins	Chert (= silex)	Radiolarite, radiolarians, chalcedony veins Microscopic group 4 Geochemical group 1, Source 8	

Tab. V.1.1 (continued)

PMZ number	Description	Original determination	Petrographic determination	Photograph
PM0671 Unretouched blade (Lithic Phase 2)	Medium-grained, very slightly translucent on edges, texture of radiolarite beige-green	Yellowish radiolarite? Chert?	Not analysed	
PM0348 Non-intentional blade (Lithic Phase 5)	Fine-grained, translucent, beige and blue, spotted, white cortex and blue under-cortical zone	Chert (= silex)	Not analysed	
PM0838 Reflaked honey-flint blade (Lithic Phase 1)	Fine-grained, homogeneous, translucent, dark honey colour	Honey flint	Not analysed	
PM0802 Bladelet (Lithic Phase 1)	Black, glassy, brilliant, homogeneous	Obsidian	Not analysed	
PM0797 Unretouched flake (Lithic Phase 1)	Saccharoid, irregular texture, translucent, yellowish colour	Quartz	Not analysed	
PM0636 (Lithic Phase 3)	Translucent, glassy, white	Quartz	Not analysed	

V.1.3. Lithic Phase 1 – Building Phases I–V

Characterisation

Lithic Phase 1 encompasses BPh I–V (EU 177–206) and constitutes a relatively small but very homogeneous and characteristic assemblage. No differences could be perceived throughout this sequence. Lithic Phase 1 is characterised by an intentional production of flakes, by the scarcity of bladelets, the scarcity of unretouched blades, a high ratio of retouched tools, the predominance of sickle inserts in the toolkit and the predominance of flakes over blades for the latter. Lithic Phase 1 is radiocarbon dated by several samples (Chapter IV) to ca. 5900–5700 calBC (2 σ), i.e. mostly to the MN I Thessalian Neolithic.²⁶⁶

Raw Materials

The Lithic Phase 1 assemblage comprises 58 artefacts and 5 debris (Tab. V.1.2). The vast majority of the flaked stones are made in R/CC: 53 pieces out of a total of 63 (88%). Five pieces are made in obsidian, one in quartz, one in honey flint, and one in a light-coloured translucent chert. As explained above, all but perhaps the quartz flake are exogenous.

Natural surfaces – cortex or neocortex – are rarely preserved, even on R/CC flakes or blades (n=7). The proportion (13%) is much lower than at Achilleion, where cortex is present on 37% of the ‘red jaspers’ and 11% of the ‘grey-green jaspers’²⁶⁷ and closer to the proportions found in eastern Thessaly (ca. 5%),²⁶⁸ further away from the Pindos sources. This suggests that at PMZ a fair number of artefacts were obtained by exchange as already flaked blanks.

Different sources were exploited. Two primary flakes show that some of the R/CC were procured, directly or indirectly, as water-rolled river pebbles (Fig. V.1.1a). The geochemical analyses confirmed that two flakes from Lithic Phase 1 corresponded to location PMZ 8, on the Peneios River.²⁶⁹ One small flake, from BPh V, bears a relatively fresh cortex, partially removed by thermal flakes (Fig. V.1.1c). It must have been collected at or near a source. The only light chert bladelet also preserved some primary, unrolled cortex on the butt, indicating procurement at or near the source (Fig. V.1.1d). The single honey flint blade must have been imported, as usual, as an already flaked blank.

Tab. V.1.2 Composition of the flaked stone assemblage from Lithic Phase 1 (C. Perlès)

	R/CC	Chert	Obsidian	Honey chert	Quartz
Debris	5				
Cores	1				
Flakes	19	1	1		1
Blades	1	1			
Bladelets	3		1		
Retouched flakes	9		2		
Retouched blades	13		1	1	
Retouched bladelets	2		1		
Total	53	2	6	1	1

²⁶⁶ Reingruber et al. 2017.²⁶⁷ Radiolarites at least are locally available at Achilleion (Geological Map of Greece, IGME, Pharsala Sheet): Elster 1989, tab. 10.1.²⁶⁸ Moundrea-Agrafioti 1981, 68.²⁶⁹ Brandl et al., this volume, 296.

Obsidian is conspicuously scarce. It amounts to 8% of the raw materials, as opposed to 28.8% at Achilleion (Phase IV)²⁷⁰ and more than 50% at Magoula Koutroulou²⁷¹ in western Thessaly. In eastern Thessaly and at Ag. Petros, the percentages range from 47 to 70%.²⁷² Figures as low as that of PMZ Lithic Phase 1 are found only much further inland, in sites such as Theopetra and Magoulitsa.²⁷³ The obsidian artefacts show no natural surfaces: they were imported as finished pieces, or flaked in situ from already prepared cores.

The Production

The radiolarite/chocolate cherts (R/CC) sample comprises 5 debris, 1 core, 1 undetermined blank, 34 flakes, 1 fine bladelet, 2 possible bladelets and 17 blades, mostly fragmented. The grain varies from coarse to extremely fine (Fig. V.1.1a–c, e–j). Some, at least, of the blocks were locally worked: the relatively high number of debris²⁷⁴ of fine-grained chocolate R/CC, fractured along natural cleavage facets and without any evidence of water abrasion, is a good indicator of local flaking activities. The exploitation of R/CC aimed at the production of both flakes and blades. There is no evidence of a distinct bladelet production, and the few specimens must have been produced alongside the production of blades.

A flat, centripetal discoid flake core, of dark radiolarite (Figs. V.1.1b, V.1.3i), and several flakes with characteristic bulbs of percussion (cf. Fig. V.1.1e) testify to in situ production of flakes with a hard stone hammer, which accords with the relative abundance of debris in this phase. This unskilled production does not present the characteristics of waste from apprenticeship: there are no multiple misplaced incipient conoids, hinged fractures are not especially abundant, and the blanks are utilised for tools, which is normally not the case when only practice is involved.²⁷⁵ Nor does it correspond to the production of specific tool types:²⁷⁶ it must therefore be considered as a local response by unskilled knappers to a shortage of more formal blanks. Similarly, the quartz laminar flake (Tab. V.1.1, PM0797) is made in coarse, granular quartz and was probably produced with a hard hammer (the proximal end is broken). This local production explains the relatively high proportion of flakes (58% of the blanks), which sets PMZ Lithic Phase I apart from contemporaneous settlements. In the obsidian-rich assemblages from Ag. Petros, Magoula Karamourlar and Sesklo B, blades represent, respectively, 55%, 68% and 77% of the blanks.²⁷⁷ The situation is comparable at Otzaki (Planum 15 and 16), with 70% blades.²⁷⁸ At Achilleion, where an exploitation of local raw materials was more important, blades still represent 50% of the blanks in Phase III and 55% in Phase IV.²⁷⁹ Even when radiolarite/cherts only are considered at Sesklo B and Magoula Karamourlar, blades are more abundant than flakes.²⁸⁰

Other radiolarite/chocolate chert flakes, more regular and thinner, were detached by the more elaborate technique of indirect percussion, as indicated by their wide-angled, flat butt without conoid (Fig. V.1.1f–i). This suggests that they were intended to shape cores for the production of blades rather than as final products per se. All the blades that bear diagnostic criteria were indeed produced by indirect percussion (Fig. V.1.2a–g): large contact zone of the punch, thick butts

²⁷⁰ Elster 1989, tab. 10.1 (the figure was calculated without ‘missing inf’).

²⁷¹ Hamilakis et al. 2017.

²⁷² Moundrea-Agrafioti 1981, tab. 1.

²⁷³ Karimali 2009, tab. 1.

²⁷⁴ See Inizan et al. 1999, 34: “Debris: applies to any shapeless fragment, when the means by which it was fractured cannot be identified.”

²⁷⁵ Klaric 2018.

²⁷⁶ As is the case, for instance, with the production of drills in the Early Neolithic at Franchthi: Perlès 2004.

²⁷⁷ Moundrea-Agrafioti 1981, 61, tab. 2.

²⁷⁸ Personal observation, C. P.

²⁷⁹ Elster 1989, tab. 10.11.

²⁸⁰ Moundrea-Agrafioti 1981, tab. 8. The information is not available for Achilleion.

when flat – or even concave – with a characteristic angle of ca. 90°; blades more curved than by pressure, with frequent waves, ripples or irregularities on the ventral surface; arrises less parallel and regular than with pressure.²⁸¹ Of the six blades that preserved their proximal end, all show a flat butt, either prepared or natural. In three cases, the overhang of previous scars had been suppressed by short removals on the dorsal face. In the absence of blade cores, of crested blades and of characteristic rejuvenation flakes (*cintrage*²⁸² and *carénage*²⁸³ of blade cores), the volumetric and technical characteristics of the cores cannot be assessed.

The fine R/CC bladelet PM0688 (Figs. V.1.1j, V.1.3j) is unique among the R/CC artefacts. It was detached either by indirect percussion, or possibly by pressure with a short shoulder crutch.²⁸⁴ There may be doubt, however, about its chronostratigraphic position: it was found just 2cm below surface F25, and could actually belong to Lithic Phase 2.

Even if a number of flakes suggest in situ blade production, the variation in raw materials makes it impossible to match any of the shaping flakes to any of the blades: they are all different in the details of the texture and colours. Each piece belongs to a different *chaîne opératoire*, represented by a single element. We are thus dealing with only extremely partial remnants of the *chaînes opératoires* that were implemented, either locally or elsewhere (Tab. V.1.3).

Pressure flaking is only securely attested in this lithic phase on obsidian and honey chert. The obsidian artefacts comprise three pressure-flaked bladelets. One is a fine mesial fragment, very regular (Fig. V.1.1k); the second a small proximal fragment with a retouched notch (Fig. V.1.1l). The butt is punctiform, with preparation of the removal on the dorsal face, a typical Middle Neolithic method.²⁸⁵ The last obsidian bladelet is a rather irregular distal fragment from a pyramidal core (Fig. V.1.1m). The two other pieces are irregular flakes coming from early phases of the debitage, detached by indirect percussion (Fig. V.1.1n–o). They may indicate in situ debitage of already prepared cores,²⁸⁶ but this cannot be ascertained given the small number of artefacts. Trade of second-choice artefacts alongside the bladelets can also be envisioned.

The honey chert blade (Fig. V.1.1p) is a large, sturdy blade with very rectilinear arrises and a straight profile that indicates pressure flaking. Its original width must have exceeded 2.2cm, as for a majority of honey chert blades of the Middle Neolithic, thus requiring the use of a lever to detach the blades.²⁸⁷ It was reflaked after initial use in order to extract one bladelet, and then crudely reflaked from the other fracture to extract splintered flakes. The bladelet and flakes extracted from this blade have not been recovered in the excavation.

This observation, together with the impossibility of matching the R/CC flakes and blades, confirm that we are mostly dealing with redeposited material and that the waste from local production is to be found in unexcavated areas of the site. However, with such a fragmented image of the individual *chaînes opératoires*, it is impossible to assess the extent of in situ production, in particular for the blades. The small number of flakes where indirect percussion could be securely identified (n=6), as well as the importance of retouch and curation, suggests that blanks were scarce and that many may have been imported as such, as is the case in most Thessalian Middle Neolithic sites.²⁸⁸

²⁸¹ Pelegrin 1994.

²⁸² See Inizan et al. 1999, 136: “Literally ‘centering’ in architecture. The term refers to the transversal convexity of the debitage surfaces of a blade core (perpendicular to the ridges).”

²⁸³ See Inizan et al. 1999, 136: “The term refers to the longitudinal convexity of the debitage surfaces of a core, which is best represented on cores with a single striking platform.”

²⁸⁴ Pelegrin 2012.

²⁸⁵ Perlès 2004.

²⁸⁶ Perlès 1990; ‘Table 5’ after Reingruber et al. 2017, tab. 5

²⁸⁷ Pelegrin 2004; Pelegrin 2012; Perlès in preparation.

²⁸⁸ Moundrea-Agrafioti 1981, 74; Karimali 2009.



Fig. V.1.1 Lithic Phase 1. a, c–i, n: unretouched flakes, b: flake core, d, j–m: bladelets, o: laterally retouched flake, p–q: reflaked blades (pseudo-burins), r: micro end-scraper, s: end-scraper, t–u: laterally retouched blades, v: microfoliate point. All in R/CC except d in light-coloured chert, k–o in obsidian, p in honey chert. a: PM0801, b: PM0846, c: PM0687, d: PM0784, e: PM0849, f: PM0884, g: PM0870, h: PM0872, i: PM0896, j: PM0688, k: PM0738, l: PM0802, m: PM0774, n: PM0820, o: PM0781, p: PM0838, q: PM0855, r: PM0723, s: PM0742, t: PM0840, u: PM0773, v: PM0848 (C. Perlès)

Tab. V.1.3 Relevant dimensions for the Lithic Phase 1 assemblage. When the functional orientation differs from the technological orientation – i.e. according to the direction of the percussion, with proximal end at the bottom – the measurements are given according to the functional orientation (C. Perlès)

PMZ number	Determination	Dimensions [cm]
PM0846	Flake core	2.7 × 3.6 × 0.7
PM0735	Primary R/CC flake	2.7 × 3.83 × 1.52
PM0862	Core preparation R/CC flake	2.12 × 1.5 × 0.43
PM0787	Core preparation R/CC flake	2.93 × 1.4 × 0.59
PM0884	Core preparation R/CC flake	3.25 × 3.1 × 0.6
PM0814	Obsidian rejuvenation flake	1.8 × 1 × 0.28
PM0797	Distal frag. of quartz laminar flake	2.7 × 1.57 × 0.7
PM0784	Proximal frag. of chert bladelet	2.04 × 1.2 × 0.4
PM0738	Mesial frag. of obsidian bladelet	1.78 × 0.9 × 0.19
PM0774	Distal frag. of obsidian bladelet	3.31 × 1.18 × 0.25
PM0802	Proximal frag. of notched obsidian bladelet	1.64 × 0.79 × 0.3
PM0852	Mesial frag. of utilised R/CC blade	1.6 × 1.55 × 0.31
PM0773	Mesial frag. of retouched R/CC blade	2.7 × 1.14 × 0.7
PM0840	Mesial frag. of retouched R/CC blade	3.03 × 1.7 × 0.42
PM0855	Proximal frag. of retouched R/CC blade	2.24 × 1.55 × 0.37
PM0871	Retouched obsidian flake	1.88 × 2.2 × 0.49
PM0820	Retouched obsidian flake	2.69 × 1.37 × 0.35
PM0833	Sickle insert on R/CC blade	5 × 1.5 × 0.65
PM0736	Sickle insert on R/CC blade	3.6 × 1.45 × 0.5
PM0875	Sickle insert on mesial frag. of R/CC blade	3.53 × 1.33 × 0.48
PM0743	Sickle insert on mesial frag. of R/CC blade	2.71 × 1.2 × 0.59
PM0808	Sickle insert on proximal frag. of R/CC blade	2.26 × 1.65 × 0.51
PM0751	Sickle insert on proximal frag. of R/CC blade	2.9 × 1.64 × 0.64
PM0746	Sickle insert on R/CC blade	2.88 × 1.77 × 0.55
PM0764	Sickle insert on R/CC blade	3.3 × 1.61 × 0.53
PM0836	Sickle insert on R/CC flake	2.7 × 1.7 × 0.62
PM0734	Sickle insert on R/CC flake	2 × 1.3 × 0.34
PM0867	Sickle insert on R/CC flake	2.8 × 1.56 × 0.68
PM0845	Sickle insert on R/CC flake	2.1 × 1 × 0.82
PM0812	Sickle insert on R/CC flake	2.68 × 1.47 × 0.57
PM0849	Sickle insert on R/CC flake	3.1 × 2 × 0.72
PM0728	Sickle insert on R/CC flake	2.9 × 1.34 × 0.35
PM0770	Sickle insert on R/CC flake	2.6 × 1.68 × 0.78
PM0742	End-scraper on R/CC blade	3.21 × 2.09 × 0.63
PM0723	Frag. of micro end-scraper	0.9 × 0.7 × 0.23
PM0848	Microfoliate R/CC point	2.06 × 0.98 × 0.35
PM0823	Splintered R/CC flake	1.13 × 2 × 0.6
PM0838	Mesial frag. of retouched honey chert blade	3.58 × 1.8 × 0.86

The Retouched Toolkit

If one leaves aside the debris and the core, 29 out of a total of 56 pieces are retouched, i.e. more than half. This ratio is higher than in any Middle Neolithic Thessalian site where the information is available. At Achilleion Early Neolithic/Middle Neolithic and Middle Neolithic, one obtains a ratio of 13.7% retouched pieces in Phase III and 13.8% in Phase IV by combining tables 10.4 and 10.3.²⁸⁹ At Otzaki²⁹⁰ the ratio is 27% for Planum 15 and 16, dated to an early Middle Neolithic. Ag. Petros, Sesklo B and Magoula Karamourlar show rates of 36.1%, 31.5% and 33.1%, respectively, for the Middle Neolithic as a whole.²⁹¹ These ratios are comparable to the ratio of retouched pieces in the Middle Neolithic at Franchthi.²⁹² The unusually high ratio at PMZ, together with the use of informal flakes, confirms that raw materials and available blanks were severely lacking.

From a typological viewpoint, the comparison between the classic technomorphological classification and the results of the functional analysis reveals interesting discrepancies. Well-developed cereal gloss had been recognised during the technological analysis, and the artefacts accordingly classified as sickle inserts on blades or flakes. On several sickle inserts, however, the polish that started to develop after rejuvenation of the edge was not visible macroscopically, so they had been considered as sickle inserts transformed into ‘retouched blades’. Similarly, the exact extension of the polish on the distal edge of the inserts could not always be assessed, leading to misidentifications: two ‘end-scrapers on sickle blades’, for instance, were functionally complete inserts with an ‘end-scrapers front’ to shape the distal end. Another short ‘end-scrapers on flake’ was in fact used to cut cereals with the ‘end-scrapers’ front. Microscopic examination was also necessary to detect minute traces of residues from hafting²⁹³ and to show that several retouched edges were not secondary transformations of sickle inserts, but a deliberate shaping of the edge for hafting.

Unless a well-developed cereal gloss covers the working edge(s), the main difficulty for the technologist is to differentiate a retouch intended to shape the piece for manual prehension or for hafting from a retouch intended to modify the characteristics of the working edge. Most of the discrepancies observed between the classical typological classification and the results of the microscopic studies arose from this difficulty.

Functional analyses also proved decisive for understanding the sickle inserts on flakes. Poorly developed polish on unusual blanks, such as informal flakes, had not always been recognised and the artefacts had been classified in a different typological category (see ‘little tranchet’, Tab. V.1.4). More generally, functional analyses allowed us to make some sense of the whole class of sickle inserts on flakes, which, when oriented according to a technological orientation – along the flaking axis – appeared all different: one had to understand that the users of the inserts, contrary to the technologist, did not care about a strict technological orientation! Traditional typologies and strict classificatory principles are clearly ill adapted when, as is the case here, the artisans or the users did not have a strict technomorphological template in mind for their tools.

Tab. V.1.4 lists the retouched pieces from Lithic Phase 1 (by building phase) and underlines, by means of italics, discrepancies between the original typological determination and the functional determination.

In the following presentation, the tools will be classified according to the results of the functional analysis, when available. The largest group by far consists of flakes and blades bearing cereal polish, i.e. sickle inserts (16 out of 28). The other tool types are mostly represented by single artefacts: end-scrapers, micro end-scrapers, ‘burin’, notched bladelet, microfoliate, retouched flakes and blades. The absence of projectile points and geometrics should be noted, but this may be due to the small size of the sample.

²⁸⁹ Elster 1989.

²⁹⁰ Mottier 1981 and personal observation C. P.

²⁹¹ Moundrea-Agrafioti 1981, tab. 10.

²⁹² Perlès 2004, docs. 8.1 and 8.2.

²⁹³ These residues have not been analysed.

Tab. V.1.4 Retouched tools from Lithic Phase 1. Italics denote discrepancies between the technomorphological and functional identifications (C. Perlès)

PMZ number	BPh/BSPH	Figure	Raw material	Technomorphological classification	Functional classification
PM0875	II	V.1.2.c, V.1.4.c	Burnt R/CC	<i>End-scraper on sickle blade</i>	<i>Sickle insert on blade, reused for another task</i>
PM0867	IIIa	V.1.2.n, V.1.4.m	R/CC	Denticulated sickle insert on flake	Sickle insert on flake
PM0855	IIIa	V.1.1.q	R/CC	Pseudo 'burin'	n/a
PM0849	IIIb	V.1.2.m, V.1.4.l	R/CC	Denticulated sickle insert on flake	Denticulated sickle insert on flake
PM0848	IIIb	V.1.1.v, V.1.3.h	R/CC	Microfoliate point	Utilised tool, undetermined use
PM0852	IIIb	V.1.3.e	R/CC	Blade with use wear	Blade used on hard or semi-hard material
PM0838	IIIb	V.1.1.p, V.1.3.d	Honey chert	Retouched and reflaked blade	Retouched blade, used on wood, reflaked
PM0823	IIIb	–	R/CC	Splintered piece	n/a
PM0840	IIIb	V.1.1.t	R/CC	Retouched blade	Retouched, utilised blade, undetermined use
PM0845	IIIb	V.1.2.o, V.1.4.n	R/CC	<i>Secondary flake from sickle blade</i>	<i>Sickle insert on flake</i>
PM0833	IIIb	V.1.2.a, V.1.4.a	R/CC	Transformed sickle blade	<i>Sickle insert on blade</i>
PM0836	IIIb	V.1.2.j, V.1.4.j	R/CC	<i>Little tranchet</i>	<i>Sickle insert on flake</i>
PM0812	IIIb	V.1.2.i	R/CC	Retouched sickle insert on flake	Retouched sickle insert on flake
PM0820	IIIb	V.1.1.n, V.1.3.f	Obsidian	Notched flake	n/a
PM0802	IIIc	V.1.1.l	Obsidian	Notched bladelet	n/a
PM0808	IIIc	V.1.2.l, V.1.4.k	R/CC	<i>End-scraper on sickle blade</i>	<i>Sickle insert on blade</i>
PM0781	IVa	V.1.1.o	Obsidian	Retouched flake	n/a
PM0773	IVb	V.1.1.u, V.1.3.c	R/CC	Retouched blade	Scraper used on skin
PM0770	Va	V.1.2.h, V.1.4.i	R/CC	<i>Retouched flake</i>	<i>Sickle insert on flake</i>
PM0764	Va	V.1.2.e, V.1.4.e	R/CC	Sickle blade	Sickle insert on blade
PM0751	Vb	V.1.2.f, V.1.4.f	R/CC	<i>Sickle blade transformed into denticulated blade</i>	<i>Sickle insert on blade</i>
PM0746	Vb	V.1.2.d, V.1.4.d	R/CC	<i>Transformed sickle blade</i>	<i>Sickle insert on blade</i>
PM0742	Vd	V.1.1.s, V.1.3.a	R/CC	Proximal end-scraper	End-scraper used on skin or hide
PM0743	Vd	V.1.2.k, V.1.4.h	R/CC	<i>Sickle blade transformed into denticulated blade</i>	<i>Sickle insert on blade</i>
PM0736	Vd	V.1.2.b, V.1.4.b	R/CC	Sickle blade transformed into denticulated blade	Sickle blade reused for another task
PM0734	Vd	–	R/CC	Sickle insert on flake	n/a
PM0728	Vd	V.1.2.g, V.1.4.g	R/CC	<i>Sickle insert transformed into point</i>	<i>Sickle insert</i>
PM0723	Ve	V.1.1.r, V.1.3.b	R/CC	Micro end-scraper	Micro end-scraper

Sickle Inserts (n=16)

The rather unusual characteristic of the sickle inserts in Lithic Phase 1 is the variety of blanks utilised. Several groups can be distinguished: sickle inserts on regular blades, sickle inserts on backed flakes, and sickle inserts on informal flakes.

Classical 'sickle blades' are surprisingly few in this assemblage. They are made on blades of variable flaking quality, all probably produced by indirect percussion, and characterised by a frequent bilateral use and oblique hafting.

PM0833 (Figs. V.1.2a, V.1.4a) stands out by its dimensions: made in a dark-brown, spotted R/CC, it measures 5cm long for a present width of 1.5cm, despite important lateral rejuvenation. The linear butt is preserved and the distal end was intentionally broken to reduce its length. According to L. P., the insert is functionally complete with cereal polish on the distal fracture and on both edges (see V.1.9. Appendix for a detailed description of the wear traces). It was first used on one edge, then turned over and used on the other edge. Both edges were rejuvenated, by a short denticulated abrupt retouch on the left edge, and a longer, subparallel, $\frac{3}{4}$ abrupt denticulated retouch on the right edge. Both edges were re-used to cut cereals for a short while after rejuvenation. It would thus belong to the small subset of Thessalian inserts that Moundrea-Agrafioti defined as '*lames-faucilles*',²⁹⁴ as opposed to the more common '*éléments de faucille*', usually between 2.6 and 3cm long. However, Mazzucco found it too altered to confirm its use.

PM0736 (Figs. V.1.2b, V.1.4b) is made on a regular blade of fine-grained chocolate R/CC with a flat butt and preparation on the dorsal face. It is functionally complete, with cereal polish on the two extremities. The distal end was intentionally broken to reduce it to a module of 3.6cm for a width of 1.45cm. It was inserted obliquely, turned over after the initial use and re-used to cut cereals. The left edge was then denticulated by $\frac{3}{4}$ abrupt retouch with no polish, while the right edge bears an alternating use retouch due to the re-use of the insert for another task.²⁹⁵ The secondary retouch of the left edge may thus be related to the rehafting of the tool when re-used.

PM0875 (Figs. V.1.2c, V.1.4c) was initially classified as an end-scraper on a sickle blade. Microscopic examination showed that cereal polish extended over the right side of the 'end-scraper' and that the latter was meant to shape the tool to a module of ca. 3.5cm. Similarly shaped sickle inserts are known in other Thessalian sites, but rare.²⁹⁶ Like the previous one, PM0875 was inserted obliquely, used on cereals, turned over and re-used. It was then retouched on both edges by a slightly denticulated $\frac{3}{4}$ abrupt retouch and used for another task.²⁹⁷

PM0746 is a mesial fragment of blade that bears cereal polish on both fractures and is therefore functionally complete (Figs. V.1.2d, V.1.4d). The left proximal part was shaped for hafting by a short inverse retouch. The right edge was used to cut cereal, rejuvenated by denticulated $\frac{1}{2}$ abrupt retouch, and used again for the same task. Remains of polish obliterated by thermal fractures are possible on the left edge.²⁹⁸

PM0764 (Figs. V.1.2e, V.1.4e) is probably functionally complete, shortened by fracture on the proximal extremity to fit the module of ca. 3.5cm. It was used to cut cereals with the right edge, and bears traces of resin on the hafted left edge. The working edge was extensively rejuvenated and used again for the same task.²⁹⁹

The following pieces constitute a second and numerically dominant group of inserts, made on flakes or laminar flakes. As mentioned above, when oriented along the technological axis, this group appeared heterogeneous by the shape of the blanks, the position of the working edge and the characteristics of the opposite edge. Its coherence is revealed when the artefacts are oriented

²⁹⁴ Moundrea-Agrafioti 1981, 119.

²⁹⁵ Observation N. Mazzucco.

²⁹⁶ Moundrea-Agrafioti 1981, 117.

²⁹⁷ Observation N. Mazzucco.

²⁹⁸ Observation N. Mazzucco.

²⁹⁹ Observation N. Mazzucco.

along the longest morphological axis: these inserts are all characterised by small dimensions, by the use of one edge only to cut cereals, by a thick opposite hafted edge, and by an only slightly oblique insertion into the haft.

Like PM0875, PM0751 (Figs. V.1.2f, V.1.4f) was initially classified as an end-scraper. Microscopic examination revealed a functionally complete sickle insert. The left edge bears a short inverse retouch on the proximal end, comparable to that of PM0764, and an irregular direct retouch on the mesial and distal parts. There is no use-wear on this edge and the retouch must have been intended to shape the insert for hafting. The piece was inserted slightly obliquely and used with the right edge. The polish is cut by a short $\frac{1}{2}$ abrupt retouch that bears no traces of cereal polish or of use on another material.

PM0728 (Figs. V.1.2g, V.1.4g), initially classified as a sickle insert reshaped into a pseudo-point, is, in fact, a functionally complete sickle insert that bears cereal polish on the two extremities. It fits within the shorter module of less than 3cm. The left edge was shaped for hafting by inverse $\frac{1}{2}$ abrupt retouch and preserves traces of resin. It was inserted very slightly obliquely into the haft. The right working edge bears an irregular direct abrupt retouch, possibly from its use when cutting cereals.³⁰⁰ It is close, morphologically and technically, to PM0770 (Fig. V.1.2h), which is made on a fragmentary flake but probably functionally complete. The right edge was shaped for hafting by $\frac{1}{2}$ abrupt inverse retouch and inserted slightly obliquely into the haft. The left edge was used to cut cereals and bears an inverse discontinuous low-angle retouch that corresponds to light rejuvenation. The insert was not used for long after rejuvenation. PM0812 (Fig. V.1.2i) is morphologically very similar to PM0770 but the 'backed' hafted edge to the right is prepared by an oblique inverse abrupt truncation. The poorly developed polish on the mesial part of the left edge was interpreted differently by the two specialists of traceology: L. P. suggests it results from the working of reeds, while Mazzucco considers it as resulting from brief work on cereals. Though slightly different, with its quadrangular morphology, PM0836 also belongs to the group of inserts on backed flakes. The cereal polish was not initially identified and the piece was described as a 'little tranchet', or bitruncation (Figs. V.1.2j, V.1.4j). The original proximal end was truncated by direct retouch; the original distal edge bears a continuous $\frac{1}{2}$ direct retouch, while the original right edge is backed by inverse abrupt retouch. The results of the functional analysis demonstrate that it was, in fact, shaped to be a sickle insert, with the left edge hafted, and the right edge used on cereals. The polish extends over the distal truncation and the insertion in the haft appears to have been slightly more oblique than with the previous pieces.

PM0743 has been so intensely rejuvenated that it now presents an unusual elongated and narrow shape. The distal end is broken. The right edge was backed in order to be inserted in the haft, by large, denticulated $\frac{1}{2}$ abrupt direct retouch (Figs. V.1.2k, V.1.4h). Like the previous pieces, it was inserted with a very slight angle into the haft. The left edge was used to cut cereals, rejuvenated – probably several times – and used again for the same task.³⁰¹

PM0808 (Figs. V.1.2l, V.1.4k) was initially interpreted as an end-scraper manufactured on a flake extracted from a sickle blade by bipolar percussion. Only one facet of the original blank is preserved, and it bears a well-developed, macroscopically visible, cereal polish. However, microscopic examination also revealed cereal polish on the 'end-scraper' front. This piece is thus another example of a thick-backed sickle insert on an unusual flake blank. Finally, PM0734 shaped on a hinged flake – possibly from bipolar percussion – is the smallest example of inserts on backed flakes. The right edge was backed by short abrupt retouch, the left edge bears a light cereal polish.³⁰²

The remaining three inserts, also on flakes, have different and very unusual shapes for sickle inserts but they share one characteristic: a very large butt that renders the insert very thick.

³⁰⁰ Observation N. Mazzucco.

³⁰¹ Observation N. Mazzucco and L. P.

³⁰² This piece had been examined in 1990 by C. P., but was not recovered during the recent studies.



Fig. V.1.2 Lithic Phase 1. Sickles inserts on blades and flakes. All in R/CC. a: PM0833, b: PM0736, c: PM0875, d: PM0746, e: PM0764, f: PM0751, g: PM0728, h: PM0770, i: PM0812, j: PM0836, k: PM0743, l: PM0808, m: PM0849, n: PM0867, o: PM0845 (C. Perlès)

PM0849 (Figs. V.1.2m, V.1.4l) was awkwardly produced with a hard hammer. Since, functionally speaking, the resulting thick butt constitutes the right edge of the insert, this piece belongs to the group of inserts with a thick hafted back. It differs, however, by its denticulated, convex working edge, shaped on the distal edge by low-angled retouch and bearing a well-developed cereal polish. Despite these unusual characteristics, the polish is absolutely similar to the other inserts, and shows that the flake was used to cut cereals.³⁰³ PM0867 (Figs. V.1.2n, V.1.4m) was also struck with a hard hammer and used on its left edge. The active edge bears a denticulated low-angled retouch, polished, but the denticulation is less pronounced than on the previous piece. After being used as a sickle insert, the flake was re-used by the distal end to scrape dry skin. The last sickle insert, PM0845, probably presents the most unusual morphology, with its narrow triangular shape and thick triangular section (Figs. V.1.2o, V.1.4n). Like the two previous ones, it presents a very large butt and was struck with a hard hammer. It was inserted diagonally, and the well-developed cereal polish on the right edge extends over the butt. Important striations and soil polish over the cereal polish indicate contact with the ground.³⁰⁴

‘Burin’ (n=1)

PM0855 (Fig. V.1.1q) is made on a unique light-beige R/CC with brown spots. Before the breakage of the proximal extremity, a strongly hinged bladelet, similar to a burin spall, was extracted on the left edge. Real burins, i.e. tools used on the angle or edge of the spall removal, are virtually non-existent in Greek Middle Neolithic assemblages. By contrast, the reflaking of large blades to obtain smaller blanks is a common practice.³⁰⁵ This piece should thus more probably be considered as a burin-like core.

End-scrapers (n=2)

The only two end-scrapers are morphologically very different from one another and they were used differently. PM0742 (Figs. V.1.1s, V.1.3a) is a proximal end-scrapers made on a wide, hinged R/CC blade or laminar flake. Both edges bear a large $\frac{3}{4}$ direct continuous retouch. The end-scrapers front is $\frac{1}{2}$ circular and was shaped by $\frac{1}{2}$ abrupt regular retouch. Microscopic examination confirms that it was used as an end-scrapers on hide, held at a high angle, with a transverse movement. PM0723 (Figs. V.1.1r, V.1.3b) is, by contrast, a fragment of a very small micro ‘end-scrapers’, made on a bladelet or small flake. A convex front was prepared on the distal part, adjacent to an inverse retouch on the left edge. The tool was not used on the whole scrapers front but only on a localised segment of the left distal extremity, with a transversal gesture on vegetal material that could not be identified.

Laterally Retouched Blades (n=3)

PM0840 (Fig. V.1.1t) is a proximal fragment of an R/CC blade with a punctiform butt, flaked by indirect percussion. It bears a bilateral low-angle retouch and was utilised on the right edge, as shown by the blunting and polish. The material worked could not be identified. PM0773 (Figs. V.1.1u, V.1.3c) is a narrow, dark-brown, matte R/CC mesial fragment of blade. Both edges were backed by a direct $\frac{3}{4}$ retouch, irregularly denticulate and used with a transversal movement on a semi-hard material, such as fresh skin.

PM0838 is the only artefact made of honey chert in this phase. As stated above, it is a typical blade made by pressure flaking with a lever (Figs. V.1.1p, V.1.3d). Possible remnants of cereal

³⁰³ Observation N. Mazzucco.

³⁰⁴ According to Mazzucco, this volume, 289–290 this could be a threshing sledge insert.

³⁰⁵ Perlès 2004.

polish on the right arris suggest it may have initially been used as a sickle blade, but this has not been confirmed. The left original edge is partly preserved and bears a low-angle direct retouch. It was used with a transverse action on hard or semi-hard material such as wood. A bladelet was then extracted on the right edge from the distal fracture. After the removal of this bladelet, the newly created edge was also used to work wood. Finally, the blade was splintered by bipolar percussion from the proximal extremity (or fracture).

Utilised Blade (n=1)

PM0852 is a short mesial fragment of a regular R/CC blade with use retouch. Microscopic examination showed that the left edge was used transversally on an undetermined hard or semi-hard material (Fig. V.1.3e).

Notched Flake and Bladelet (n=2)

The only two notched pieces are both in obsidian. PM0802 (Fig. V.1.11) is made on the smallest obsidian bladelet. A small notch was retouched on the proximal part of the left edge. PM0820 (Figs. V.1.1n, V.1.3f), flaked on the lateral side of an obsidian core by indirect percussion, was modified by a short $\frac{3}{4}$ abrupt retouch that created two shallow notches on the right edge.

Retouched Flakes (n=1)

The second obsidian flake, PM0781 (Fig. V.1.1o), was also flaked by indirect percussion. It bears a regular direct $\frac{1}{2}$ abrupt retouch on the left edge.

'Microfoliate' (n=1)

PM0848 (Figs. V.1.1v, V.1.3h) is a most unusual tool in a Middle Neolithic context; it has no equivalent that we know of, and constitutes a real 'typological puzzle': should it be considered as a microfoliate point or, if one reverses the axis, as a very narrow transverse arrowhead? Made on a R/CC bladelet or flake, PM0848 has been nearly entirely shaped by bilateral, bifacial, low-angle covering retouch. Like on the large Final Neolithic/Early Bronze Age foliate points, the bevelled base was shaped by axial retouch. Microscopic examination revealed blunting and polish on the point, but neither the gesture nor the material worked could be identified.

Splintered Piece (n=1)

PM0823 is a thick R/CC flake that bears two negatives on the ventral face. It may correspond to the very initial phase of use of a splintered blade.

The PMZ Lithic Phase 1 in the Thessalian Context

Apart from the sickle inserts, few formal tool types are represented in this small assemblage. In terms of activities identified, the harvest of cereals is largely predominant. Domestic crafts – woodworking, hide working, bone tool and ornament manufacturing – and food preparation, such as meat cutting, are either absent or conspicuously underrepresented.

The importance of sickle inserts is not specific to PMZ Lithic Phase 1: it holds true in all our Middle Neolithic Thessalian reference collections, Achilleion, Ag. Petros, Sesklo B, Magoula Karamourlar and Otzaki. Their percentage in the toolkits is usually lower than at PMZ, in particular because splintered pieces are abundant, while splintered pieces are conspicuously rare or even absent at PMZ in Phase 1. When splintered pieces are removed, the proportions become comparable, slightly above 50% of the retouched tools. On the other hand, the PMZ assemblage differs

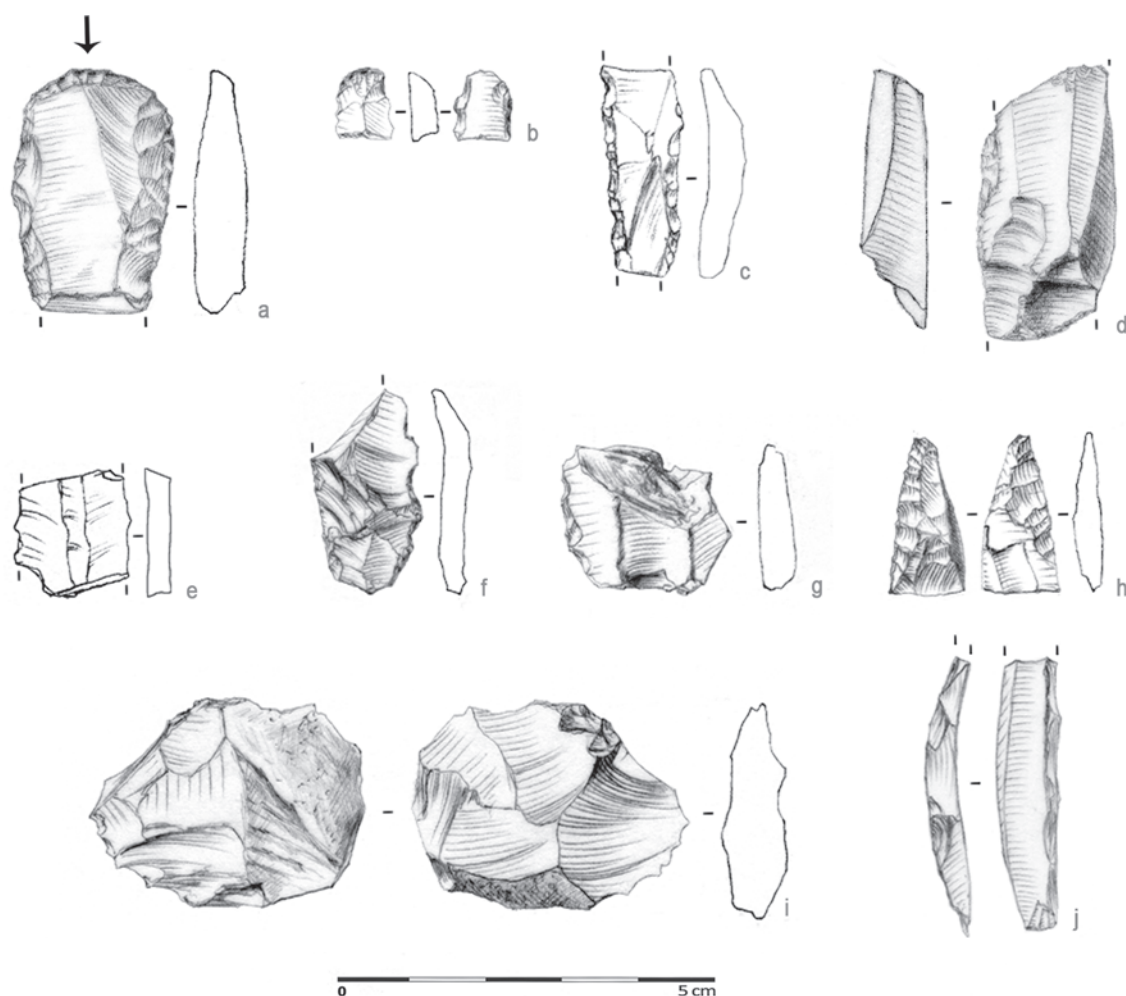


Fig. V.1.3 Lithic Phase 1. a: proximal R/CC end-scraper (PM0742), b: micro R/CC end-scraper (PM0723), c: laterally retouched R/CC blade (PM0773), d: retouched and reflaked honey chert blade (PM0838), e: utilised R/CC blade fragment (PM0852), f: notched obsidian bladelet (PM0820), g: retouched obsidian flake (PM0781), h: R/CC microfoliate point (PM0848), i: R/CC flake core (PM0846), j: R/CC lateral bladelet (PM0688) (C. Perlès, drawings: M. Ballinger)

from all others by the nature of the sickle inserts and the predominance of thick-backed flakes. Sickle inserts on flakes, and in particular on thick-backed flakes, are present in other series, where they constitute a clearly distinct type, but they are a minority: 1 out of 12 at Otzaki³⁰⁶ and barely 8% in the Thessalian sites studied by Moundrea-Agrafioti.³⁰⁷ At Achilleion (Early Neolithic and Middle Neolithic), C. P. counted 16 backed flakes with cereal polish for 67 sickle blades among the blanks that could be identified. In addition, sickle inserts on backed flakes at Achilleion tend to be more regular than at PMZ: they are made on laminar flakes, the functional axis corresponds to the technological axis and they do not have especially thick butts.³⁰⁸

Since many of the blades used as sickle inserts in eastern Thessalian sites were imported as already prepared blanks,³⁰⁹ as shown by the relative scarcity of flakes, we suggested that the predominance of sickle inserts on flakes at PMZ was due to difficulties in obtaining adequate blades through trade. However, the inserts on flakes are not, or not always, a shorter version of

³⁰⁶ See Mottier 1981, pl. 72.3 for an unusually large example.

³⁰⁷ Moundrea-Agrafioti 1983, 203.

³⁰⁸ Few are depicted in the publication, but see Elster 1989, fig. 109.4, nos. 6 and 8.

³⁰⁹ Moundrea-Agrafioti 1981, 102.

inserts on blades. The ‘sickle blades’ were intended to be used on both sides, and both edges were consequently left sharp. Some of the inserts on flakes at Achilleion were used on both edges, and can be considered as a shorter version of the same type.³¹⁰ Conversely, most of the sickle inserts on flakes from PMZ present a thick hafted edge, either natural or intentionally backed, and were used unilaterally. They also seem to have been hafted more parallel in the haft than blades and may thus correspond to two different types of sickles, both used to cut cereals. For functional or traditional reasons, the farmers of PMZ Lithic Phase 1 may have preferred this second type of sickle. It remains possible, nevertheless, that it was ‘preferred’ at PMZ precisely because regular blades were too scarce.

The few other retouched tools are common tool types in Middle Neolithic assemblages: retouched flakes and blades, end-scrapers, notched pieces. There are two exceptions: the micro end-scraper and the microfoliate point, both unique not only for Thessaly, but, as far as we know, for Greece in general. Altogether, the retouched toolkit from Lithic Phase 1 presents many idiosyncratic features: a predominance of thick-backed sickle inserts on flakes, a quasi-absence of splintered pieces, an absence of borers and geometrics, the presence of unique tool types. None of these features are found in the other Middle Neolithic assemblages published. Nor do they evoke earlier, Early Neolithic characteristics: Thessalian Early Neolithic assemblages are actually very similar to Middle Neolithic ones. They must rather be understood as a temporary answer to local conditions and the scarcity of blades.

Stratigraphic Distribution and Contexts

The stratigraphic distribution of the flaked stones of Lithic Phase 1 is uneven throughout the sequence. The basal ditch (BPh I) yielded only one R/CC unretouched flake. BPh II comprises the sediments overlying the ditch, where no architectural remains were preserved. They yielded six R/CC pieces, spread over the whole excavation surface (Fig. III.8): two debris, three unretouched flakes and the sickle blade PM0875 (Fig. V.1.2c). Considering its stratigraphic position, this bilaterally retouched sickle blade shaped with an ‘end-scraper front’ thus defines a type that can securely be considered early Middle Neolithic.

Five R/CC pieces are associated with the level of the collapsed wall W39 (BSPH IIIa, Fig. III.10): two debris, two unretouched flakes, and the sickle insert on denticulated flake PM0867 (Fig. V.1.2n). Even if this insert was incorporated into the wall from earlier sediments, it confirms that sickle inserts on both blades and flakes were in use simultaneously in the earliest phases of occupation. The burin-like blade PM0855 (Fig. V.1.1q) was recovered in the burnt layer directly overlying W39, together with two unretouched flakes.

BSPH IIIb comprises surfaces F33a–d (Fig. III.12), described as intermingled remnants of fires and dissolved clay from building materials.³¹¹ Despite evidence for repeated firing, only one piece is clearly burnt. It thus appears doubtful that they were deposited on the original surfaces before the firing episodes. Altogether, the three surfaces and interstratified deposits yielded a richer assemblage: 18 pieces, including the first two obsidian elements and the first honey chert blade. The flake core PM0846 (Figs. V.1.1b, V.1.3j) was associated with the lowermost of these surfaces. However, none of the corresponding flakes were recovered, and it cannot be surmised that it was worked there rather than redeposited. Retouched pieces are numerous: four sickle inserts on flakes (PM0812, PM0836, PM0849, PM0845, Figs. V.1.2i–j, m, o, V.1.4i–j, l, n), one sickle insert on blade (PM0833, Figs. V.1.2a, V.1.4a), the honey chert blade PM0838 (Figs. V.1.1p, V.1.3d), a retouched R/CC blade (PM0840, Fig. V.1.1t), one obsidian retouched flake (PM0820, Fig. V.1.1n) and the microfoliate point (PM0848, Figs. V.1.1v, V.1.3h). Again, all can be considered as representative of the lithic tools of the earliest phases of occupation, even if it cannot be proven that they were strictly in situ.

³¹⁰ See for instance at Achilleion: Elster 1989, fig. 10.3, no. 2.

³¹¹ Toufexis – Batzelas, this volume, 92.

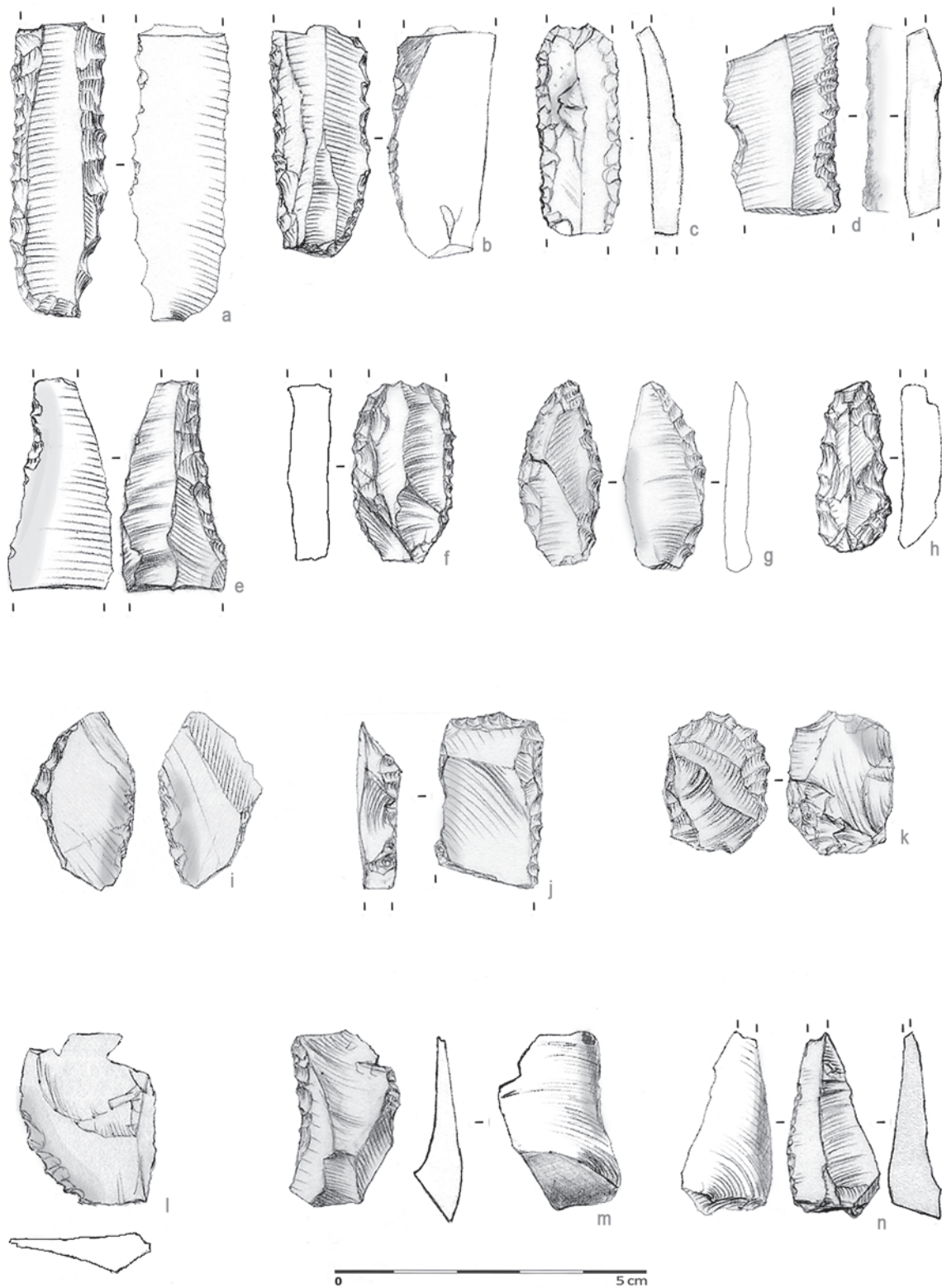


Fig. V.1.4 Lithic Phase 1. Sickles inserts on blades and flakes. All in R/CC. a: PM0833, b: PM0736, c: PM0875, d: PM0746, e: PM0764, f: PM0751, g: PM0728, h: PM0743, i: PM0812, j: PM0836, k: PM0808, l: PM0849, m: PM0867, n: PM0845 (C. Perlès, drawings: M. Ballinger)

In terms of technical activities, this represents five tools used to cut cereals, one tool used to scrape wood, and four pieces of indeterminate use. The sickle inserts were clearly not used in situ, but may have been de-hafted around the hearths. The other pieces may, conversely, have been used where they were discarded. If they were, however, their small number and diversity testifies to episodic, short-term technical activities rather than real production workshops.

Five pieces were associated with the surface uncovered in BSPH IIIc (Fig. III.15): one obsidian bladelet, one R/CC fragmentary burnt blade and three R/CC flakes, including two which were accidentally burnt. Since no hearths were noted on this surface, the burnt pieces must have been redeposited from elsewhere and this casts doubts for the other pieces as well: they may all derive from earlier contexts. The only retouched piece is the obsidian bladelet (PM0802, Fig. V.1.11), but its use has not been investigated.

BSPH IVa corresponds to another surface (F32) with remnants of a wall, a thermal structure and possible postholes (Fig. III.17). Despite this architectural richness, it yielded only five flaked stones: an obsidian flake, the quartz laminar flake, a light chert bladelet, a R/CC debris and a R/CC flake. The obsidian flake is retouched (PM0781, Fig. V.1.1o) but its use has not been investigated. These artefacts must be in situ, but are unfortunately not informative in terms of chronology or activities.

No flaked stone was directly associated with surface 31 and its architectural features (BSPH IVb, Fig. III.19). This is all the more unfortunate in that F31 is considered to be the internal floor of a house limited by the wall W37. The two pieces attributed to this building phase come from the destruction deposits above the floor: an obsidian bladelet (PM0774, Fig. V.1.1m) and a retouched R/CC blade PM0773 (Figs. V.1.1u, V.1.3c) used to scrape skin, most certainly redeposited here and not used in situ. Similarly, no flaked stone artefacts are associated with surface F30, despite the presence of postholes that suggest a living floor (Fig. III.21). PM0770, a thick-backed sickle insert (Fig. V.1.2h), was found above F30 and just below the next surface, F29, but no data allows us to say whether it was in situ or redeposited. Conversely, PM0764, a sickle insert on blade (Fig. V.1.2e) was uncovered during the excavation of earthen floor F29, and can be presumed to be in situ.

The three artefacts attributed to BSPH Vb were found in the deposits above surface F29 and hearths TS 29–31 (Fig. III.22). They again consist of three R/CC sickle blades (PM0746, PM0751 and PM0745, Figs. V.1.2d, f, o, V.1.4d, f, n). Four more were uncovered in BSPH Vd³¹² (Fig. III.24): PM0728, PM0734 and PM0743, three sickle inserts on flakes, and PM0736, a sickle insert on a blade (Figs. V.1.2b, g, k, V.1.4b, g–h). From the same building phase come the large proximal end-scrapers (PM0742, Figs. V.1.1s, V.1.3a), a utilised bladelet and an unretouched flake. Despite the presence of thermal structure TS 26, no piece is burnt. Unfortunately, it is unclear whether these artefacts were found directly on surface F27 or between F26 and F27.³¹³ They suggest, however, that both types of sickle insert as well as end-scrapers on large blades persisted throughout the early Middle Neolithic phases.

Finally, the micro end-scrapers (PM0723, Figs. V.1.1r, V.1.3b) was found on surface F26 in BSPH Ve (Fig. III.25), together with two unretouched R/CC flakes, a retouched one (PM0607) and the bladelet PM0688 (Fig. V.1.1j, V.1.3j) found just below surface F25 from BPH VI. The micro end-scrapers is thus also characteristic of the early Middle Neolithic phases from PMZ.

The concentration in BSPH Va–e of retouched and utilised artefacts, and the quasi-absence of unretouched pieces is puzzling. Surfaces F26, F27 and F28 are described as activity areas with well-built hearths and remnants of walls. We can thus suggest that flaking stone was avoided in this activity area, that a few tools were used for technical tasks and that the sickle inserts, which

³¹² There are no flaked artefacts in BSPH Vc.

³¹³ These pieces are attributed to SU 100–101. SU 100 corresponds to the deposits above surface F28, whereas SU 101 corresponds to surface F27.

are dominant, were de-hafted and replaced. None, however, was found in direct spatial association with a hearth.

On the whole, very few artefacts from Lithic Phase 1 are directly related to floors, hearths and architectural features. No in situ knapping is firmly evidenced, and there is no proof that the artefacts were used where they were found, especially considering the predominance of sickle inserts. To what extent the typological similarities of the flaked stone assemblages from BPh I to V are due to reworking of earlier material, or reflect an archaeological reality, is difficult to assess. Nevertheless, these deposits appear to have accumulated very quickly,³¹⁴ which reinforces the plausibility of technological and typological homogeneity. In particular, the predominance of sickle inserts and the presence of inserts on both flakes and blades in BSPH Vd and Ve align them with the earlier levels. There is no argument in the lithic assemblage to confirm the break between BSPH Vc and Vd that is observed in the pottery assemblages.³¹⁵

V.1.4. Lithic Phase 2 – Building Phase VI

Characterisation

The small assemblage from Lithic Phase 2 (n=27) (EU 211–234) shows indisputable elements of continuity with Lithic Phase 1, but equally marked changes in the proportions of the different classes of artefacts. Radiolarite/chocolate cherts are less predominant in the raw materials, obsidian correlatively better represented, radiolarite blades become rare and flakes relatively more abundant, and the proportion of retouched pieces is lower. This phase also presents the first instance of percussion with a soft stone hammer. Apart from one aberrant date (MAMS 32122), Lithic Phase 2 was dated to 5837–5681calBC 2σ (MAMS 32123), i.e. within the chronological range of Lithic Phase 1, but with a best fit at 5657 ± 1 (Chapter IV).

Raw Materials

The range of raw materials is identical to Lithic Phase 1: radiolarites/chocolate cherts (n=13), non-chocolate cherts (n=2), obsidian (n=6), honey chert (n=3), undetermined (n=2) and quartz (n=1), but the proportions differ significantly (Tab. V.1.5).³¹⁶ Cortical and neo-cortical pieces are better represented than in Lithic Phase 1 (about $\frac{1}{5}$), but the proportion remains much lower than at Achilleion.³¹⁷ The raw materials were mostly procured as water-rolled pebbles: a few flakes were extracted from a core on a R/CC pebble that rapidly split (Figs. V.1.5a, V.1.6a); two primary R/CC flakes, the quartz flake and the large chert blade, were also flaked from water-rolled pebbles (Fig. V.1.5b–d, h). No artefact bears fresh cortex.

The Production

The radiolarite/chocolate chert sample comprises 2 debris, 1 core, 9 flakes and 1 blade. The high proportion of flakes versus blades was already noted as a specificity of PMZ.³¹⁸ This is even more pronounced in Lithic Phase 2, whether one considers the R/CC artefacts only or the whole assemblage (Tab. V.1.5). Again, the procurement of blades, or of raw material adequate to produce blades, appears to have been difficult.

³¹⁴ Weninger et al., this volume, Tab. IV. 1.

³¹⁵ Pentedeka in press; Pentedeka in preparation.

³¹⁶ $\chi^2=10.8$, $df = 4$, $p < 0.05$.

³¹⁷ Elster 1989, tab. 10.15.

³¹⁸ See above, 209.

Tab. V.1.5 Composition of the flaked stone assemblage from Lithic Phase 2 (C. Perlès)

	R/CC	Chert	Obsidian	Honey chert	Quartz	Undetermined
Debris	2					
Cores	1					
Flakes	6		2		1	1
Blades						1
Bladelets			3			
Retouched flakes	3	1	1	1		
Retouched blades	1	1		2		
Retouched bladelets						
Total	13	2	6	3	1	2

In situ production of R/CC flakes with a hard stone hammer on flat striking platforms is again attested by the core and a few non-matching flakes struck with a hard stone hammer. A few other flakes, produced by indirect percussion, can be attributed to the shaping of blade cores, despite the rarity of blades in the assemblage (Fig. V.1.6d). Yet, one large flake and the only two R/CC blades present the characteristics of soft stone hammer percussion;³¹⁹ a large flat butt with a marked angle towards the ventral face, but a more diffuse bulb of percussion than with a hard stone hammer (Fig. V.1.5e–f). In turn, a large fragmentary blade made on variegated chert with rectilinear ar-rises (Fig. V.1.5h) suggests the use of indirect percussion, but the proximal end is broken and this cannot be ascertained.

Indirect percussion was used to detach two of the three obsidian bladelets (Figs. V.1.5i, k, V.1.6b), whereas the third was produced by pressure flaking (Fig. V.1.5j). The butts are flat or linear, with preparation for the detachment on the dorsal face, a normal Middle Neolithic procedure. The obsidian sample also comprises two lateral core preparation flakes (Fig. V.1.5l), and a very small flake that could correspond to the rejuvenation of a striking platform. The presence of this flake, too small to be used (Tab. V.1.6), suggests that obsidian was at least partially worked on the site.

The two honey chert blades were produced by pressure flaking. Even before rejuvenation, their width must have been under 2cm, so that the use of a lever was not necessary. A long standing-crutch would have nevertheless been required, at least for PM0696 (Figs. V.1.5n, V.1.6c).³²⁰ The third honey chert artefact is a flake extracted from a retouched blade, a practice already observed in Lithic Phase 1 and current on Middle Neolithic honey cherts blades.³²¹ The flaking technique of the quartz flake remains undetermined.

As in Lithic Phase 1, details of raw material show that every piece comes from a different core, and every *chaîne opératoire* is represented by a single piece. While the local production of R/CC flakes can be considered certain and the flaking of obsidian probable, it is impossible to determine whether the few R/CC blades and bladelets were produced in situ or imported as already flaked blanks. As usual, the honey chert blades must have been introduced into the settlement as already flaked blanks.

³¹⁹ Pelegrin 2000.

³²⁰ Pelegrin 2012.

³²¹ Perlès 2004.

Tab. V.1.6 Relevant dimensions for the Lithic Phase 2 assemblage (C. Perlès)

PMZ number	Determination	Dimensions [cm]
PM0613	Distal frag. of obsidian bladelet	1.15 × 1.1 × 0.21
PM0815	Proximal frag. of obsidian bladelet	2.36 × 0.86 × 0.29
PM0634	Proximal frag. of obsidian bladelet	1.92 × 0.64 × 0.21
PM0696	Sickle insert on blade	3.7 × 1.38 × 0.62
PM0652	Sickle insert on flake	3.06 × 1.86 × 0.51
PM0644	Sickle insert on obsidian flake	2.25 × 1.6 × 0.43
PM0686	Retouched honey chert blade	3.08 × 1.14 × 0.25
PM0635	Retouched and blunted blade	3.3 × 1.18 × 0.52
PM0642	Retouched chert flake	4.1 × 2.33 × 0.7
PM0649	Beak	3.24 × 1.9 × 0.67
PM0685	Splintered flake	2.9 × 2.1 × 0.85

The Retouched Toolkit

The proportion of retouched tools is lower than in Lithic Phase 1: nine pieces out of a total of 24, excluding the core and debris.³²² This proportion becomes comparable to that of eastern Thessalian sites (and Franchthi) and remains much higher than at Achilleion.³²³ Of the four artefacts that were examined for use-wear traces, one only was misidentified macroscopically: a presumed sickle blade that was actually used to work hides (Tab. V.1.7). Nevertheless, sickle inserts are still the best-represented category of tools, but in a lower proportion than before. As a consequence, they are now less abundant than in our reference assemblages, where they represent ca. 50% of the retouched tools, splintered pieces excepted.³²⁴ The absence of classical tool types such as end-scrapers cannot be considered significant given the small size of the sample.

Sickle Inserts (n=3)

Even in this very small sample, the peculiarity of the early Middle Neolithic assemblages at PMZ remains observable: of the three sickle inserts, two are made on flakes. As previously noted,³²⁵ sickle inserts on flakes usually represent less than 10% of the sickle inserts in Thessaly.³²⁶ Even more surprising, and apparently unique in Thessalian assemblages, one of them is an obsidian flake.

PM0696 is the only sickle insert on blade, a large, pressure-flaked honey chert blade. It has a long biography: it was first shaped as a long sickle insert with a casually manufactured inverse distal truncation (Figs. V.1.5n, V.1.6c). Both edges were successively used to cut cereals. The proximal part of the blade was then broken, the left edge entirely retouched by $\frac{1}{2}$ abrupt to $\frac{3}{4}$ abrupt direct retouch, the right edge by subparallel, very regular direct $\frac{1}{2}$ retouch. The tool was then used on the distal edge, left edge and distal half of the right edge on dry hide, with an angle of ca. 75°. A similar re-use of honey chert sickle blades on hide had already been observed in the Middle Neolithic at Franchthi.³²⁷

³²² The difference from Lithic Phase 1 is not statistically significant.

³²³ See above, 209.

³²⁴ See above, 209.

³²⁵ See above, 220.

³²⁶ Moundrea-Agrafioti 1983, 203.

³²⁷ Perlès – Vaughan 1983.

Tab. V.1.7 Retouched tools from Lithic Phase 2, by architectural subphase. Italics denote discrepancies between the technomorphological and functional identifications (C. Perlès)

PMZ number	BPh/ BSPh	Figure	Raw material	Technomorphological classification	Functional classification
PM0679	VIa	–	Honey chert	Flake from a retouched blade	n/a
PM0685	VIa	–	R/CC	Splintered flake	n/a
PM0686	VIa	V.1.5.p, V.1.6.e	Honey chert	<i>Sickle blade</i>	<i>Blade used on skin</i>
PM0696	VIa	V.1.5.n, V.1.6.c	Honey chert	Transformed sickle blade	Transformed sickle blade
PM0652	VIb	V.1.5.o, V.1.6.d	R/CC	Retouched sickle insert on flake	Sickle insert
PM0635	VIb	V.1.6.g	R/CC	Retouched and blunted blade	n/a
PM0642	VIb	V.1.5.e, V.1.6.i	Chert, burnt?	Retouched flake	n/a
PM0644	VIb	V.1.5.m, V.1.6.f	Obsidian	Blunted sickle insert	Sickle insert
PM0649	VIb	V.1.5.h, V.1.6.h	Chert	Unretouched beak	n/a

PM0652 (Figs. V.1.5o, V.1.6d) is a fine example of a sickle insert on a large thick-backed flake. Made on an elongated lateral core preparation flake, it was backed on the right side by $\frac{3}{4}$ abrupt retouch and inserted slightly obliquely into the haft. The working edge, to the left, was shaped by short inverse retouch and was used to cut cereals.

PM0644 is a smaller insert, also made on a lateral core preparation flake but of obsidian. Whereas obsidian sickle blades are not uncommon in Thessaly where they amount to ca. 15% of all sickle blades,³²⁸ or in the Peloponnese (25% of the sickle inserts at Franchthi),³²⁹ this is the first insert on an obsidian flake we have encountered. The piece is functionally intact and both edges show a marked blunting, over an unretouched edge to the right, over an inverse retouch on the left (Figs. V.1.5m, V.1.6f). Microscopic examination shows that it was used as the other sickle inserts, but for a short while.³³⁰

Laterally Retouched Blades and Flakes (n=3 + 1)

PM0686, the second honey chert blade, is a mesial fragment with two straight fractures (Figs. V.1.5p, V.1.6e). It was first used on both edges on a semi-hard to hard animal material such as hide, with an open angle. Both edges were then rejuvenated or transformed by regular subparallel $\frac{3}{4}$ abrupt retouch, but the retouch bears no discernible use-wear traces.

The three other laterally retouched artefacts were not examined microscopically and their function is unknown. PM0635, a R/CC irregular blade, bears a continuous inverse retouch of the right edge, overlaid by a pronounced blunting (Fig. V.1.6g). PM0642 is a large foliate flake of coarse chert (Tab. V.1.6) with a short continuous direct retouch on the right edge (Figs. V.1.5e, V.1.6i). PM0679 is not a retouched flake per se: it is a secondary flake that was extracted from a honey flint blade with bilateral direct retouch. The blade itself has not been recovered.

³²⁸ Moundrea-Agrafioti 1983.

³²⁹ Perlès 2004.

³³⁰ Observation N. Mazzucco.



Fig. V.1.5 Lithic Phase 2. a: flake core, b–f, i–l: unretouched flakes and bladelets, h: unretouched, heavily used borer, g: inversely retouched R/CC bladelet, m, o: sickle inserts on flakes, n: sickle insert on blade, p: bilaterally retouched blade. a–c, e–g, o: R/CC. d: quartz. i–m: obsidian. n, p: honey chert. a: PM0667, b: PM0633, c: PM0673, d: PM0636, e: PM0642, f: PM0671, g: PM0635, h: PM0649, i: PM0615, j: PM0634, k: PM0613, l: PM0672, m: PM0644, n: PM0696, o: PM0652, p: PM0686 (C. Perlès)

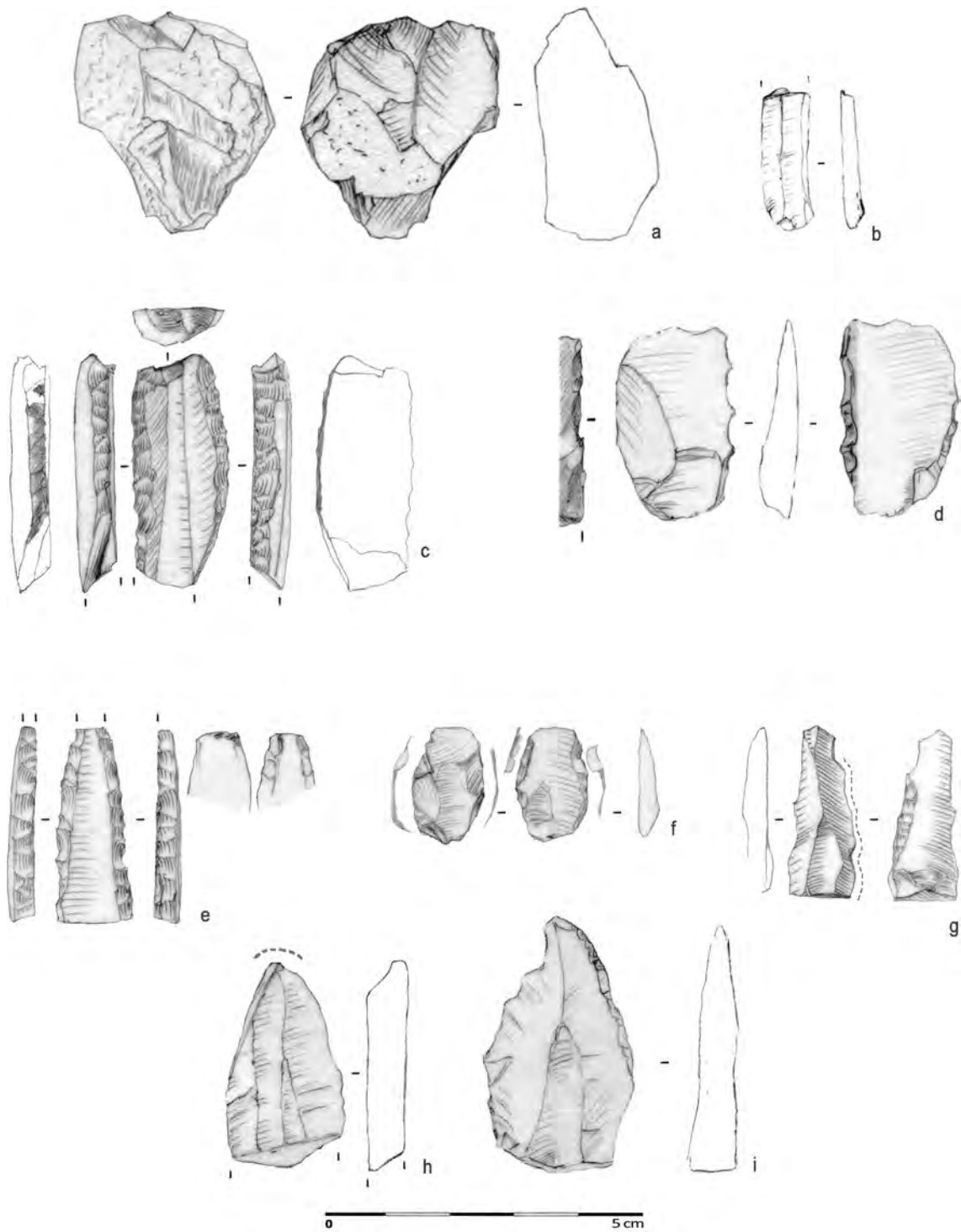


Fig. V.1.6 Lithic Phase 2. a: R/CC flake core (PM0667), b: obsidian bladelet (PM0615), c: R/CC sickle insert on blade (PM0696), d: R/CC sickle insert on flake (PM0652), e: retouched honey chert blade (PM0686), f: sickle insert on obsidian flake (PM0644), g: retouched R/CC bladelet (PM0635), h: unretouched R/CC beak (PM0649) (C. Perlès, drawings: M. Ballinger)

Beak (n=1)

The distal extremity of PM0649 presented a triangular shape due to the convergence of the right edge with an abrupt natural facet on the left edge. This sturdy point, now heavily blunted, was used directly without retouching in a rotary or semi-rotary motion (Figs. V.1.5h, V.1.6h). Although the tool has not been examined under a microscope, its use to bore mending holes on pottery appears plausible.

Splintered Flake (n=1)

Splintered pieces are again conspicuously rare in this assemblage. PM0685 is a primary R/CC flake reflaked by bipolar percussion, either during use as an intermediate piece or to try and extract a few more very small flakes.

Contexts and Stratigraphic Distribution

The composition of the Lithic Phase 2 assemblage differed from the Lithic Phase 1 assemblage in several quantitative aspects. Nevertheless, both samples are small: the differences may reflect actual changes, but they may also be due to random spatial variation. Indeed, from a typological and functional viewpoint, this very small assemblage is similar to the retouched toolkit of Lithic Phase 1. The activities identified through microscopic examination are the same, i.e. harvesting cereals and preparing hides, although other tools were probably involved in different activities. The specificity of PMZ within the Thessalian context is confirmed, with two of the three sickle inserts made on flakes and splintered pieces conspicuously rare.

However, what is probably the most striking feature of Lithic Phase 2 is how few artefacts and retouched tools were recovered. BSPH VIa and VIb correspond to two surfaces (F25 and F24, Figs. III.26–27) with remains of walls and hearths. Even if the surface was reduced while excavating phase VIb, the excavation still covered 20m². Yet only eleven artefacts were recovered in phase VIa, none of which can be attributed with certainty to ‘Floor F25’ and associated structures rather than to the overlying deposits. The honey flint blade PM0686 (Figs. V.1.5n, V.1.6c) and the splintered flake PM0687 were found ‘directly above F25’. It is therefore possible that this blade was in situ, confirming the continuous presence of honey chert sickle blades in Lithic Phase 2. Six other artefacts from BSPH VIa, none of which were retouched, were found in the yellowish sandy soil between F25 and F24.

In BSPH VIb, a debris, two R/CC flakes and the flake core PM0667 (Figs. V.1.5a, V.1.6a) were found in the destruction layer just below F24, and are probably not in situ. Conversely, the sickle insert on flake PM0652 (Figs. V.1.5o, V.1.5d) was found during the excavation of Floor F24: it confirms that sickle inserts on flakes were still in use during Lithic Phase 2 and do not come – or do not come solely – from the reworking of older material. All the other artefacts attributed to BSPH VIb (n=11) were found in the overlying deposits, between F24 and F23, so that their precise original context is unknown.

V.1.5. Lithic Phase 3 – Building Subphase VIIa*Characterisation*

Lithic Phase 3 (EU 231, 233, 236–243) is again a small assemblage (n=44). It is characterised by a statistically significant drop in the proportion of retouched tools, a relative increase of radiolarites/chocolate cherts, the presence of the first arrowheads and the first geometric tool. The only ¹⁴C sample analysed gave an aberrant date (MAMS 32121).

Tab. V.1.8 Composition of the flaked stone assemblage from Lithic Phase 3 (C. Perlès)

	R/CC	Chert	Obsidian	Honey chert	Quartz	Undetermined
Debris	1					
Cores	2					
Flakes	15	4	2		1	1
Blades	3		1			
Bladelets	6	1	3			
Retouched flakes	1					
Retouched blades	2			1		1
Retouched bladelets						
Total	30	5	6	1	0	2

Raw Materials

Raw materials are less diversified than in Lithic Phase 2 since quartz is absent. Radiolarites/chocolate cherts predominate with 30 artefacts, followed by obsidian (n=6), light-coloured cherts (n=5), honey chert (n=1) and two undetermined raw materials.³³¹ Cortical pieces are extremely rare (n=3) and the cortical surfaces are very small. This very low rate of cortical pieces now aligns PMZ with eastern Thessalian sites where few blocks of raw materials were introduced as such in the settlements.³³² The use of river pebbles remains probable, but a small R/CC cortical flake with a fresh pink cortex indicates procurement at or near the source. The dimension and quality of bladelet PM0576 (Figs. V.1.7f, V.1.8b), as well as the presence of a tiny patch of pink cortex on the distal extremity, seemingly unrolled, similarly points towards procurement at a primary source. As before, we cannot ascertain whether the procurement was direct or indirect, but the very low proportion of cortex suggests indirect procurement of already prepared cores and finished blanks. Among the translucent cherts, the composition of PM0580 (Fig. V.1.7e) matches with location PM 4, high up the Portaikos.

The Production

The Lithic Phase 3 assemblage comprises 2 cores, 23 flakes, 4 blades, 12 bladelets, 2 undetermined blanks and 1 debris (Tab. V.1.8). Although flakes still predominate, the proportion of laminar blanks is higher than in the two earlier lithic phases and becomes more comparable to other Thessalian assemblages, especially Achilleion (50% in Phase III and 55% in phase IV).³³³ However, the high proportion of small bladelets rather than blades still sets PMZ apart.

The proportion of flakes nevertheless remains high, and this is due to a local production of flakes. The R/CC flake core testifies again to unskilled hard hammer percussion (Fig. V.1.7a). Local flaking is also exemplified by two ‘handfuls’ of flakes in the western part of the trench, many of which are too small to be used and therefore unlikely to have been traded.

Struck in a concave facet of a ‘flat’ or dihedral butt with a lip on the ventral surface, three larger R/CC flakes were detached by indirect percussion and would instead correspond to crest preparation for blade cores (Fig. V.1.7b–c). Neither the cores nor the corresponding blades/bladelets have been recovered. Yet, the assemblage comprises several very regular bladelets on homogeneous,

³³¹ Compared with Lithic Phase 2, the difference is not significant at $p < 0.05$.

³³² Moundrea-Agrafioti 1981, 68.

³³³ See Elster 1989, tab. 10.11.

fine-grained R/CC. The exceptionally long PM0576 presents a dihedral butt with concave facets, a marked lip as well as undulations on the ventral face and the arrises, which indicate that it was detached by very well-mastered indirect percussion (Figs. V.1.7f, V.1.8b). The much smaller PM0594 was detached by indirect percussion on a concave flat butt with removal of the overhang on the dorsal face (Fig. V.1.7g). Both indirect percussion and pressure flaking are possible for the small mesial fragment PM0612 (Fig. V.1.7i) and for two even smaller bladelets (Tab. V.1.9; Figs. V.1.7h, V.1.8d).

The three obsidian bladelets, one of them transformed into a trapeze, show the characteristic straight profile and rectilinear arrises of pressure flaking (Fig. V.1.7j–k). The other three obsidian artefacts are very small flakes. One of them is less than 1cm long, showing the high standard of recovery during excavation, and again suggesting local flaking of obsidian.

Some translucent cherts were probably also worked in situ, since two preparation flakes by indirect percussion have been recovered. Both PM0630, in a brown chert with translucent veins (Fig. V.1.7d) and PM0580 (Figs. V.1.7e, V.1.8a) in a light translucent chert, have a faceted butt characteristic of bilateral crests in the shaping of blade or bladelet cores.

The honey flint blade was pressure flaked (PM0623, Figs. V.1.7o, V.1.8e). Its original width, before reduction by retouch, can be estimated at around 2cm, therefore around the limit between standing pressure flaking and lever pressure flaking.³³⁴

The situation is thus comparable to the previous lithic phases: a local production of flakes is assured, some local working of obsidian, radiolarite/cherts and translucent chert is probable, but, given the patchiness of the *chaînes opératoires*, it cannot be ascertained whether all the blanks were locally produced or whether some were imported.

The Retouched Toolkit

The low proportion of retouched pieces (n=6) is the most striking characteristic of Lithic Phase 3. Compared with Lithic Phase 2, the difference is statistically significant.³³⁵ The proportion is now close to the figure calculated for Achilleion (ca. 13%) but much lower than in eastern Thessalian sites, where retouched pieces reach around 30%.³³⁶

Despite their small number, four of the retouched pieces represent new types in the PMZ assemblages: a truncated blade, a trapeze and two transverse arrowheads. Given their absence in the richer retouched toolkits from Lithic Phases 1 and 2, their presence here constitutes a significant novelty. Would these types appear in Thessaly only in a relatively late phase of the Middle Neolithic, rather than at its beginning? The answer to this question cannot be provided by Thessalian lithic assemblages, which either lack these types or have not been subphased within the Middle Neolithic. Franchthi, however, does give some support to the hypothesis of a later introduction of transverse arrowheads in Middle Neolithic assemblages,³³⁷ but not of trapezes and truncations.³³⁸

PM0575 is a small trapeze on a pressure-flaked obsidian bladelet (Figs. V.1.7k, V.1.8g).³³⁹ The oblique proximal truncation is direct and abrupt, the distal one $\frac{3}{4}$ abrupt and less oblique. The left lateral edge is broken. Trapezes are seemingly very rare in Thessaly: they are not mentioned or illustrated at Achilleion and Otzaki,³⁴⁰ and Moundrea-Agrafioti only found Middle Neolithic trapezes at Ag. Petros in the Sporades – one of them in obsidian – and none in eastern Thessaly.

³³⁴ Pelegrin 2012.

³³⁵ $\chi^2 = 3.9$, $p < 0.05$, $df = 1$.

³³⁶ See above, 213.

³³⁷ Perlès 2004, Doc. 4.47.

³³⁸ Perlès 2004, Docs. 4.46 and 4.71.

³³⁹ The exact stratigraphic position of this piece has long remained uncertain and it may belong to BSpH VIIb. The marked typological similarity between Lithic Phases 3 and 4 does not allow us to discriminate on this basis.

³⁴⁰ Elster 1989; Mottier 1981.

Tab. V.1.9 Relevant dimensions for Lithic Phase 3 (C. Perlès)

PMZ number	Determination	Dimensions [cm]
PM0593	R/CC flake core	2.9 × 2.1 × 1.3
PM0580	Light chert crest preparation flake	2.46 × 2.16 × 0.35
PM0605	Proximal frag. of R/CC blade	1.48 × 1.5 × 0.41
PM0576	R/CC bladelet	5.09 × 1.01 × 0.28
PM0594	R/CC bladelet	2.68 × 1.2 × 2.02
PM0609	Mesial frag. of R/CC bladelet	1.16 × 1.17 × 0.25
PM0611	Distal frag. of R/CC bladelet	1.4 × 1.1 × 0.25
PM0612	Mesial frag. of R/CC bladelet	1.52 × 0.97 × 0.27
PM0569	Proximal frag. of light chert (?) bladelet	1.3 × 1 × 1.19
PM0585	R/CC microbladelet	1.38 × 0.51 × 0.19
PM0610	R/CC microbladelet	1.5 × 1.3 × 0.17
PM0588	Obsidian rejuvenation flake	0.59 × 0.9 × 0.2
PM0587	Mesial frag. of obsidian bladelet	1.18 × 0.7 × 0.16
PM0595	Mesial frag. of obsidian bladelet	1.4 × 0.9 × 0.24
PM0627	Mesial frag. of obsidian bladelet	1.76 × 0.81 × 1.75
PM0623	Honey chert sickle blade	4 × 1.62 × 0.52
PM0592	End-scraper on glossed R/CC flake	4.4 × 2.6 × 0.68
PM0622	Truncated R/CC blade	3.64 × 1.5 × 0.63
PM0616	R/CC transverse arrowhead	1.75 × 1.86 × 0.41
PM0626	R/CC transverse arrowhead	1.64 × 1.31 × 0.31
PM0575	Trapeze on obsidian bladelet	1.07 × 1.18 × 0.3

Tab. V.1.10 Retouched tools from Lithic Phase 3 (C. Perlès)

PMZ number	BPh/ BSPH	Figure	Raw material	Technomorphological classification	Functional classification
PM0575	VIIa	V.1.7.k, V.1.8.g	Obsidian	Trapeze	n/a
PM0592	VIIa	V.1.7.p, V.1.8.f	R/CC	Sickle insert on flake	n/a
PM0616	VIIa	V.1.7.l, V.1.8.h	R/CC	Transverse arrowhead	n/a
PM0626	VIIa	V.1.7.m, V.1.8.i	R/CC	Transverse arrowhead	n/a
PM0622	VIIa	V.1.7.n	R/CC	Truncated blade	n/a
PM0623	VIIa	V.1.7.o, V.1.8.e	Honey chert	Sickle blade	Sickle blade, re-used

³⁴¹ Some, however, were recovered in earlier assemblages (Sesklo C), but trapezes have a long chronological distribution: the presence of this trapeze at PMZ in Lithic Phase 3 cannot be taken as evidence for an Early Neolithic occupation.

Trapezes are usually considered as a type of transverse arrowheads³⁴² despite the occurrence of the two types in the same assemblages.³⁴³ The two following artefacts can actually be considered as technically intermediate between typical bitruncated trapezes and axial transverse arrowheads. Morphologically, PM0616 is an axial transverse arrowhead of small size, in radiolarite/chocolate chert (Fig. V.1.7l, V.1.8h). Technically, it is an interesting intermediate between a trapeze and an axial transverse arrowhead. It is manufactured on a flake, probably struck from a river pebble. It was shaped by $\frac{1}{2}$ abrupt proximal and distal direct truncations,³⁴⁴ but also bears a direct subparallel retouch of low angle on the left edge, more characteristic of true transverse arrowheads. The left angle is broken by a deep impact fracture. PM0626 is another intermediate between the two types: it was shaped by bitruncating a very regular R/CC blade, as for trapezes, but by bifacial $\frac{1}{2}$ abrupt retouch, a technique characteristic of transverse arrowheads (Figs. V.1.7m, V.1.8i). These two pieces, are, to our knowledge, the first transverse arrowheads published from Thessalian collections.³⁴⁵ They are abundant further south at Franchthi, where they are clearly associated with the Middle Neolithic, and with the Middle Neolithic only.³⁴⁶ To the west, conversely, bifacially worked transverse arrowheads, of a shape different from ours, are present in small numbers in Late Neolithic contexts at Drakaina Cave.³⁴⁷

The truncated blade PM0622 also constitutes a novelty in the assemblage. Made on a very regular R/CC blade, flaked by expert indirect percussion or possibly pressure, it bears a short, direct, abrupt truncation on the distal end (Fig. V.1.7n). Despite a proximal fracture, it is sufficiently well preserved to ascertain that it is not a fragmentary geometric microlith or a sickle insert.

The last two retouched artefacts, conversely, establish a typological and functional link with the previous lithic phases. PM0623 is another illustration of the long use life of many honey chert sickle blades (Figs. V.1.7o, V.1.8e). It was reduced to a module of 4cm by two fractures – the proximal one with traces of cereal polish – and hafted by the right edge, which preserved microscopic residues of resin. It was used to cut cereals with the left edge, and rejuvenated several times until the edge was so abrupt it could no longer function. The right edge was then used in turn, on a semi-hard/hard vegetal material, and also briefly, with an oblique gesture, on a hard, possibly osseous material. Finally, the distal fracture shows a rugged polish and traces of a colouring matter, and may have been used to process a mineral matter such as ochre.

PM0592 appears to be a sickle insert on a large flake, but the piece has not been examined microscopically and the nature of the polish, limited to the mesial segment of the left edge and of marginal extension, has not been verified. This large flake (Figs. V.1.7p, V.1.8f) is badly burnt and broken in two. The distal end bears an end-scraper made by direct $\frac{3}{4}$ abrupt retouch. We do not know whether the end-scraper was functional, or whether it was meant to shape the tool.

A Small but Original Assemblage

The Lithic Phase 3 assemblage differs from the preceding ones by the higher proportion of bladelets as a whole, and the quality of the R/CC bladelets. Compared with other Thessalian sites, it alternately aligns with eastern and western Thessalian sites, depending on whether one considers the ratio of cortical pieces or the ratio of retouched pieces. However, the assemblage

³⁴¹ Moundrea-Agrafioti 1981, 155.

³⁴² Rozoy 1978. But see Gurova 2017 for other uses as well.

³⁴³ Perlès 2004, Docs. 4.46 and 4.47.

³⁴⁴ Which appear as the right and left edges on the illustration due to a functional orientation of the piece.

³⁴⁵ Nevertheless, they occur in Thessaly: C. P. has seen transverse arrowheads in unpublished surface collections.

³⁴⁶ Perlès 2004.

³⁴⁷ Stratouli – Metaxas 2009.



Fig. V.1.7 Lithic Phase 3. a–j: unretouched flakes and bladelets, k–m: trapezes/transverse arrowheads, n: truncated blade, o: sickle insert on blade, p: sickle insert on flake. a–c, f–l, n: R/CC, d–e, p: light-coloured cherts, j–k: obsidian, o: honey chert. a: PM0593, b: PM0598, c: PM0596, d: PM0630, e: PM0580, f: PM0576, g: PM0594, h: PM0585, i: PM0612, j: PM0627, k: PM0575, l: PM0616, m: PM0626, n: PM0622, o: PM0623, p: PM0592 (C. Perlès)

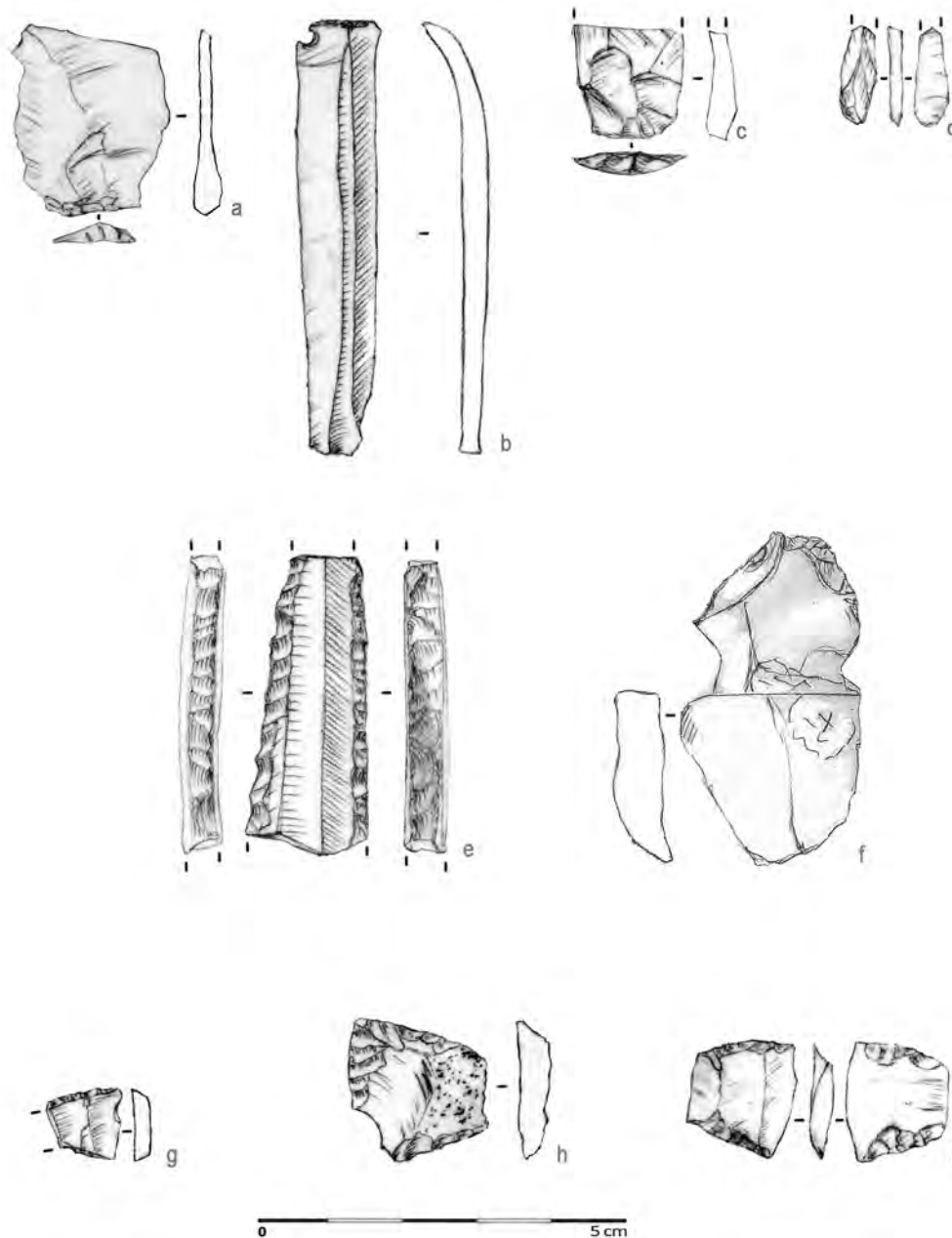


Fig. V.1.8 Lithic Phase 3. a: crest preparation flake, translucent chert (PM0580), b: R/CC bladelet (PM0576), c: proximal fragment of R/CC blade (PM0605), d: R/CC bladelet (PM0585), e: honey chert sickle blade (PM0623), f: burnt R/CC flake with gloss (PM0592), g: obsidian trapeze (PM0852), h–i: R/CC transverse arrowheads (PM0616 and PM0626) (C. Perlès, drawings: M. Ballinger)

is very small and the figures are to be treated with caution. Conversely, the very small size of the retouched assemblage makes the presence of new types, which constitute two-thirds of the retouched tools, all the more significant. Lithic Phase 3 indeed differs from almost all other Thessalian assemblages by the presence of a trapeze and two transverse arrowheads, unknown in almost all other sites. For the same reasons, it differs from the preceding phases, where these types were absent despite larger toolkits. In spite of the indisputable element of continuity introduced by the honey chert blade PM0623 (Fig. V.1.7o), if a break had to be established within the Middle Neolithic sequence on the basis of the flaked tools, it would be with Lithic Phase 3.

Contexts

The distribution of flaked stone artefacts in Lithic Phase 3 differs from the preceding ones. This phase corresponds to BSPh VIIa (Fig. III.29), which comprises the surface F23 and few structures: two postholes, a thermal structure (TS 20) and probably a second one (TS 36) as well as a pit (SU 130). Only two artefacts are directly associated with Surface F23: a small splinter and a flake heavily covered with concretions, both in radiolarite/chocolate chert. No flaked stone was associated with the other structures and all the remaining ones come from the deposits above Surface F23. Nevertheless, two concentrations of flaked stones were uncovered in the western half of the trench, in the deposits immediately overlying F23 (SU 132). The smallest one consisted of a small fragment of R/CC flake, barely 1cm long, the microbladelet PM0585 (Figs. V.1.7h, V.1.8d) and a small fragmentary obsidian flake. The largest concentration numbered ten artefacts, all in radiolarite/chocolate chert: four flakes or fragments of flakes, three fragmentary blades, one bladelet and two undetermined fragmentary blanks. Their size ranges from 1.2 to 2.5cm. None are retouched. What these concentrations represent is unclear: the raw materials differ in nature or texture, thus they cannot be the remnants of the flaking of a core or two; several artefacts appear too small to be used, so that caches of blanks appear unlikely; yet they were dropped or deposited together, in between two recognised surfaces. The only interpretation we can suggest is that a living floor or work area was cleared, and handfuls of waste discarded further away, where no activity was taking place.

Above the deposits immediately overlying F23 (SU 132) a thin fire-destruction stratum intervened between surfaces F23 and F22 (SU 133–134). The clay house model³⁴⁸ was uncovered in this stratum, which also yielded nine lithic artefacts: the transverse arrowhead PM0616 (Fig. V.1.7i), five flakes and three bladelets, all unretouched but two of which were burnt. The deposition of exceptional flaked tools in or near hearths has been identified in sites such as Kitsos or Tharrounia³⁴⁹ and it was tempting to hypothesise that this could also be the case at PMZ. Unfortunately, these artefacts were found neither near the house model nor grouped together, but instead widely dispersed over the southern and western parts of the trench. Additionally, none can be considered ‘exceptional’. There is no argument to suggest intentional deposition, even less ritual deposition.

V.1.6. Lithic Phase 4 – Building Subphases VIIb and VIIc

Characterisation

Lithic Phase 4 encompasses BSPh VIIb and VIIc (EU 244, 246a, 247, 251, 252, 253, 255, 256). The assemblages from these two phases showed absolutely no technological, typological or statistical differences, and were consequently grouped together as Lithic Phase 4. This similarity is surprising since the dates of these two subphases hardly overlap: 5629–5531 calBC 2 σ (MAMS-32120, BSPh VIIb) and 5545–5472 calBC 2 σ (MAMS-32119, BSPh VIIc).³⁵⁰

Once again, the contrasts between Lithic Phases 3 and 4 pertain less to the typology of the tools than to a statistically significant difference in the proportion of flakes, blades and bladelets, and a highly significant difference in the ratio of retouched tools. If flakes remain predominant,

³⁴⁸ Alram-Stern, this volume, chapter VI.3; Toufexis – Batzelas, this volume, 113.

³⁴⁹ Perlès 1981; Perlès 1994b.

³⁵⁰ However, when calibrated with IntCal20 rather than CalPal (V.2019.5) as used here, there is substantial overlap between the two dates: respectively 5630–5485 and 5611–5412 calBC. We thank an anonymous reviewer for pointing this out and resolving the apparent discrepancy.

blades are now twice as abundant as bladelets³⁵¹ and retouched tools again represent a third of the assemblage.³⁵²

Raw Materials

The assemblage is larger than in the preceding phases (n=79), but the raw materials do not differ qualitatively or quantitatively from Lithic Phase 3. Radiolarite/chocolate cherts still predominate with 57 specimens. The proportion of cortical or neo-cortical pieces is slightly higher than in the preceding phase, but remains low (8.8%) and again suggests the introduction of already prepared cores or finished blanks. A primary flake with rolled neo-cortex shows that river pebbles were still exploited. However, most of the seven cortical pieces show a rather fresh cortex that indicates procurement at or near the source (Figs. V.1.9a–b, r, V.1.11a). A shift in procurement strategies can be suspected, with a higher incidence of exchange with groups located nearer to the sources. The results of the geochemical analyses on PM0471 (Fig. V.1.9b) confirm this hypothesis, since it corresponds to location PM 5, a primary source along the Portaikos. Obsidian is represented by eleven pieces, none of which bears any cortex, as usual. Similarly, none of the eight translucent cherts, nor the two honey chert blades, bear any cortical facet. Importation as finished blades is the most likely for the last two blades, as in all Neolithic sites from Greece.

The Production

The Lithic Phase 4 assemblage altogether comprises 3 debris, 47 flakes, 14 blades, 11 bladelets, 1 core and 3 undetermined blanks (Tab. V.1.11). The high proportion of flakes, a characteristic of the PMZ assemblages,³⁵³ still holds true in the later Middle Neolithic. The intentional production of R/CC flakes by hard hammer percussion is still documented (Fig. V.1.9d–e), but most of the diagnostic R/CC flakes were now produced by indirect percussion and correspond to the shaping (Figs. V.1.9c, f–g, V.1.11b–d) and rejuvenation (Fig. V.1.9h–i) of blade cores. As usual, we do not have the corresponding cores and blades of precisely the same variety of R/CC, but the relatively high number of shaping and rejuvenation flakes suggests that some, at least, of the blades were produced locally.

The R/CC blades are, on the whole, wide (1.5–2cm), relatively flat, very regular, with butts at an angle of about 90° (Tab. V.1.12). They testify to skilled craftsmanship in the use of indirect percussion (see Fig. V.1.10a–b, g). The production of such blades required high-quality, homogeneous raw materials and this correlates with the suspected shift in raw material procurement towards primary sources. The cores were prepared with crests, as shown by a fragmentary blade that removed part of an anterior crest (Fig. V.1.9j); secondary crests were occasionally manufactured to restore the axial convexity (*'carénage'*) of the core, as shown by PM0534 (Figs. V.1.9k, V.1.12e).

The large module of the blades contrasts with the module of the R/CC bladelets, often under a centimetre wide (Tab. V.1.12). Bladelets were a distinct objective of the production and show more varied modes of production than blades. Some of the larger ones were produced by indirect percussion and probably correspond to the final stage of blade cores exploitation. This applies to PM0499, which, despite its extreme thinness, shows ripples on the ventral surface hardly compatible with pressure flaking (Fig. V.1.9m, V.1.11g). It is also the case for the already mentioned secondary crested blade PM0534 (Fig. V.1.9k).

Interestingly this same blade, with several – hardly successful – attempts at extracting micro-bladelets from the distal extremity, illustrates a second method of production, on pseudo-burins.

³⁵¹ The difference in the distribution of flakes, blades and bladelets is significant at $p < 0.05$ ($\chi^2 = 6.8$, $df = 2$).

³⁵² The difference in the ratio of retouched tools is significant at $p < 0.02$ ($\chi^2 = 6.3$, $df = 1$).

³⁵³ See above, 209, 225.

Tab. V.1.11 Composition of the flaked stone assemblage from Lithic Phase 4 (C. Perlès)

	R/CC	Chert	Obsidian	Honey chert	Quartz	Undetermined
Debris	2	2				1
Cores	1					
Flakes	33	3	4			
Blades	3					
Bladelets	5		1			
Undetermined		1				
Retouched flakes	3	2	2			
Retouched blades	6		3	2		
Retouched bladelets	3	2				
Undetermined retouched	1		1			
Total	57	8	11	2		1

This method was also implemented on PM0531, a larger blade that bears the negatives of three bladelets, the last one strongly hinged (Fig. V.1.9l).

Other R/CC bladelets were produced by pressure flaking, and a fragmentary core shows that some, at least, of this production was local. This microcore was conical or cylindrical, and was rejuvenated by a platform tablet at least once (Figs. V.1.9n, V.1.11h). While none of the bladelets recovered comes from this core, several confirm the use of pressure flaking for small modules, a technique already suspected in Lithic Phase 3 (Figs. V.1.9o, V.1.10r, V.1.11i–j). Given the width of the bladelets, pressure with the hand or a shoulder crutch (modes 1 and 2) would have sufficed.³⁵⁴

The rather heterogeneous set of obsidian artefacts also shows varied techniques of production. The proximal part is only preserved on one of the seven flakes,³⁵⁵ which was flaked by indirect percussion (Fig. V.1.9p). Of the two blades, one was flaked by indirect percussion (Figs. V.1.10l, V.1.12b), the other, as well as two bladelets, by pressure flaking (Figs. V.1.9q, V.1.10p). These blades and bladelets are larger than the R/CC pressure-flaked ones, and would have required a short crutch in a sitting position (mode 3). The pressure-flaked bladelet that preserved its proximal part shows the characteristics of a Middle Neolithic method of preparation, with suppression of the overhang on the dorsal and a small linear butt.

Among the six artefacts attributed to the category of light or translucent cherts, four artefacts suggest local chert workmanship: a platform rejuvenation flake (Figs. V.1.9s), a retouched proximal fragment of a large anterior crested blade with a large flat butt (Figs. V.1.10j, V.1.12d), a very small flake, too small to have been traded, and an undetermined fragment. The other artefacts comprise two fragmentary retouched blades in very different cherts, one of which is of high craftsmanship (Figs. V.1.10o, V.1.12m). Their flaking technique cannot be identified.

The technique of flaking of the honey chert blade PM0489, a distal fragment, cannot be determined (Figs. V.1.10i, V.1.12g). The second blade, PM0495 (Figs. V.1.10e, V.1.11l), a long and well-preserved mesial fragment, presents wavy arrises on the dorsal surface and ripples on the

³⁵⁴ Pelegrin 2012.

³⁵⁵ One of these obsidian flakes (PM0567) is on a very black, very glossy obsidian, somehow more ‘plastic’ than ‘glassy’, which does not look typically Melian.



Fig. V.1.9 Lithic Phase 4. a–j, m, p–s: unretouched flakes and bladelets, k–l: reflaked blades, n: pressure-flaked micro-core, o: pressure-flaked bladelet. a: PM0568, b: PM0471, c: PM0520, d: PM0460, e: PM0558; f: PM0463, g: PM0473, h: PM0477, i: PM0557, j: PM0462, k: PM0534, l: PM0531; m: PM0499, n: PM0487, o: PM0536, p: PM0497, q: PM0470, r: PM0461, s: PM0511 (C. Perlès)

Tab. V.1.12 Relevant dimensions for Lithic Phase 4 (C. Perlès)

PMZ number	Determination	Dimensions [cm]
PM0487	R/CC bladelet microcore frag.	1 × 1.11 × 0.77
PM0463	Large crest preparation R/CC flake	3.41 × 2.7 × 0.45
PM0473	R/CC core preparation flake	2.1 × 1.5 × 0.5
PM0500	Platform rejuvenation flake	1.06 × 1.63 × 0.18
PM0477	Platform rejuvenation flake	1.84 × 2.4 × 0.35
PM0499	Distal frag. of R/CC bladelet	2.34 × 0.96 × 0.17
PM0465	Platform rejuvenation R/CC flake	1.61 × 2.39 × 0.47
PM0560	Mesial frag. of R/CC bladelet	0.8 × 0.6 × 0.11
PM0488	Distal frag. of R/CC bladelet	1.3 × 0.7 × 0.32
PM0560	Mesial frag. of R/CC bladelet	0.8 × 0.6 × 0.11
PM0470	Mesial frag. of obsidian bladelet	1.8 × 1.18 × 0.32
PM0531	Reflaked R/CC blade frag.	2.2 × 1.5 × 0.63
PM0526	R/CC utilised bladelet	1.8 × 0.78 × 0.28
PM0462	Mesial frag. of R/CC crested blade	1.8 × 1.4 × 0.46
PM0541	Proximal frag. of chert blade	2.5 × 1.87 × 0.86
PM0472	Distal frag. of R/CC blade	3.5 × 1.4 × 0.54
PM0529	R/CC blade	3.27 × 1.6 × 0.41
PM0497	Retouched obsidian flake	1.9 × 2.4 × 0.39
PM0469	Retouched chert flake	2.28 × 2.13 × 0.63
PM0523	Retouched R/CC laminar flake	3.7 × 1.96 × 0.72
PM0556	Truncated R/CC flake	2.7 × 1.6 × 0.37
PM0457	Obsidian splintered piece	2.3 × 2.6 × 0.5
PM0515	Chert retouched crested blade	3.26 × 2.1 × 1.15
PM0534	Reflaked retouched R/CC crested blade	3.47 × 0.96 × 0.67
PM0549	Proximal frag. of retouched obsidian bladelet	2.2 × 1.16 × 0.38
PM0476	Frag. obsidian transverse arrowhead	1.17 × 1.42 × 0.25
PM0512	R/CC transverse arrowhead	1.75 × 1.8 × 0.47
PM0502	Distal frag. truncated chert blade	1.4 × 2.35 × 0.33
PM0527	Distal frag. of truncated obsidian blade	1.7 × 1.26 × 0.24
PM0505	End-scraper on obsidian blade	5 × 1.36 × 0.5
PM0514	R/CC end-scraper	2.51 × 1.81 × 0.45
PM0495	Honey chert sickle blade	5.5 × 1.4 × 0.6
PM0489	Frag. of honey flint sickle blade	2.05 × 1.15 × 0.46
PM0503	R/CC Sickle blade/end-scraper	2.8 × 1.93 × 0.41
PM0530	Distal frag. of R/CC sickle blade	0.91 × 1.3 × 0.42
PM0453	Frag. R/CC sickle blade	2.37 × 1.8 × 0.35
PM0498	Frag. of R/CC sickle bladelet	2.77 × 1.16 × 0.65

ventral face that exclude pressure flaking. It constitutes a rare example of the use of indirect percussion on typical honey chert.

With a larger proportion of wide and regular blades, the Lithic Phase 4 assemblage differs from the preceding phases and undoubtedly resembles more the ‘classic’ Thessalian Middle Neolithic assemblages from Achilleion, Sesklo B, Ag. Petros, Otzaki and Magoula Karamourlar. Nevertheless, the local production of flakes and their overall abundance continue to set PMZ apart, and to suggest that blades, or their raw material, were still too scarce to answer all the needs of the community.

The Retouched Toolkit

Retouched tools again become proportionally abundant: debris and core apart, they represent 24 artefacts out of a total of 75, i.e. one third. This ratio again aligns PMZ with the eastern Thessalian sites, where all the raw materials had to be imported, in contrast to Achilleion located near radiolarite sources and where the ratio is much lower.³⁵⁶ Despite the long-term trend of a decrease in the proportion of sickle inserts in general, and of sickle inserts on flakes in particular, clear elements of continuity with the preceding phases can be perceived within the toolkit. However, sickle inserts being less abundant, the toolkit is more diversified than in most preceding phases.

The confrontation between the technomorphological typology and the results of the wear-trace analyses again brought some surprises (Tab. V.1.13). In two cases, the end-scrapers on sickle blades were not a secondary transformation but part of the shaping of the sickle insert, although in another case the end-scraper may indeed have been used to scrape hides. Another end-scraper was not used to work skin or hides, but on a mineral material. One of the presumed sickle blades was not used to cut cereals, but an undetermined material. Finally, two retouched tools showed no wear traces. As previously, the classification of the tools will follow the results of the use-wear analysis when available.

Sickle Inserts (n=5)

The progressive diminution of the proportion of sickle inserts in the toolkit since Lithic Phase 1 is confirmed in Lithic Phase 4, even if sickle inserts remain the best-represented tool type. Significantly, all are now made on blades, thus corresponding better to the usual standards in Thessalian (and Greek) Middle Neolithic assemblages. Their modules, however, are surprisingly different.

PM0503 (Figs. V.1.10a., V.1.11m) had a long and diversified use-life. It was manufactured on a wide R/CC blade of the highest quality. The butt is long and narrow, with a lip on the ventral face. It was probably detached by indirect percussion. Both edges were first used extensively to cut cereals and rejuvenated for the same task, with an insertion parallel to the haft for the right edge and slightly more oblique for the left. The sickle blade was then transformed: an end-scraper was manufactured on the distal end and used on hide, while the two edges, modified by bilateral $\frac{3}{4}$ abrupt retouch, were used on an undetermined material.³⁵⁷

The similar-looking PM0453 (Figs. V.1.10b, V.1.11n) was also manufactured on fine, homogeneous R/CC and on a large regular blade. Despite the technomorphological resemblance, its biography is very different. Like PM0503 it bears an ‘end-scraper’ on the distal edge, but traces of cereal polish extend over the retouch: the end-scraper was therefore part of the initial shaping of the insert. The insert was not used for long – possibly because the proximal end broke – and only on the left edge. The polish is too limited to determine how the insert was hafted.

PM0498 (Figs. V.1.10d, V.1.11o), also on chocolate R/CC, is of a much smaller module, possibly pressure flaked. The proximal extremity bears what was initially interpreted as an oblique

³⁵⁶ See above, 213.

³⁵⁷ Observation L. P. and N. Mazzucco.

Tab. V.1.13 Retouched tools from Lithic Phase 4. Italics denote discrepancies between the technomorphological and functional identifications (C. Perlès)

PMZ number	BPh/ BSPH	Figure	Raw material	Technomorphological classification	Functional classification
PM0556	VIIb	4.1.10.q, 4.1.12.m	R/CC	<i>Obliquely truncated flake</i>	Flake used on fresh skin by the unretouched edge
PM0549	VIIb	4.1.10.l	Obsidian	Denticulated blade	n/a
PM0541	VIIb	4.1.10.k, 4.1.12.g	Burnt translucent chert	<i>Retouched blade</i>	Not utilised
PM0536	VIIb	4.1.9.o, 4.1.11.i	R/CC	Retouched bladelet	n/a
PM0534	VIIb	4.1.9.k, 4.1.12.e	R/CC	Retouched and reflaked bladelet	n/a
PM0531	VIIb	4.1.9.l	R/CC	Reflaked blade ('burin')	n/a
PM0530	VIIb	4.1.10.c	R/CC	<i>End-scraper on sickle blade</i>	<i>Sickle blade</i>
PM0527	VIIb	4.1.10.p	Obsidian	Truncated blade	n/a
PM0523	VIIb	4.1.10.h, 4.1.12.c	R/CC	<i>End-scraper on laminar flake</i>	<i>Edge used on mineral material</i>
PM0515	VIIb	4.1.10.j, 4.1.12.d	Light chert	Retouched crested blade	n/a
PM0514	VIIb	4.1.10.g 4.1.12.a	R/CC	End-scraper on blade	End-scraper (hide)
PM0512	VIIb	4.1.10.m, 4.1.12.k	Burnt R/CC	Transverse arrowhead	n/a
PM0510	VIIb	–	R/CC	Splintered flake	n/a
PM0505	VIIb	4.1.10.f, 4.1.12.b	Obsidian	End-scraper on retouched blade	n/a
PM0503	VIIb	4.1.10.a, 4.1.11.m	R/CC	End-scraper on sickle blade	End-scraper on sickle blade
PM0502	VIIb	4.1.10.o, 4.1.12.l	Light variegated chert	Truncated blade	Not utilised
PM0498	VIIc	4.1.10.d, 4.1.11.o	R/CC	<i>End-scraper on sickle bladelet</i>	<i>Sickle insert</i>
PM0497	VIIc	4.1.9.p, 4.1.12.i	Obsidian	Retouched flake	n/a
PM0495	VIIc	4.1.10.e, 4.1.11.l	Honey chert	Transformed sickle blade	Transformed (?) sickle blade
PM0490	VIIc	4.1.10.r, 4.1.12.n	R/CC	<i>Arched backed bladelet</i>	<i>Utilised point</i>
PM0489	VIIc	4.1.10.i, 4.1.12.f	Honey chert	<i>Sickle blade</i>	<i>Used, not on cereals</i>
PM0476	VIIc	4.1.10.n, 4.1.12.j	Obsidian	Frag. of transverse arrowhead	n/a
PM0469	VIIc	4.1.12.h	Light chert	Retouched flake	n/a
PM0457	VIIc	4.1.10.s	Obsidian	Splintered flake	n/a
PM0453	VIIc	4.1.10.b, 4.1.11.n	R/CC	<i>Proximal end-scraper on sickle</i>	<i>Sickle blade</i>

abrupt ‘end-scraper’, but it showed no traces of use and must again be part of the shaping of the insert.³⁵⁸ The tool was inserted parallel to the haft, and the left edge bears a well-developed cereal polish, rejuvenated by inverse scalariform retouch, partially polished. This insert constitutes the first instance of deliberate rejuvenation on the ventral face, rather than the dorsal face.

PM0530 (Fig. V.1.10c) is a very small distal fragment of a sickle insert on an R/CC blade of medium width, which also bears an abrupt end-scraper front. The blade was inserted parallel to the haft by the right edge. The left edge bears a well-developed cereal polish and was rejuvenated, but not used for long afterwards since the retouch scars show only limited polish. A distal ‘end-scraper’ was then manufactured, but it bears no traces of use and its significance is unclear.

PM0495, a honey chert blade, presents a pinkish hue that may indicate that the chert has been heated (Figs. V.1.10e, V.1.11i). The blade was extracted from the side of the core and the left edge is almost abrupt. This edge was consequently not used and bears wear and possible residues related to hafting. The distribution of the cereal polish on the right edge, extensive on the proximal end and absent on the distal end, suggests an oblique hafting. This sickle blade was used extensively and rejuvenated several times by $\frac{3}{4}$ direct abrupt retouch until it was no longer functional. The left edge was subsequently modified by a low-angle retouch, and used on a different material, possibly hide.

End-scrappers

From a classical typological viewpoint, seven artefacts would have been classified as end-scrappers, and they would have constituted the best-represented typological group. However, four were manufactured on sickle blades (see above, 242, 244) and their actual use as an end-scraper was only confirmed for one of them (PM0503, above, 242).

Of the three remaining potential candidates, one only, PM0514, has been confirmed as a classic end-scraper used to work hide (Figs. V.1.10g, V.1.12a). It is a short end-scraper on a regular blade produced by indirect percussion. It was certainly rejuvenated several times, given its present length. The working front is wide and bears a regular subparallel direct retouch. Wear traces indicate a transversal movement on hide.

Typologically, PM0505 is a narrow end-scraper on a retouched, irregular obsidian blade flaked by indirect percussion on a faceted platform. It bears a very short $\frac{1}{2}$ abrupt direct retouch on the right edge and a narrow direct end-scraper. It has not been examined microscopically and its use cannot be confirmed (Figs. V.1.10f, V.1.12b). Finally, PM0523 was utilised not by its distal, retouched front, but by the lateral edges and will therefore be classified as a side-scraper.

Side-scraper (n=1)

PM0523 was manufactured on a laminar R/CC flake produced during the lateral shaping of a core (Figs. V.1.10h, V.1.12c). As mentioned above, the distal ‘end-scraper’ is part of the shaping of the tool, as the wear traces extend slightly on its left side. The left edge was regularised by $\frac{1}{2}$ abrupt retouch and the tool used by its left distal part on a mineral matter.

Laterally Retouched Blades and Bladelets (n=6)

The retouched blades and bladelets constitute a heterogeneous group, differing by their dimensions, the location and nature of the retouch. The most unusual tool is PM0515, the fragment of the large, crested blade in blue-grey chert with white spots (Figs. V.1.10j, V.1.12d). The left edge bears a large and regular low-angle inverse retouch and is completely blunted, indicating use on hard material. A few discontinuous direct retouch scars on the right edge suggest that it was also

³⁵⁸ Observation N. Mazzucco.



Fig. V.1.10 Lithic Phase 4. a: sickle insert with an end-scraper, b–e: sickle inserts on blades, f–g: end-scraper on blades, h: side-scraper, i: bitruncated blade, j: inversely retouched crested blade, k: inversely retouched flake, l: bilaterally retouched blade, m–n: transverse arrowheads, o–p: truncated blades, q: obliquely truncated flake, r: arched backed bladelet, s: splintered piece. a–d, g–h, m, p–r: R/CC. e, i: honey chert. f, k, o: light-coloured cherts. l, n, p: obsidian. a: PM0503, b: PM0453, c: PM0530, d: PM0498, e: PM0495, f: PM0505, g: PM0514, h: PM0523, i: PM0489, j: PM0515, k: PM0490, l: PM0549, m: PM0512, n: PM0476, o: PM0502, p: PM0527, q: PM0556, r: PM0490, s: PM0457 (C. Perlès)

utilised. Of a very different module, PM0536 (Figs. V.1.9o, V.1.11i), a pressure-flaked bladelet on good quality R/CC, shows a short $\frac{1}{2}$ abrupt retouch on the left edge, adjacent to the fracture. This retouch is possibly accidental. PM0534 (Figs. V.1.9k, V.1.12e), already mentioned as a reflaked secondary crested blade, was retouched on the proximal half of the right edge by direct low-angle retouch on a $\frac{1}{2}$ abrupt edge.

The small honey chert blade PM0489 (Figs. V.1.10i, V.1.12f) was initially identified as a sickle insert because some polish could be observed on the right edge. The tool was cursorily truncated at both extremities and lightly retouched on the dorsal face of both edges. Some microscopic residues and blunting on the left edge must be related to the hafting of the tool. It was then used with a bidirectional movement, for cutting or sawing wood, not for cutting cereals.

PM0541, a proximal fragment on burnt translucent chert, was retouched on the left edge by large $\frac{1}{2}$ abrupt retouch. On the ventral face, a large, splintered retouch scar is visible next to a thermal scar (Figs. V.1.10k, V.1.12g). This piece was examined microscopically but bore no wear traces.

The single retouched obsidian bladelet, PM0549 (Fig. V.1.10l) was modified on both edges by short abrupt retouch. The right edge is denticulated, the left one rectilinear. There are no use-wear data for this tool.

Retouched Flakes (n=2)

PM0469 (Fig. V.1.12h), made on a coarse-grained, dark-pink chert with black spots, presented an abrupt distal edge that bears a direct low-angle retouch. It was examined microscopically, but showed no wear traces. The second retouched flake, PM0497, on obsidian, shows a short, direct, $\frac{1}{2}$ abrupt retouch on the proximal half of the right edge (Figs. V.1.9p, V.1.12i).

Transverse Arrowheads (n=2)

PM0512 (Figs. V.1.10m, V.1.12k), on burnt R/CC, is morphologically very similar to the first transverse arrowheads encountered in Lithic Phase 3 and of similar – small – dimensions (Fig. V.1.7l). The four sides of the arrowhead were shaped by various combinations of retouch: large bifacial low-angle retouch on the distal edge, inverse low-angle retouch on the left and right edges, and a direct abrupt truncation on the proximal edge.

The typological determination of the second piece is more uncertain since part of the base and left edge are broken. PM0476 (Figs. V.1.10n, V.1.12j) is manufactured on a small obsidian flake and of roughly quadrangular shape. The distal end was inversely truncated, then retouched on the dorsal face by regular $\frac{1}{2}$ abrupt subparallel retouch. The small part of the proximal end that is preserved shows an inverse low-angle retouch. As stated earlier, the presence of radiolarite and obsidian transverse arrowheads in the same assemblages is frequent.

Truncated Blades (n=2)

PM0502, made on a very unusual, fine-grained, beige and red translucent chert, is unfortunately preserved only by its distal section (Figs. V.1.10o, V.1.12l). The blade was wide and flat, with regular arrises, possibly pressure flaked. The distal extremity is truncated by regular direct subparallel retouch. Microscopic examination revealed no wear traces. The second truncated blade, PM0527, is made on obsidian, and shows a similar direct truncation but was not examined for wear traces (Fig. V.1.10p).

We mentioned that truncated blades, as individual tools, are very rare in the Thessalian Middle Neolithic,³⁵⁹ but truncations are used to calibrate sickle inserts and, more rarely, to manufacture

³⁵⁹ Moundrea-Agrafioti 1981, 148.

trapezes. PM0502 could thus possibly be a distal fragment of a sickle blade. PM0527 is better preserved and this use can be excluded. It is also too long to be a fragmentary trapeze and can thus be considered as a true truncated blade, comparable to the blade found in Lithic Phase 3.³⁶⁰

Obliquely Truncated Flake (n=1)

Manufactured on good quality R/CC the elongated flake PM0556 was probably extracted, by indirect percussion, at the end of a phase of blade production. The right edge was then obliquely truncated by short direct abrupt retouch. Despite the pointed shape created by this retouch, the point was not used and the retouch was probably intended to facilitate hafting. The left edge was used unretouched with a wide angle on fresh hide (Figs. V.1.10q, V.1.12m).

Arched Backed Bladelet (n=1)

PM0490 represents an unusual type in a Greek Middle Neolithic assemblage. This R/CC pressure-flaked bladelet was backed and obliquely truncated by a short abrupt retouch on the distal half of the right edge and shaped into a narrow point (Figs. V.1.10r, V.1.12n). In contrast to the previous truncated flake, the point was the active zone on PM0490, but the material worked could not be determined.

Splintered Pieces (n=2)

Splintered pieces are still surprisingly rare, if not absent at PMZ in the late Middle Neolithic. The two artefacts presented here do not correspond to the usual standards of splintered pieces. PM0457 is made on a thick flake or fragment of obsidian core (Fig. V.1.10s) awkwardly flaked by bipolar percussion and partly split. Was it a last attempt to extract a few obsidian flakes, or a beginner's practice? Similarly, PM0510, a thick flake on mediocre-quality R/CC, was splintered by bipolar percussion on the ventral face. It may have been used briefly as a wedge.

'Burin' (n=1)

Typologically, PM0531 should be called a burin, with several bladelets extracted from a proximal fracture (Fig. V.1.9l). We have already presented it as a burin-like core rather than a tool: true burins are indeed absent from Greek Middle Neolithic assemblages, whereas the reflaking of blades is a common practice.³⁶¹

Contexts and Chronological Attribution

BSPH VIIb comprises Surface F22, a fragmentary floor that overlaid the fire destruction stratum where the house model was deposited (Fig. III.32). It was only preserved around the Early Bronze Age pit in the eastern half of the trench. A large hearth (TS 19) and two postholes were associated with F22. The four artefacts found directly on Surface F22, a burnt debris, two R/CC and an obsidian flake, were dispersed in the southern part of the trench and were not associated with any recognised structure. A 'handful' of flaked stones, similar to those from BSPH VIIa, was uncovered precisely at the limit between these BSPH VIIa and VIIb (SU 135), again in the western half of the trench. It consists of a microbladelet of red R/CC with white and green spots, the crest preparation flake PM0557, the obliquely truncated flake PM0556 in homogeneous chocolate R/CC (Fig. V.1.10q), the small flake PM0558 in a darker R/CC (Fig. V.1.9e) and a small R/CC

³⁶⁰ See above, 234.

³⁶¹ Perlès 2004.

splinter. Like the earlier ones, this small group does not correspond to a flaking sequence, cannot be considered as a cache of blanks, includes at least one piece that we would not call ‘waste’ and remains unexplained.

Surface F21 (BSPH VIIc, Fig. III.34) included a compacted yellowish clayish soil (SU 144) at a depth of 4.94 to 4.95m. This floor was recognised as small patches over the whole trench, the Early Bronze Age pit excepted. The only flaked stone directly associated with the floor was the small sickle insert PM0498 (Figs. V.1.10d, V.1.11o). A quadrangular pit, 0.62 × 0.38m, unconnected with the remnants of the floor, was uncovered in the northwest area of the trench, filled with black burnt soil (see Fig. III.34, area A). This context can thus be considered a secure, ‘closed context’. It contained ten flaked stone artefacts: the small bladelet microcore PM0584 (Figs. V.1.9n, V.1.11h), five fragmentary R/CC flakes, a fragmentary R/CC bladelet, a R/CC splinter, but also the honey chert blade PM0495 (Figs. V.1.10e, V.1.11i) and the arched bladelet PM0490 (Figs. V.1.10r, V.1.12n). This group of artefacts is even more puzzling than the above-mentioned one: most are broken, half of them are heated or burnt but not the others; several are too small to be of any use, with a maximum length under 1.5cm. And yet, they are associated with two perfectly preserved tools.

Fifteen other flaked artefacts were found dispersed over the entire Surface F21, outside the floor patches. None was heated or burnt. Besides fragmentary R/CC flakes, they include six retouched tools: the obsidian end-scraper on blade (PM0505, Figs. V.1.10f, V.1.12b), the obsidian transverse arrowhead (PM0476, Fig. V.1.12j), the retouched obsidian flake (PM0497, Figs. V.1.9p, V.1.12l), the fragment of chert truncated blade (PM0502, Figs. V.1.10o, V.1.12m), and two sickle inserts (PM0503 and PM0498, Figs. V.1.10a, d, V.1.11m, o). Even though they are not associated with the yellow clay soil, there is no indication that these artefacts were redeposited. Finally, fourteen other pieces were found in the deposits – destruction layer – between surfaces F21 and F20, also spread over the entire preserved Neolithic surface of the trench. Their original context and date is more uncertain.

The tool types from BSPH VIIb and VIIc present striking similarities. It was previously thought that Surface F22 (BSPH VIIb) was the last Middle Neolithic surface, and Surface F21 (BSPH VIIc) the first Late Neolithic surface. However, several tools found on F21, in particular the long honey flint sickle blade PM0495 (Fig. V.1.10e), the small insert PM0498 (Fig. V.1.10c) and the transverse arrowhead PM0476 (Fig. V.1.12j), have their exact correspondence in earlier phases. Since there is no indication that these artefacts were redeposited from earlier contexts, in terms of flaked stone assemblages, both the assemblages from BSPH VIIb and VIIc belong to the Middle Neolithic and show close correspondences with Lithic Phase 3.

The activities represented by these tools are the same as before – harvesting cereals and working hide – with one exception: PM0523 (Figs. V.1.10h, V.1.12c) that worked a mineral matter. With sickle inserts as the predominant tool type, and with all sickle inserts made on blades, the assemblage from Lithic Phase 4 presents clear analogies with other Thessalian Middle Neolithic assemblages. Nevertheless, the proportion of sickle inserts – one fifth of the retouched tools – is now clearly lower than in other sites, where sickle inserts represent about 50% of the toolkit, splintered pieces excepted. The Lithic Phase 4 assemblage also differs from the assemblages from Achilleion, Sesklo B, Magoula Karamourlar or Ag. Petros in the importance of flakes in the debitage, the quasi-absence of splintered blades and the presence of tool types rare or absent elsewhere: truncated blades and transverse arrowheads.

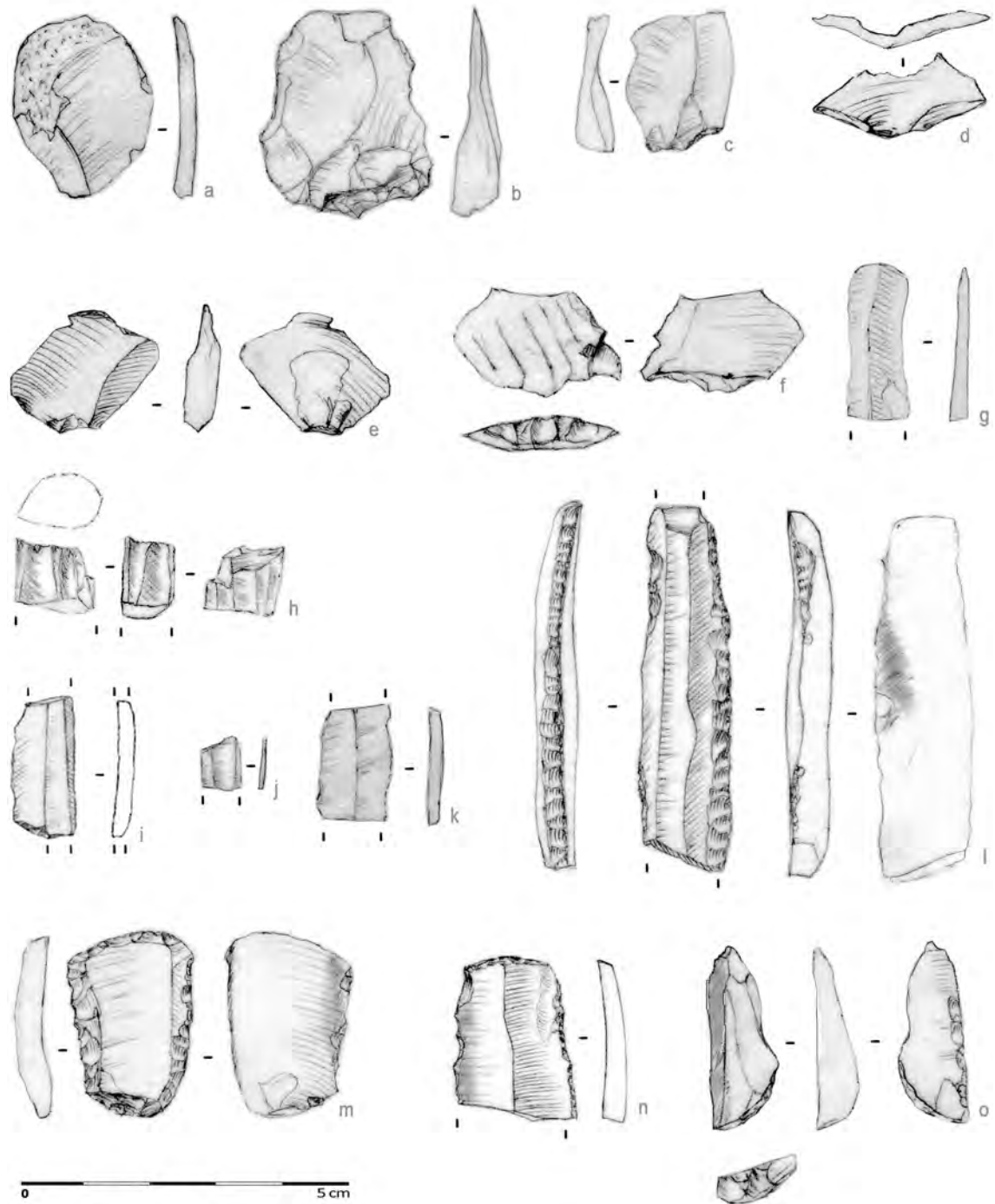


Fig. V.1.11 Lithic Phase 4. a-f: trimming and preparation flakes, g, i-k: bladelets (i with proximal retouch), h: pressure-flaked microcore, l: sickle blade, m: end-scraper on sickle blade, n: sickle insert on blade, o: sickle insert on bladelet. All in R/CC except l in honey chert. a: PM0568, b: PM0463, c: PM0473, d: PM0511, e: PM0477, f: PM0465, g: PM0499, h: PM0487, i: PM0536, j: PM0556, k: PM0470, l: PM0495, m: PM0503, n: PM0453, o: PM0498 (C. Perlès, drawings: M. Ballinger)

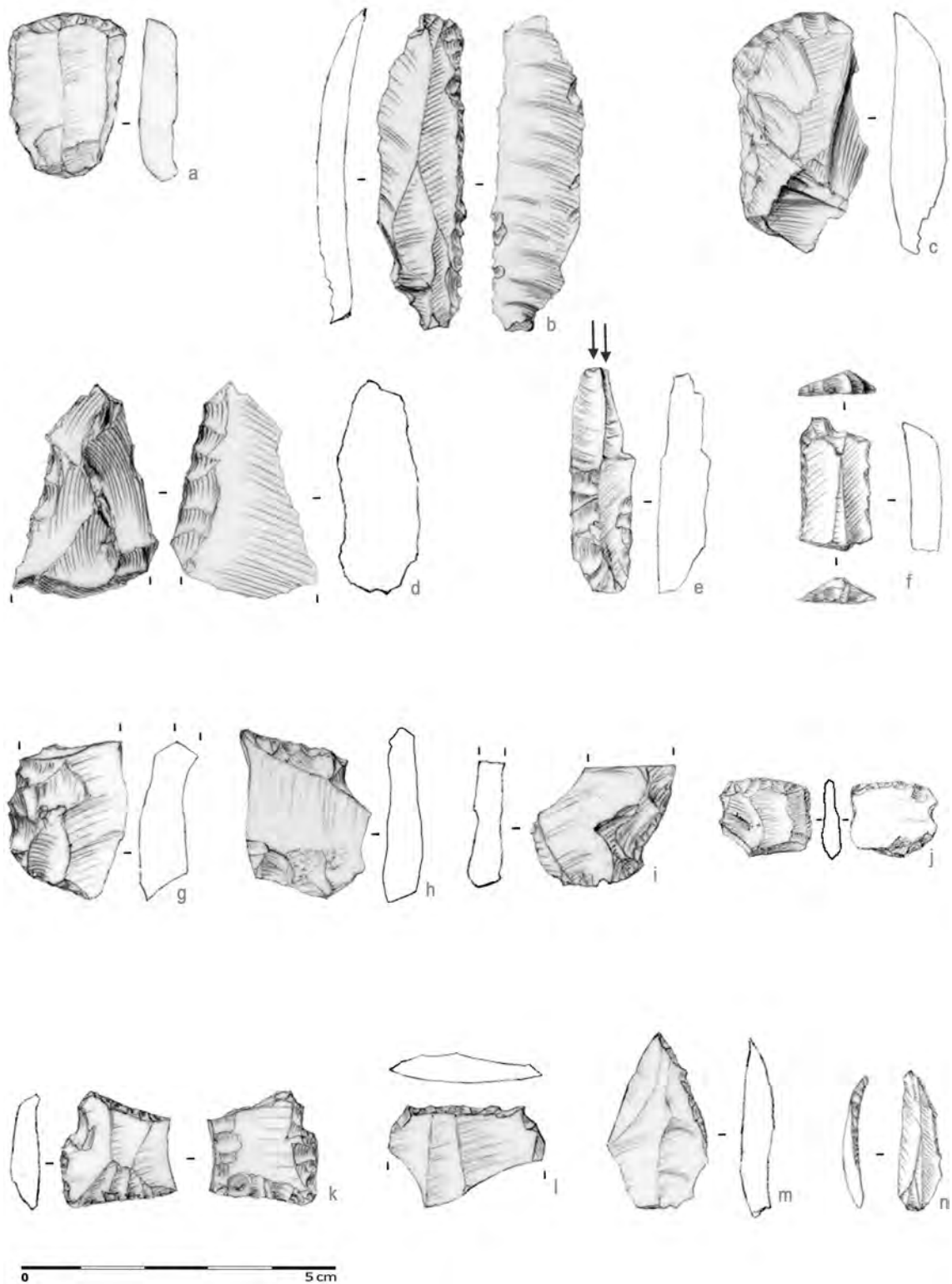


Fig. V.1.12 Lithic Phase 4. a–b: end-scraper on blades, c: side-scraper on flake, d: inversely retouched crested blade, e: reflaked secondary crested blade, f: bitruncated blade, g: retouched blade, h–i: retouched flakes, j–k: transverse arrowheads, l: truncated blade, m: obliquely truncated flake, n: arched backed bladelet. a, c, e, k, m–n in R/CC, b, i–j in obsidian, d, g–h, l in translucent cherts, f in honey chert. a: PM0514, b: PM0505, c: PM0523, d: PM0515, e: PM0534, f: PM0489, g: PM0541, h: PM0468, i: PM0497, j: PM0476, k: PM0512, l: PM0502, m: PM0556, n: PM0556 (C. Perlès, drawings: M. Ballinger)

V.1.7. Lithic Phase 5 – Building Phase VIII³⁶²*Characterisation*

Contrary to what occurred with the previous lithic phases, Lithic Phase 5 (EU 258–260, 264–265, 278–279, 281–283, 285–286) differs from the preceding ones less by quantitative criteria than by qualitative criteria: a more systematic choice of high-quality R/CC, the appearance of pressure-flaked R/CC blades, and new tool types, in particular perforating tools (*mèches*). Conversely, the heavily retouched sickle blades, present in all phases up to now, are now absent. Some quantitative changes can nevertheless be observed: a higher proportion of unretouched bladelets, and, especially, a significant drop in the proportion of obsidian. The microscopic examination also reveals an increase of activities related to plant processing and of versatile tools used on several different materials.

Raw Materials

Of a total of 58 artefacts, R/CC amount to 45 specimens, obsidian 2, translucent cherts 4, quartz 3, and honey chert 1. Three specimens were not identified.³⁶³ Many of the R/CC are of a high, homogeneous quality, and bear very well their usual denomination of ‘chocolate flint’ or ‘chocolate jasper’. Of special interest is an irregular flake that shows that both light-red matte and dark, lustrous chocolate radiolarite/chert can be found in the same block of raw material (Fig. V.1.13a). Many other R/CC pieces have a lustrous surface, but associated with evidence of thermal alteration. As before, we suspected heat treatment, but found no definite evidence. The pink hue of the honey chert blade fragment PM0384 (Fig. V.1.13s) is also probably due to heating. The fact that the fracture is more lustrous than the surfaces again suggests intentional heat treatment, but this cannot be ascertained on such a small fragment.

Among the R/CC, several bear surfaces corresponding to cleavage planes, but only three show true cortex or neo-cortex: As in the earlier phases, they attest to both procurement in the river and at or near the source (Figs. V.1.13b, n). The results of the geochemical analyses confirm the exploitation of secondary sources both on the Peneios (PM 8) and the Portaikos (PM 2).

With only two pieces, obsidian is rarer in this Lithic Phase V than it has ever been and, since none of them comes from a secure context,³⁶⁴ the possibility of redeposition from earlier contexts cannot be ruled out. Whichever the case, the scarcity or absence of obsidian is unexpected. There are no Thessalian flaked stone assemblages of the earliest Late Neolithic to compare PMZ with,³⁶⁵ but, at Ag. Petros in the Sporades, the early Late Neolithic assemblage comprised 70% obsidian.³⁶⁶ At Tharrounia and Sarakenos Cave (LN Ia) obsidian reached 95%,³⁶⁷ and it constituted 63% of the assemblage in Lithic Phase III at Franchthi.³⁶⁸ Later Late Neolithic eastern Thessalian

³⁶² BPh IX should belong to this lithic phase, but it yielded no flaked stones.

³⁶³ Compared with Lithic Phase 4, the difference in distribution of raw materials is significant at $p = 0.56$.

³⁶⁴ Below, 260, 262.

³⁶⁵ Visviki Magoula and Arapi are the only other published sites from Thessaly with Tsangli-Larissa occupations. Unfortunately, the Tsangli-Larissa deposits from Magoula Visviki, found at the bottom of Trench B, yielded no retouched artefacts (Bergner 2015a, 385) and the lithics from Arapi have not been published (Hauptmann – Milojević 1969). Orgozinos, in western Thessaly, with only 3% obsidian (Karimali 2009) compares well with PMZ in this respect, but we do not know which phase of the Late Neolithic is represented. Potential elements of comparison will therefore have to be sought either further away (Ag. Petros in the Sporades, the Sarakenos Cave in Boeotia, Tharrounia in Euboea, Kitsos in Attica, Franchthi in the Argolid) or in later Thessalian Late Neolithic sites (Ag. Sophia, Dimini).

³⁶⁶ Moundrea-Agrafioti 1981, tab. 1.

³⁶⁷ Perlès 1994b, tab. 2.

³⁶⁸ Perlès 2004, tab. 5.1.

Tab. V.1.14 Composition of the flaked stone assemblage from Lithic Phase 5 (C. Perlès)

	R/CC	Chert	Obsidian	Honey chert	Quartz	Undetermined
Debris	3				1	
Cores	1					
Flakes	16	1	1		2	2
Blades	1			1		
Bladelets	8	2	1			
Retouched flakes						1
Retouched blades	5	1				
Retouched bladelets	7					
Total	45	4	2	1	3	3

assemblages yielded up to 85% obsidian. PMZ always had limited access to obsidian trade networks, but the situation seems to have worsened in the Tsangli-Larissa phase.

Finally, three pieces are made on quartz. One was lost and could not be examined. The other two consist of a cortical flake and a debris and may have been produced during the use of a quartz pebble as a percussive tool (Tab. V.1.14).

The Production

One cortical and two non-cortical flakes struck with a hard hammer suggest that an independent production of flakes was still taking place, but probably on a modest scale (Figs. V.1.13c–d, V.1.14c). Most of the flakes were produced by indirect percussion and probably correspond to the shaping of blade or bladelet cores (Fig. V.1.13e–g). PM0831, for instance, removed the side or the back of a core shaped with two crests (Fig. V.1.13g). Crest preparation is also attested by two bladelets that bear traces of antero-lateral crests (Figs. V.1.13i–j, V.1.15b–c). However, the volumetric conception of the cores, in particular the initial number of crests, remains undetermined: the only blade or bladelet core is residual, with a few flakes removed by indirect percussion at the end of the exploitation (Figs. V.1.13h, V.1.15a).

Most of the R/CC blades and bladelets were flaked by indirect percussion (e.g. Fig. V.1.13k–l), with a linear butt and suppression of the overhang. This was also the technique used on the translucent chert blade PM0382 (Figs. V.1.13m, V.1.15i). However, a remarkable feature of Lithic Phase 5 is the presence of several unretouched R/CC pressure-flaked blades and bladelets (Figs. V.1.13n–r and possibly j, V.1.15d–g). Assuming that the R/CC react as chert,³⁶⁹ the R/CC bladelets securely identified as pressure-flaked in the previous phase were small enough to be produced by ‘mode 2’, with a shoulder crutch, while the bladelets from Lithic Phase 5 would have required at least a ‘mode 3’ flaking, with a short crutch held while seated.³⁷⁰ In turn, PM0391, nearly 1.4cm wide would have required ‘mode 4’, with a long crutch held while standing (Figs. V.1.13o, V.1.15g). PM0342 was possibly also pressure flaked and would have required the same device (Figs. V.1.14a, V.1.16a). Of the three bladelets that preserved their proximal part, two present a faceted butt, the third a linear butt, without removal of the overhang on the dorsal face (Figs. V.1.13n, q–r, V.1.15d–f). The differences in flaking techniques and modes of preparation of the detachment of the bladelets suggest they were produced by knappers with different technical traditions or abilities.

³⁶⁹ Which seems to be the case, according to the experiment conducted by J. Pelegrin on a R/CC pebble collected in the Peneios by C. P.

³⁷⁰ Pelegrin 2012, fig. 18.12.

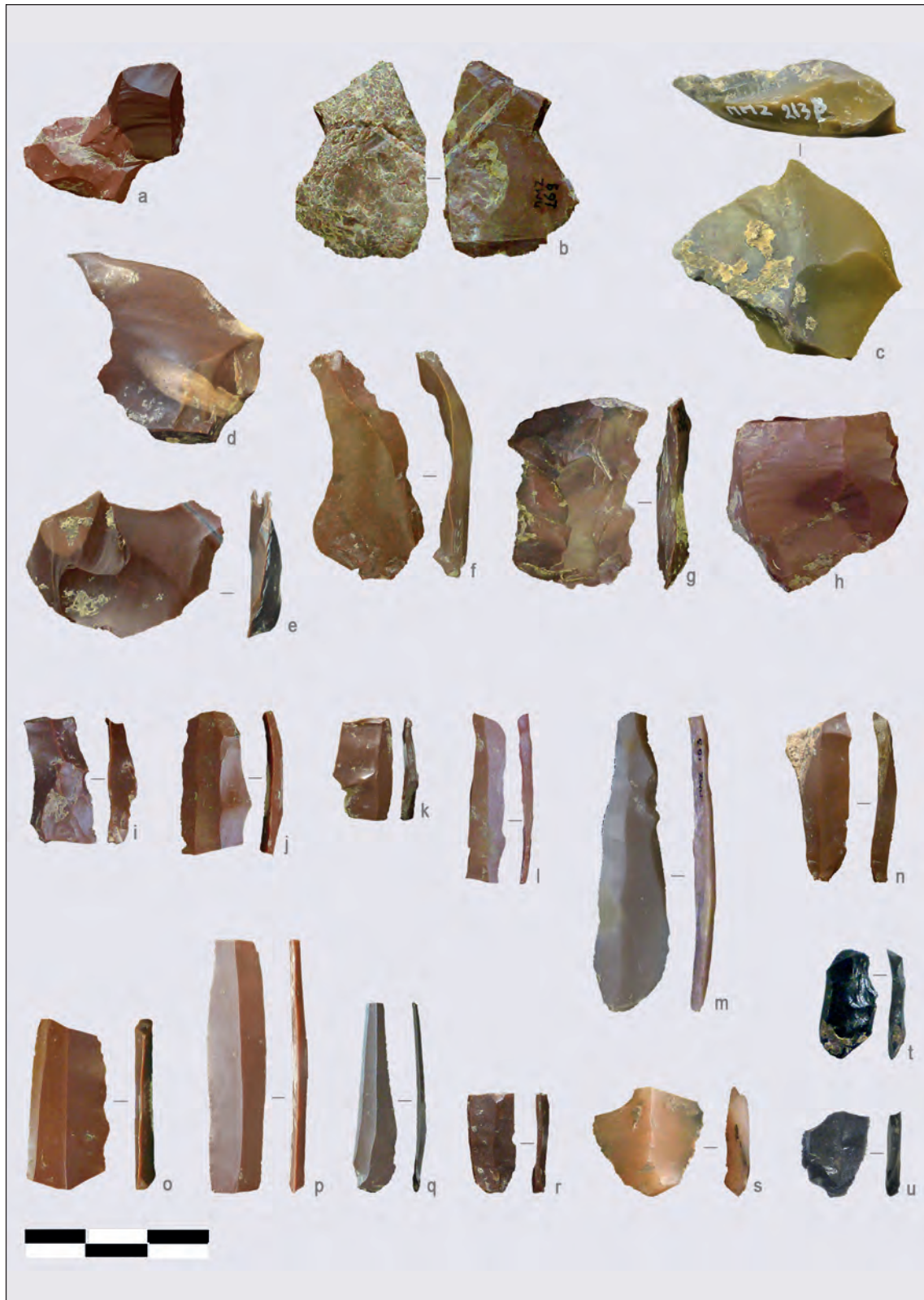


Fig. V.1.13 Lithic Phase 5. a–g: unretouched flakes, h: bladelet core, i–j: secondary crested bladelets, k–s: unretouched blades and bladelets, t: core rejuvenation flake. a–l, n, r: R/CC. m, p–q: light coloured cherts. s: honey chert. t–u: obsidian. a: PM0384, b: PM0390, c: PM0449, d: PM0380, e: PM0448, f: PM0389, g: PM0381, h: PM0378, i: PM0440, j: PM0397, k: PM0351, l: PM0448, m: PM0382, n: PM0363, o: PM0391, p: PM0422, q: PM0385, r: PM0357, s: PM0384, t: PM0405, u: PM0334 (C. Perlès)

Tab. V.1.15 Relevant dimensions for Lithic Phase 5 (C. Perlès)

PMZ number	Determination	Dimensions [cm]
PM0378	R/CC residual core	2.71 × 2.82 × 2.04
PM0380	R/CC hard hammer flake	3.1 × 4.56 × 1.23
PM0449	R/CC hard hammer flake	3.23 × 3.8 × 1.03
PM0381	R/CC core shaping flake	3.23 × 2.35 × 0.51
PM0389	R/CC core shaping flake	3.8 × 1.8 × 0.42
PM0397	R/CC under-crest bladelet (frag.)	2.33 × 1.13 × 0.3
PM0440	R/CC under-crest bladelet (frag.)	2.1 × 1.04 × 0.48
PM0363	R/CC bladelet	2.9 × 1.14 × 0.33
PM0385	R/CC utilised bladelet	3.14 × 0.71 × 0.13
PM0350	Distal frag. of R/CC bladelet	1.69 × 0.99 × 0.25
PM0391	Mesial frag. of utilised R/CC blade	2.76 × 1.35 × 0.27
PM0392	Proximal frag. of R/CC blade	1.73 × 1.9 × 0.35
PM0339	Proximal frag. of obsidian blade	1.44 × 1.30 × 0.22
PM0405	Obsidian rejuvenation flake	1.9 × 0.9 × 0.31
PM0384	Proximal frag. of honey chert blade	1.7 × 1.8 × 0.39
PM0382	Translucent chert bladelet	4.83 × 1.19 × 0.24
PM0422	Translucent chert bladelet	4 × 0.91 × 0.27
PM0342	Sickle insert on blade (frag.)	2.2 × 1.45 × 0.55
PM0351	Sickle insert on bladelet (frag.)	1.32 × 1 × 0.26
PM0441	Sickle insert on flake	3.4 × 1.8 × 0.66
PM0399	Beak	2.20 × 1.04 × 0.33
PM0366	Beak/borer	3 × 1.16 × 0.45
PM0334	Beak/borer	2.41 × 0.65 × 0.38
PM0340	Borer	1.92 × 0.9 × 0.4
PM0338	End-scraper on frag. blade	1.7 × 1.7 × 0.39
PM0386	Bitruncated triangle	1.06 × 2.02 × 0.3
PM0358	Retouched R/CC blade (frag.)	1.9 × 1.61 × 0.54
PM0452	Retouched R/CC blade (frag.)	2.7 × 1.51 × 0.33
PM0421	Retouched flake	2.4 × 2.23 × 1.02
PM0364	Retouched flake	1.5 × 1.6
PM0404	Splintered piece?	1.72 × 1.9 × 0.47
PM0337	Splintered piece	3.03 × 2.06 × 0.77
PM0341	Utilised laminar flake	2.79 × 1.02 × 0.56
PM0451	Utilised laminar flake	3 × 1.88 × 0.7

The two obsidian artefacts consist of one small rejuvenation flake (Fig. V.1.13t) and a single fragmentary obsidian blade (Fig. V.1.13u). The latter presents a linear butt with suppression of the overhang on the dorsal face, a typical Middle Neolithic method of preparation for the detachment;³⁷¹ this is a further argument to suspect a redeposition from an earlier context.

Whichever the raw material, blades and bladelets still constitute two distinct objectives in the production: the width of the bladelets varies from 0.7 to 1.19cm, while the width of the blades ranges from 1.3 to 1.8cm, with a majority over 1.45cm (Tab. V.1.15). Like in the previous phases, however, the extent of local production versus imported blanks is difficult to assess. If the very small obsidian rejuvenation flake actually belongs to this phase, it would testify that obsidian, as in the preceding phases, was at least partially worked in situ. The presence of two R/CC under-crest bladelets, of a possible core pyramidion, and, even more significant, of a platform rejuvenation R/CC flake, suggests a local production of blades and bladelets. This, however, does not preclude the importation, in parallel, of already flaked blanks.

Utilised and Retouched Tools

With only 16 specimens from a total of 58, the retouched toolkit is proportionally slightly smaller than in the preceding phase.³⁷² This renders the presence of three retouched perforating tools, the first in the PMZ assemblages, all the more significant. In addition, at least four bladelets and flakes were utilised and, in one case at least, hafted without retouch. This may possibly be a new feature,³⁷³ related to the lighter module of the blades and bladelets, which could not undergo important retouching.

Among the retouched tools examined under microscope, one or two were misidentified: PM0399, identified as a beak/borer (with a broken point) was actually used bilaterally on the proximal half. However, since the point is broken, the former use cannot be entirely excluded. PM0351 was classified as a sickle insert transformed into a small end-scraper: once again, microscopic examination revealed it was not a transformation but part of the original shaping of the insert.

Sickle Inserts (n=3)

Already rare in the previous phase, sickle inserts remain few in number and constitute a thoroughly heterogeneous group.

PM0342 is a sickle insert made on a pressure-flaked R/CC blade, broken after use on both extremities (Figs. V.1.14a, V.1.16a). It was inserted parallel to the haft without any modification of the hafted edge, and used on its right edge only. This edge was damaged – possibly by a pick during excavation – but was otherwise left unretouched, with a few use-scars creating a very small denticulation. Unretouched but slightly denticulated working edges may be characteristic of the Late Neolithic since several instances were recorded at Ag. Sophia.³⁷⁴

PM0351 is a very small and narrow insert on a R/CC bladelet (Figs. V.1.14b, V.1.16b). It was shaped before use by an ‘end-scraper front’, inserted into the haft by the right edge and used to cut cereals with the left edge. The edge was rejuvenated by short abrupt retouch and the piece re-used for the same task. A very short final retouch – from use? – removed the blunting of the edge.³⁷⁵ Several sickle inserts shaped for hafting with an ‘end-scraper’ front were present in the

³⁷¹ Perlès 2004; Kourtessi-Philippakis et al. 2008.

³⁷² The difference is not statistically significant.

³⁷³ Unretouched blades and bladelets have not been systematically examined for wear traces.

³⁷⁴ Observation C. P.

³⁷⁵ Observation N. Mazzucco.

Tab. V.1.16 Retouched and utilised artefacts from Lithic Phase 5 (C. Perlès)

PMZ number	BPh	Figure	Raw material	Technomorphological classification	Functional classification
PM0342	VIII	V.1.14.a, V.1.16.a	R/CC	Sickle insert on blade	Sickle insert
PM0351	VIII	V.1.14.b, V.1.16.b	R/CC	<i>End-scraper on sickle bladelet (frag.)</i>	<i>Sickle insert</i>
PM0441	VIII	V.1.14.c, V.1.16.c	R/CC	Sickle insert on flake	Sickle insert
PM0399	VIII	V.1.14.g, V.1.16.g	R/CC	<i>Beak</i>	<i>Tool used laterally on hide or vegetal matter</i>
PM0366	VIII	V.1.14.d, V.1.16.d	R/CC	Beak/borer	Borer used on wood
PM0334	VIII	V.1.14.e, V.1.16.e	R/CC	Beak/borer	Borer used on skin and wood
PM0340	VIII	V.1.14.f, V.1.16.f	R/CC	Borer	n/a
PM0338	VIII	V.1.14.j, V.1.16.i	Heated or burnt R/CC	End-scraper on blade	End-scraper used on skin
PM0386	VIII	V.1.14.n, V.1.16.o	R/CC	Bitruncated triangle	n/a
PM0358	VIII	V.1.14.i, V.1.16.h	R/CC	Retouched blade (frag.)	n/a
PM0452	VIII	V.1.14.h	R/CC	Retouched blade (frag.)	n/a
PM0364	VIII	V.1.16.j	R/CC	Retouched flake	n/a
PM0421	VIII	V.1.16.k	R/CC	Retouched flake/splintered piece	n/a
PM0404	VIII	V.1.14.m, V.1.16.n	R/CC	Splintered piece?	n/a
PM0346	VIII	V.1.14.l, V.1.16.l	R/CC	Split splintered piece	n/a
PM0337	VIII	V.1.14.k, V.1.16.m	Heated or burnt R/CC	Splintered piece	n/a
PM0391	VIII	V.1.13.o, V.1.15.g	R/CC	Utilised blade	Blade utilised on hide
PM0451	VIII	V.1.14.p	R/CC	Utilised flake	n/a
PM0341	VIII	V.1.14.o	Burnt chert ?	Utilised flake	n/a
PM0385	VIII	V.1.13.q, V.1.15.f	R/CC	Utilised bladelet	Bladelet utilised on skin and wood
PM0422	VIII	V.1.13.p, V.1.15.j	Radiolarite or chert	Utilised bladelet	Bladelet utilised on plants

earlier PMZ phases, but they are also known in Late Neolithic contexts,³⁷⁶ though mostly on larger blades.

The third insert, PM0441 is a sickle insert on a large flake. With its bifacial retouch and serrated working edge, it evokes Helladic inserts³⁷⁷ (or even *tribulum* inserts³⁷⁸) rather than Middle Neolithic ones. The hafted right edge was mostly shaped by direct retouch, the left edge was shaped by bifacial retouch (Figs. V.1.14c, V.1.16c). It was used to cut cereals with the left edge, rejuvenated several times, then re-used for another task on both edges.³⁷⁹ We know of no equivalent sickle insert in Late Neolithic assemblages.

Perforating Tools (n=3)

The presence of three retouched perforating tools (borers or '*mèches*') constitutes an innovation in the PMZ toolkit: none had been identified previously, even in larger assemblages. PM0366 was manufactured on a R/CC blade by regular bilateral $\frac{3}{4}$ abrupt retouch converging to shape a sturdy beak. Microscopic examination showed the point was used in a rotary motion on dry wood (Figs. V.1.14d, V.1.16d). PM0334 was similarly manufactured on a R/CC bladelet by direct abrupt retouch of the left edge and the distal half of the right edge (Figs. V.1.14e, V.1.16e). The point was used on both hide and wood, either successively or, perhaps, by perforating a hide set on a wooden stand. The point of PM0340 is broken and its use cannot be confirmed, but the similarity of the shaping technique with the two preceding artefacts, by bilateral abrupt retouch, makes its use as a borer very likely (Figs. V.1.14f, V.1.16f). Similar perforating tools, shaped by direct bilateral retouch, were uncovered in the Late Neolithic levels from Ag. Petros,³⁸⁰ Tharrounia,³⁸¹ Kitsos³⁸² and Ag. Sophia.³⁸³ They thus appear to represent a typical Late Neolithic type of perforating tool.

Retouched Blades (n=3)

This set of three artefacts does not constitute a homogeneous category. If all had been analysed for wear traces, very different uses would undoubtedly have been documented. PM0399, made on a regular R/CC blade, was shaped by direct bilateral abrupt retouch, but shorter than on the three preceding artefacts (Figs. V.1.14g, V.1.16g). The distal extremity is broken, and it was initially classified as a broken perforating tool, which remains a possibility. However, microscopic examination showed it was used on the proximal part of both the right and left edges, either on a soft vegetal matter or on fresh hide, with a transversal gesture. The fragmentary blade or laminar flake of homogeneous R/CC PM0452 was not examined for wear traces, but the very different retouch makes a similar use unlikely. Both edges bear a very short irregular direct retouch, continuous on the left edge and limited to the mesial part on the right edge (Fig. V.1.14h). Conversely, the proximal blade fragment PM0358 presents a steep-backed right edge, opposed to a naturally abrupt left edge (Figs. V.1.14i, V.1.16h).

³⁷⁶ E.g. Moundrea-Agrafioti 1981, 125 (Dimini); Perlès 1994b, pl. 7.4–6 (Tharrounia); Kourtessi-Philippakis et al. 2008, pl. 4.57.

³⁷⁷ However, given its stratigraphic position on Surface F20 and its coordinates, a contamination from Helladic levels can be ruled out. This is one of the few securely dated Late Neolithic artefacts, see below, 260.

³⁷⁸ See N. Mazzuco, this volume, 289–290.

³⁷⁹ Observation L. P. and N. Mazzuco.

³⁸⁰ Moundrea-Agrafioti 1981, pl. 5.7.

³⁸¹ Perlès 1994b, pl. 12.1–2.

³⁸² Perlès 1981, fig. 112.4.

³⁸³ Milošević et al. 1976, pl. 22.9.



Fig. V.1.14 Lithic Phase 5. a–c: sickle inserts, d–f: borers, g–i: laterally retouched blades, j: end-scraper, k–m: splintered pieces, n: bitruncated triangle, o–p: utilised bladelet and flake. All in R/CC cherts except o, light-coloured chert. a: PM0342, b: PM0351, c: PM0441, d: PM0366, e: PM0334, f: PM0340, g: PM0399, h: PM0452, i: PM0358, j: PM0338, k: PM0337, l: PM0346, m: PM0404, n: PM0386, o: PM0341, p: PM0451 (C. Perlès)

End-scraper (n=1)

True end-scrapers are generally rare in Neolithic Thessalian assemblages³⁸⁴ and PMZ Late Neolithic is no exception. This single specimen, PM0338, made on an unretouched R/CC blade, was used briefly with a transverse movement on fresh or dry hide. Compared with the Middle Neolithic end-scrapers from PMZ, it is made on a distinctly narrower and flatter blade, with a lower

³⁸⁴ Moundrea-Agrafioti 1981, 153.

and very regularly shaped working front (Figs. V.1.14j, V.1.16i). These traits are characteristic of one type of Late Neolithic end-scrapers.³⁸⁵

Retouched Flakes (n=2)

The two retouched flakes have little in common. PM0364 (Fig. V.1.16j) is a small, fragmentary platform rejuvenation flake with a short regular abrupt inverse retouch on the left edge, a style of retouch that is frequent in Late Neolithic assemblages.³⁸⁶ PM0421 (Fig. V.1.16k) is, conversely, a thick flake that may be the pyramidion of an irregular pyramidal core. It bears a direct denticulated retouch on two segments of the periphery, and was later re-used as a splintered piece.

Splintered Pieces (n=3 + 1?)

Besides the above-mentioned piece, splintered pieces are represented by a split fragment (*'bâtonnet de pièce esquillée'*) in R/CC (PM0346, Figs. V.1.14l, V.1.16l) and a large, burnt, splintered blade or laminar flake with neo-cortex (PM0337, Figs. V.1.14k, V.1.16m). PM0404 (Figs. V.1.14m, V.1.16n) is more ambiguous since one modified edge only bears unifacial retouch and the removals are not really 'splintered'. It could correspond to a very brief use as a splintered piece, or to a failed attempt at manufacturing a bifacial tool. Whichever the case, the presence of at least three splintered pieces in this small series is important, since we repeatedly noticed their unexpected absence in the previous phases.

Bitruncated Triangle (n=1)

PM0386 is an unusual bitruncated triangle in R/CC, manufactured on a wide blade by two direct $\frac{3}{4}$ abrupt truncations (Figs. V.1.14n, V.1.16o). It may be considered as a variant of a trapeze. Geometrics are never abundant in Greek Neolithic assemblages, but they can occur in all chronological phases. Four were uncovered in Late Neolithic assemblages at Kitsos,³⁸⁷ one in Phase III at Sitagroi.³⁸⁸

Utilised Blanks

As mentioned above, several blanks were utilised without any modification of the working edge. Despite its apparent brittleness, PM0385 (Figs. V.1.13q, V.1.15f) was utilised by the left edge on a supple or semi-hard vegetal matter (wood) with a longitudinal movement, and by the right edge on fresh hide, with a transversal movement. PM0391 (Figs. V.1.13o, V.1.15g) was used with the right edge on dry hide, again with a transversal movement. PM0397 (Figs. V.1.13j, V.1.15c) was also examined under the microscope but did not reveal any wear traces. Conversely, the laminar flakes PM0341 and PM0351 (Fig. V.1.14o–p), not examined under the microscope, bear clear use retouch.

Contexts

Surface F20, tentatively identified as a floor by the excavator, defines the base of BPh VIII (Fig. III.37). F20 consisted in a 4cm-thick surface of compacted yellowish, clayish earth covering the entire surface of the excavation (Early Bronze Age pit excepted). Hearth TS 18 was found on this surface. Eight artefacts were directly associated with F20, all in R/CC. These artefacts can thus be securely dated to the early Late Neolithic (Tsangli-Larissa phase) but, aside from a sickle

³⁸⁵ See Miložević et al. 1976, pl. 23; Perlès 1994b, pl. 8; Kourtessi-Philippakis et al. 2008, pl. 4.

³⁸⁶ Perlès 1994b, pl. 6.

³⁸⁷ Perlès 1981, pl. VII.5–6.

³⁸⁸ Tringham 2003, fig. 4.3z.

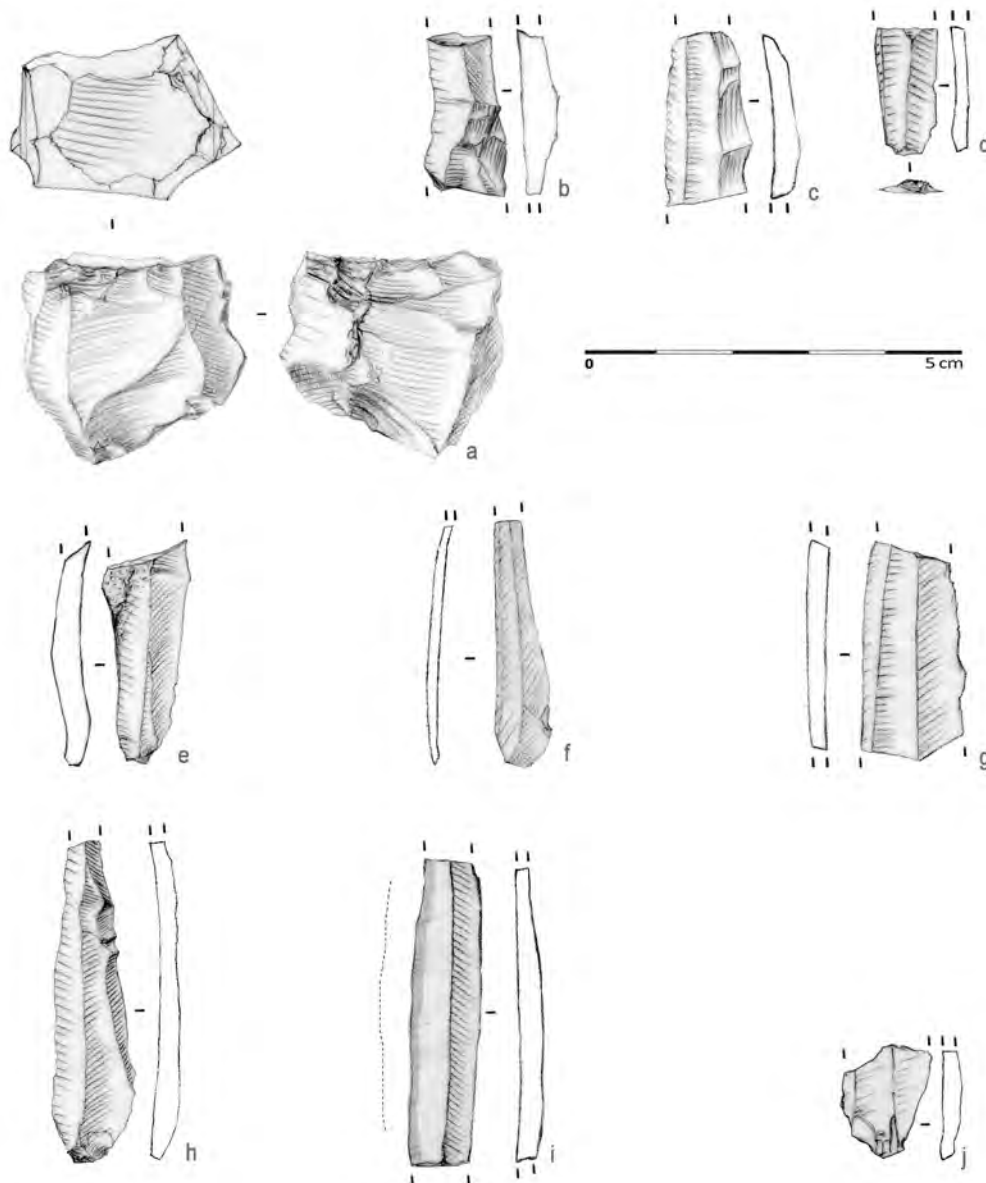


Fig. V.1.15 Lithic Phase 5. a: exhausted flake and bladelet core, b–c: secondary crested blades, d–g: pressure-flaked bladelets and blade, h–i: indirect percussion bladelet and blade, k: proximal fragment of obsidian blade. All in R/CC except i–j in translucent chert and k in obsidian. a: PM0378, b: PM0440, c: PM0397, d: PM0357, e: PM0363, f: PM0385, g: PM0391, h: PM0392, i: PM0382, j: PM0422, k: PM0339 (C. Perlès, drawings: M. Ballinger)

insert, they are not very informative. A fragmentary under-crest bladelet (PM0440, Figs. V.1.13i, V.1.15b) was found very close to the sickle insert on flake (PM0441, Figs. V.1.14c, V.1.16c) in the western part of the trench. PM0442, a debris, was found on the same surface, close to the Early Bronze Age pit. Two unretouched flakes and a fragmentary bladelet (PM0443, PM0448–9) were found in ‘a small pit on F20’ in the south-western part of the trench, while two flakes, including the retouched flake PM0452 (Fig. V.1.14h) were found together in the centre of the western part.

A quartz debris was uncovered immediately above F20, but the vast majority of flaked artefacts from Lithic Phase 5 come from the thick deposits ($\pm 0.6\text{m}$) overlying F20, where no surface, floor, hearth or other feature was identified.³⁸⁹ Among the 48 artefacts recovered from these

³⁸⁹ Toufexis – Batzelas, this volume, 123.

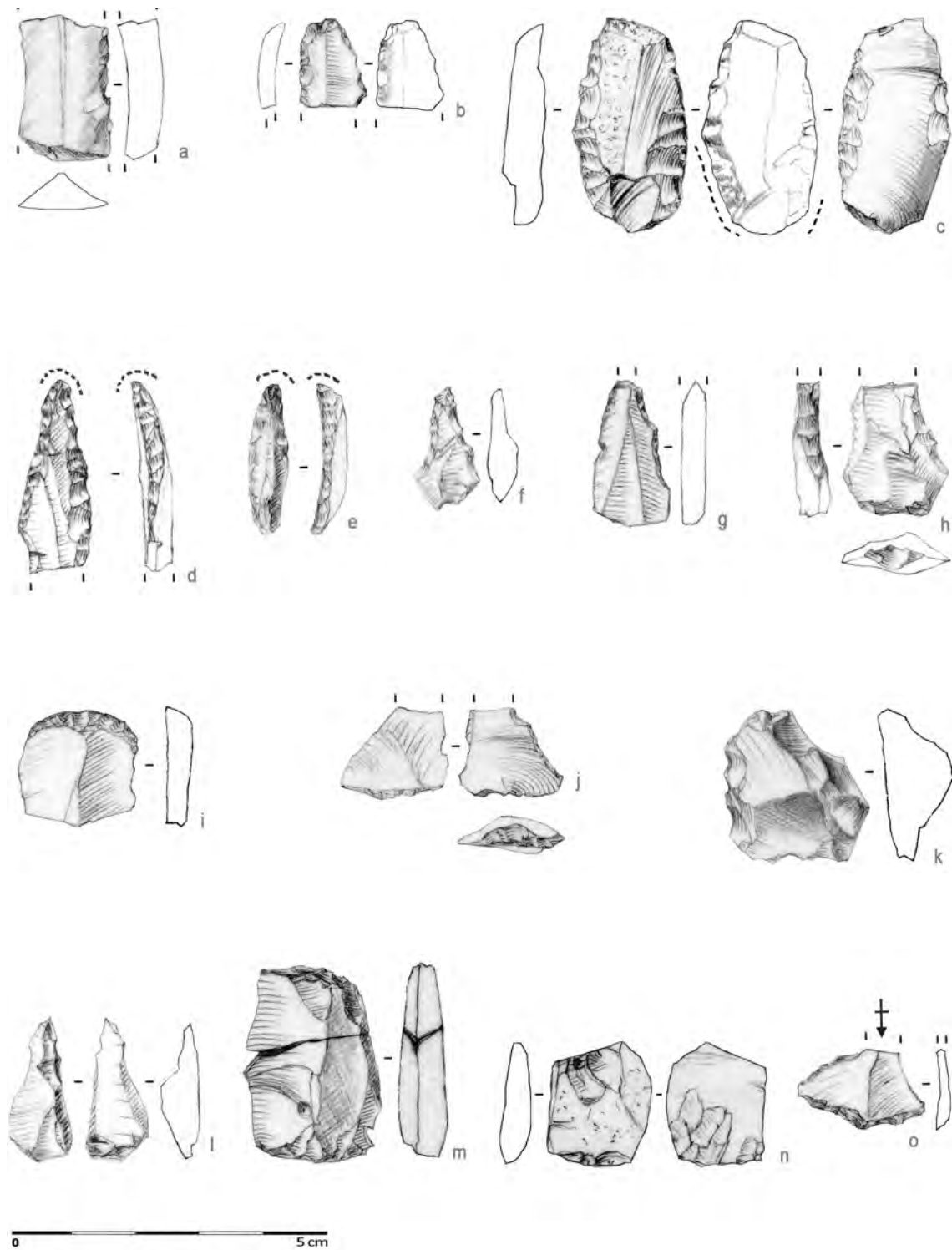


Fig. V.1.16 Lithic Phase 5. a–c: sickle inserts, d–f: beaks/borers, g–i: laterally retouched bladelet and blade, h: end-scraper, i: retouched flake, j: reflaked retouched flake, k–m: splintered pieces and fragment of splintered piece, m: splintered piece, n: bitruncated triangle. All in R/CC. a: PM0342, b: PM0351, c: PM0441, d: PM0366, e: PM0334, f: PM0399, g: PM0358, h: PM0338, i: PM0364, j: PM0421, k: PM0346, l: PM0337, m: PM0404, n: PM0386 (C. Perlès, drawings: M. Ballinger)

deposits, which unfortunately include several diagnostic pieces such as pressure-flaked bladelets and perforating tools, at least ten show thermal alteration. Since no hearth was found in these deposits, this proves beyond any doubt that they were redeposited from other contexts. While the absence of retouched perforating tools in the earlier assemblages suggests that these tools mostly date to the Late Neolithic, the presence of artefacts reworked from earlier contexts cannot be excluded.

PMZ Lithic Phase 5 and Early Late Neolithic Lithic Assemblages

Late Neolithic flaked stone assemblages, and especially early Late Neolithic assemblages in Greece are known only by a restricted number of collections and present few idiosyncratic characteristics. One of them is a rather radical transformation in the preparation of the obsidian cores for the detachment of pressure-flaked obsidian bladelets through faceted platforms,³⁹⁰ resulting in large, flat, triangular or faceted butts without suppression of the overhangs. However, the only obsidian bladelet from the Lithic Phase 5 assemblage (PM0339, Fig. V.1.13t) presents all the characteristics of a Middle Neolithic mode of preparation: a linear butt with abrasion of the overhang. It was found in the deposits overlying Surface F20, where artefacts were redeposited, possibly from earlier contexts (see above).

A second important characteristic of early Late Neolithic assemblages is the appearance of barbed and tanged arrowheads.³⁹¹ None was found at PMZ, but our sample is small and they are absent from other early Neolithic assemblages such as Drakaina Cave, where a very characteristic type of asymmetrical points prevails,³⁹² and from the earliest Late Neolithic levels at Franchthi (Phase III), again a very small assemblage.

In the absence of these two major features of early Late Neolithic assemblages, the most significant elements of Lithic Phase 5 are the three perforating tools (*mèches*) and the semicircular end-scraper on a flat blade. Given the very small number of retouched pieces (13 plus 3 splintered blades) their presence can be considered a significant shift in the composition of the toolkit, and they all fit well within early Late Neolithic assemblages. A reorientation in the activities using stone tools is also reflected by a higher representation of plant and woodworking. Interestingly this concerned unretouched bladelets, often thought to be the best-fitted tools for butchery. Yet, they were used for entirely different tasks, and butchery activities have still not been identified at PMZ.

A last element that is usually characteristic of Late Neolithic assemblages is a rise in the proportion of obsidian. This is clearly not the case at PMZ. On the contrary, there may even be doubts that any obsidian reached PMZ during Lithic Phase 5. This is all the more paradoxical given that, at precisely that time, PMZ was the centre of active trade in pottery.³⁹³ Obviously, pots were not traded against obsidian: these trading networks were entirely independent.

V.1.8. Discussion

The main objective of our work was to investigate diachronic change in the strategies of raw material procurement, tool production and tool use during the Middle Neolithic and the Middle to Late Neolithic transition. In this respect, we considered it important to integrate techno-typological and functional analyses, and document not only transformations in the conception of the tools but also the tasks they fulfilled and the way they were used.³⁹⁴ This integration has indeed proved

³⁹⁰ Perlès 2004.

³⁹¹ See, e.g., Perlès 1981; Perlès 1994b.

³⁹² Stratouli – Metaxas 2009.

³⁹³ Pentedeka 2011; Pentedeka 2012; Pentedeka 2017b.

³⁹⁴ We were especially hopeful that we would find contrasts in tool use between the Middle and the Late Neolithic. Unfortunately, the sample to be analysed was chosen at the beginning of our studies, using the only chronological framework available, based on Demoule et al. 1988. It turned out that half of the artefacts that were thought to be Late Neolithic belonged to our Lithic Phase 4, of Middle Neolithic character, thus limiting the possible comparisons.

very fruitful in improving our understanding of the characteristics of the material and the nature of the activities at or near the settlement, and did bring to light diachronic change. In many respects, however, continuity prevailed over change. Throughout the sequence, access to raw materials appears to have been limited, even though PMZ appeared a priori ideally located vis-à-vis recognised lithic trade networks. Even if the proportions vary, the range of raw materials remains stable. Similarly, and perhaps related to the scarcity of raw materials, flakes always predominate over blades and systematically comprise production with a hard hammer. In all phases also, they coexist with blades and bladelets produced by indirect percussion or by pressure. This suggests different levels of expertise among the knappers and a complex, but stable, organisation of production. Finally, from Lithic Phase 1 to Lithic Phase 4, the flaked stone assemblages reveal indisputable similarities in the techniques of production, tool types and dominant activities represented.

Set against this common background, several transformations have nevertheless been documented. Five lithic phases have thus been recognised on the basis of variation in the proportions of raw materials, flakes and blades, retouched and unretouched blanks, tool types and main activities represented. However, the differences from phase to phase are more often of a quantitative than a qualitative order. Considering the relatively small surface excavated and the small size of the lithic samples, this raises the possibility of random spatial variation. Fortunately, some long-term trends, perceptible in raw material exploitation, tool types and activities represented, support the archaeological validity of the sequence we have defined and underline the specificities of the PMZ assemblages in the Thessalian context.

Continuity in Raw Material Procurement and Exchange Networks

The absence of suitable raw material in the vicinity of the settlement necessarily entailed reliance on regional and supra-regional sources. The inhabitants of PMZ mostly used regionally available radiolarites and ‘chocolate cherts’ from the Pindos Range, which predominate throughout the sequence. In this respect, PMZ belongs to Karimali’s western Thessalian geographical sphere,³⁹⁵ where the use of R/CC predominates over obsidian, together with Achilleion or Prodromos for instance.

However, in all phases also, the proportion of cortical products (ca. 10%) is lower than at Achilleion, where R/CC were locally available. The proportion rather aligns with the proportions observed in eastern Thessalian sites, far from the sources, and where radiolarites and chocolate cherts were obtained by trade. This suggests that there was little direct procurement at the sources – whether primary or secondary – and that most of the radiolarites/chocolate cherts were obtained through exchange as already prepared cores and blanks, like in the eastern geographical sphere. The relative proportion of R/CC at PMZ is admittedly much higher than in eastern Thessalian sites, but this does not necessarily imply that more R/CC cores or blanks reached PMZ. Indeed, obsidian is conspicuously scarce at PMZ, thus automatically inflating the relative proportion of R/CC.³⁹⁶ The very low ratio of flaked stones per m³ and the altogether small size of the Neolithic assemblage rather suggest that only limited quantities of R/CC were available to the inhabitants of PMZ.

The relative and absolute scarcity of obsidian in all Middle Neolithic phases, and even more so in the Tsangli-Larissa Lithic Phase 5, is a second – and striking – element of continuity. The marginal position of PMZ in obsidian trade networks was not a brief or anecdotal phenomenon, but a long-term feature that became even more pronounced in the early Late Neolithic. The proportion of obsidian varies from 3.5 to 22%, but it is systematically lower than at Sesklo, Magoula

³⁹⁵ Karimali 2009.

³⁹⁶ For problems in estimating the abundance of a given raw material, see Karimali 2000; Perlès 2004; Perlès 2007; Karimali 2009.

Karamourlar or even Achilleion,³⁹⁷ and closer to the figures from sites located even further away from the coasts, such as Prodomos, Magoulitsa and Theopetra. The small quantity of obsidian, especially in Lithic Phase 5, when PMZ was exporting wares over large areas, demonstrates that lithic and pottery trade networks were completely independent. In turn, this independence accords with the hypothesis of itinerant knapping specialists dealing only with the production of obsidian tools.³⁹⁸

The paucity of obsidian may appear strange: according to Karimali's model, PMZ would be located right on a presumed axis of diffusion of obsidian from east to west.³⁹⁹ However, since Karimali's model was published, two Middle Neolithic sites located in the southernmost part of the Western Thessalian Plain, Magoula Koutroulou and Magoula Imvrou Pigadi, revealed lithic collections dominated by obsidian. Obsidian reaches 58% at Magoula Koutroulou,⁴⁰⁰ located some 40km from the Gulf of Lamia as the crow flies. The contrast between PMZ and Magoula Koutroulou, and to a lesser extent with Achilleion, actually suggests that instead of a single east-west network of diffusion, there were two distinct obsidian networks, one from the Gulf of Lamia to western Thessaly and one from the Gulf of Volos to eastern Thessaly. Rather than being in a 'central' position, PMZ would thus have been in a marginal position vis-a-vis both networks.

This marginality, however, cannot be understood solely in terms of geographic distances, as already underlined by Karimali.⁴⁰¹ Admittedly, the nearest shore for PMZ would be the Gulf of Volos, at about 70km as a crow flies, i.e. further inland than Magoula Koutroulou and Achilleion if they were indeed provisioned from the Gulf of Lamia. This distance is, nevertheless, comparable to the distance from Otzaki and Ag. Sophia to the Gulf of Volos (ca. 60km), two sites where the proportion of obsidian reaches 69% and 86%.⁴⁰² Equally significant is the fact that obsidian appears to be more abundant at Magoula Koutroulou than at nearby Achilleion, even though the two sites are located at the same distance from the Gulf of Lamia. Rather than to a straightforward geographic factor, the paucity of obsidian at PMZ must also be attributed to social factors. Insights on this question can be gained through Karimali's study of the production of threshing sledges in Thessaly. She showed that several production systems and overlapping distribution networks operated simultaneously, and that the 'distance' between producers and consumers was primarily a distance in kinship and sociocultural ties: "The fact that human relationships are deeply entrenched on the degree of 'familiarity' developed among human groups assigns a new content to the concept of 'distance', with effective analogies to the Neolithic".⁴⁰³

Trade in honey chert blades could not compensate for the scarcity of obsidian. This third exchange network for provisioning lithic raw materials, or rather flaked blanks, also appears to have been stable over time. Honey chert blades were recovered in each phase, and in good enough contexts to eliminate the hypothesis of redeposited older material.⁴⁰⁴ These blades are rare at PMZ, but so are they at every Thessalian site. Their overall proportion at PMZ is about 3% of all flaked stones,⁴⁰⁵ but about 15% of the regular blades. It compares well with the percentage of 'light-

³⁹⁷ The figure of 14.4% for Achilleion (Karimali 2009, tab. 1) is an average for the whole Neolithic sequence. If only Phases III and IV are considered, i.e. the Early Neolithic/Middle Neolithic and Middle Neolithic, the percentages are 27.1 and 28.6%, respectively (Elster 1989, tab. 10.1). Even when considering the whole assemblage, a rough estimation suggests that obsidian was six times more abundant per m³ at Achilleion than at PMZ.

³⁹⁸ Perlès 1990.

³⁹⁹ Karimali 2009.

⁴⁰⁰ Hamilakis et al. 2017.

⁴⁰¹ Karimali 2009.

⁴⁰² Karimali 2000. C. P., who has studied both collections, would not exclude biases in recovery at Otzaki. Conversely, the large assemblage from Ag. Sophia appears reliable.

⁴⁰³ Karimali 2005, 53.

⁴⁰⁴ Below, Fig. V.1.18.

⁴⁰⁵ This proportion is misleading, since honey cherts were never flaked locally. Consequently, the percentage does not include flaking wastes, as it does with the other categories of raw material.

coloured cherts' in Middle Neolithic assemblages such as Magoula Karamourlar or Sesklo B.⁴⁰⁶ For these blanks of excellent quality, PMZ was not at a disadvantage compared to contemporaneous settlements of the same region.⁴⁰⁷ Their high value is demonstrated by technical and functional criteria. These tools, no matter what their function was, usually have two or three active zones, often used on different materials. In almost all cases, these versatile tools were extensively used before they were abandoned, a common pattern in Middle Neolithic assemblages.⁴⁰⁸

Multiple Systems of Procurement and Production

The difficulties in obtaining laminar blanks, or suitable raw materials for the production of blades, would explain two other unusual elements of continuity: the predominance of flakes over blades and bladelets, and the high proportion of retouched flakes. The proportion of flakes at PMZ is higher than at any other Thessalian site, including those where local raw materials were exploited such as Achilleion and Ag. Petros (Sporades).

The flakes belong to two distinct technological *chaînes opératoires*: the shaping of blade or bladelet cores, and the deliberate production of flakes on discoid cores. Whereas shaping flakes are present in all Thessalian assemblages, where they amount to about a third of the debitage products, the independent production of flakes is more rarely documented.⁴⁰⁹ Its presence at PMZ in all phases accounts for the unusually high proportion of flakes and supports the hypothesis of persistent limitations in the supply of radiolarite and obsidian blades. Casually produced with a hard hammer, these flakes can be attributed to unskilled knappers⁴¹⁰ who needed to supplement their supply of laminar products.

The coexistence of these two categories of flakes raises the question of the organisation of production at PMZ. Indeed, even if 'trade networks' can be brought to light, this says little about the state of introduction of the raw materials, the degree of local transformation and the status of the knappers. These aspects are, unfortunately, difficult to apprehend with the assemblages from PMZ. It is probably not an exaggeration to state that each reducing sequence from PMZ is represented by one piece only, leading to indisputable frustration for the analyst... Some hypotheses can nevertheless be put forward.

We have seen that some of the R/CC flakes were produced locally by unskilled craftsmen. It is thus logical to think that they were inhabitants of the settlement, and to consider the production of flakes as a domestic production. Indeed, the absence of local raw materials would have had immediate consequences on the possibility of learning elaborate *chaînes opératoires*. Apprenticeship in lithic production requires years of practice and the consumption of large quantities of wasted raw material before one can fully master the production of blades by indirect percussion or pressure.⁴¹¹ One can thus assume that local apprenticeship was essentially limited to the much easier production of flakes. However, even for this simple production, local craftsmen would have had to use pebbles that could not be found in the immediate vicinity of the site. Direct procurement further upstream the Peneios and the Portaikos would have required a two-day trip across the Karditsa Plain. This can be envisioned, at least occasionally. However, as we argued, we would have expected larger quantities of raw material, better qualities and a higher proportion of cortical flakes if this had been systematically the case. It is thus possible that even the river pebbles, already partially decorticated, were obtained by exchange with communities nearer to the secondary sources.

⁴⁰⁶ Moundrea-Agrafioti 1981, tab. 1.

⁴⁰⁷ Although precise comparisons are difficult, it would seem that honey chert is much more abundant in the Middle Neolithic at Franchthi, for instance: Perlès 2004.

⁴⁰⁸ Perlès – Vaughan 1983.

⁴⁰⁹ Moundrea-Agrafioti 1981, 101. It is absent at Sesklo B and Magoula Karamourlar, but present on local raw materials at Ag. Petros.

⁴¹⁰ But not to beginners, as discussed 209.

⁴¹¹ Olausson 2008; Klaric 2018.

In addition, we know that during the Early and Middle Neolithic in central and southern Greece, obsidian blades and bladelets were also usually produced *in situ*, but by itinerant specialists who perfectly mastered pressure flaking. They brought with them already prepared cores, often already partially exploited, and produced the required blades and bladelets in the villages.⁴¹² The very small number of obsidian artefacts at PMZ, the absence of cortical pieces, the presence of small rejuvenation flakes and pressure-flaked bladelets support this general model. Finally, we know that, conversely, all over Greece during the Early and Middle Neolithic honey chert blades were produced at the sources and traded as finished blanks. Here again, with no indication of local production, PMZ fits the usual pattern.

We can therefore already document three different modes of procurement of the tools: a domestic production, an *in situ* production of obsidian bladelets by itinerant specialists, and trade in finished honey chert blanks produced at or near the sources.

The situation is more ambiguous for the blades and bladelets in R/CC and translucent cherts. We found repeated indications of a local production for at least some of the laminar products: flakes produced by indirect percussion, crested blades, and a pressure-flaked microcore. The importation of high-quality blocks of raw materials to be worked *in situ* can again be ruled out, given the low proportion of cortical pieces. There remains i) the possibility that local experts obtained already prepared cores from communities living nearer to the sources and produced the blades and bladelets at the site; or ii) that itinerant specialists, similar to those procuring the obsidian, came and flaked upon request at the settlement. Both alternatives have been documented in Neolithic lithic production systems.⁴¹³ However, as argued above, it would have been difficult to train for blade production in a settlement devoid of local raw materials. Production by itinerant specialists thus appears more plausible, but does not preclude trade in finished blanks to supplement this *in situ* production, as for honey chert blades.

The PMZ data thus points towards multiple modalities of procurement and production of the flaked stone tools, a situation that is actually the rule in central and southern Greece, where local resources, obsidian and honey chert blades were always used simultaneously, but for different purposes. Comparable configurations are also known in historical times. Karimali's study of the production of threshing sledges provides an example for the coexistence of multiple systems of procurement and production: some threshing sledge specialists produced the sledges at the villages upon request, using wood and stone they had collected on the way or locally. Others, by contrast, manufactured the complete sledges at home, in the mountains, and came down seasonally to the plain to trade finished products.⁴¹⁴ Eventually, when needed, the villagers could also manufacture their threshing sledges themselves.

Continuity in Tool Conception and Use

Some of the most characteristic tool types are remarkably similar from one lithic phase to another (Fig. V.1.17). This is not unexpected considering the relatively short duration of the Neolithic sequence and the homogeneity documented in the pottery sequence.⁴¹⁵ As discussed earlier, there is, however, the risk for both categories of remains that this homogeneity was created, or minimally reinforced, by the regular reworking of older remains and their incorporation into later assemblages. We can indeed show that some at least of the artefacts found in the 'destruction deposits' between two identified surfaces were redeposited,⁴¹⁶ and cannot eliminate the possibility that they originally came from earlier contexts. Ideally, the analyses ought to be based primarily on the material recovered on recognised 'surfaces'.

⁴¹² Perlès 1990.

⁴¹³ E.g. Perlès 1990; Léa 2005; Gassin et al. 2010.

⁴¹⁴ Karimali 2005.

⁴¹⁵ Demoule et al. 1988; Pentedeka in press; Pentedeka in preparation.

⁴¹⁶ In particular by the presence of burnt pieces in deposits where no thermal structures were uncovered.

Unfortunately, the flaked stone material directly associated with the more securely stratified contexts, surfaces, floors, pits or hearths, is a small minority: less than one fifth of the total. It also contains extremely few formal tool types. None of the characteristic Middle Neolithic end-scrapers, for instance, comes from such contexts. Only three elements of typological continuity can be demonstrated through the recognised 'surfaces': the presence of sickle blades with bilateral continuous steep retouch from Lithic Phase 1 to Lithic Phase 4, the presence of sickle inserts on flakes in Phases 1 and 2, and the presence of the trapezes and transverse arrowheads in Phases 3 and 4 (Fig. V.1.18). Despite their small number, these examples indicate that the typological continuity is not solely due to the reworking and redeposition of material.

When, perforce, one considers all the material from each lithic phase, other diachronic continuities can be brought to light. Interestingly, several of them appear specific to PMZ: i) the high proportion of sickle inserts on flakes, especially in Lithic Phases 1–3; ii) among the sickle inserts on flakes, the good representation of a distinct subtype on thick-backed flakes; iii) the frequent shaping of the sickle inserts with an 'end-scrapers' front; iv) the large, wide-fronted end-scrapers (Fig. V.1.17).

Continuity throughout most of the sequence is also exemplified in the activities identified through use-wear analyses, their relative intensity and in the activities absent from the sample. The dominant category of tools in particular, the sickle inserts, appear to have been used in a similar way from Lithic Phase 1 to Lithic Phase 5. They present typical traces of cereal harvest, such as a well-developed undulating polish and thin striations parallel to the edge. A few of them also show traces of abrasive elements, implying that they came into contact with the soil; they may have been inserted at the tip of the sickle during the harvest, or re-used after the harvest, for instance for cutting the stems near the ground in a dry or semi-dry state, since the stems can be used as fodder or in mudbricks.⁴¹⁷ Throughout the sequence, the sickles appear to have been used with a low cut on dry or semi-dry cereals. This would be expected for domesticated cereals, since they lost their brittle rachis and their seeds ripen at the same time, making harvest in a ripe state more profitable.⁴¹⁸

The best-represented activity after the harvest is hide working, both on fresh hide and dry hide/leather. Almost all of the tools that show traces of hide working in the different phases performed a transverse movement; only one was used in a rotary motion. Interestingly, only a few typical end-scrapers were found at the site, and they do not show signs of exhaustion. Most of the tools that worked hide were simple flakes or blades, with or without retouch. More precisely, most of these tools were retouched in the earlier lithic phases, whereas even unretouched blades performed a transverse action on hide in Lithic Phase 5. In addition, several of these tools were also used for other tasks. This absence of specialisation is quite striking, and suggests that hide working was not particularly important. The sample analysed probably corresponds to a small-scale activity rather than to a specialised toolkit for leather production.

Finally, a few tools in the analysed sample worked plant materials other than cereals. Two or three tools worked on soft plants, and show the typical plant polish and striations perpendicular or oblique to the edge that imply a transverse action. Tools that worked on hard or semi-hard plant matter, like wood, performed different motions: transverse, bidirectional longitudinal and rotary. This variety reflects different procedures for transforming wood. As we concluded earlier regarding hide working, woodworking was also a small-scale activity: the number of tools involved is small and there is no consistency in the assemblage. Noteworthy is the complete absence in the sample of tools used to butcher carcasses, cut meat, manufacture bone tools or scrape pottery. According to the sample studied by functional approaches, technical activities involving flaked stone tools always remained marginal, except for the exploitation of cereals, and never required a specialised toolkit.

⁴¹⁷ Perlès – Vaughan 1983; Clemente – Gibaja 1998; Ibáñez Estevez et al. 2008.

⁴¹⁸ Unger-Hamilton 1999; Ibáñez Estevez et al. 2014.



Fig. V.1.17 Typological continuity through Lithic Phases 1–4. LP Lithic Phase. BPh/BSPH Building Phase/Building Subphase. a–d: bilaterally used and retouched sickle inserts on blades, e–f: retouched honey chert blades, g–h: sickle inserts on backed flakes, i–k: sickle inserts on blades shaped with an ‘end-scaper’ front, l–n: end-scrapers on large blades, o–p: transverse arrowheads (C. Perlès)

Random Quantitative Variation?

Despite many elements of continuity in the PMZ assemblages, statistically significant variation in the proportion of raw materials, blanks and tools have also been brought to light.

Short-term quantitative variations in raw material proportions are probably structurally inevitable when a large proportion of the raw materials and blanks are obtained through exchange. They were exemplified in the few sequences published in detail, such as Achilleion or Franchthi. In turn, the variation in traded raw materials and blanks could entail variation in the ratio of flakes to blades and bladelets, and possibly in the ratio of retouched tools. If this was the case, the lithic phases from PMZ that differ only by quantitative differences, such as Lithic Phases 1 and 2 on the one hand, and Lithic Phases 3 and 4 on the other, may simply reflect the hazards of provisioning at PMZ, rather than regional diachronic trends. A more conservative approach would thus consist in relying mostly on qualitative differences, i.e. techniques of production and tool types. This would reduce the number of lithic phases to three: Lithic Phases 1 and 2, Phases 3 and 4, and Phase 5. To a certain extent, this tripartite scheme echoes the original division of the sequence into a 'Sesklo', a 'Zarko' and a 'Tsangli-Larissa' phase,⁴¹⁹ but the limits do not correspond: the 'Zarko phase', as it was defined, would encompass Lithic Phases 2 to 4.

Even with this reduced framework, it is, however, difficult, for reasons already explained, to assess the archaeological validity of these phases. Even when in situ production is attested, the *chaînes opératoires* are very incomplete: the flakes corresponding to the cores, or, conversely, the cores corresponding to the flakes are missing from our samples. This inevitably raises the question of the representativity of our samples. The small size of the excavation relative to the size of the settlement and the very low density of stone tools render random spatial variation almost inevitable. Fortunately, some long-term trends suggest that, beyond random variation, a diachronic structure is really present.

Long-Term Trends

Several long-term trends in the flaked stone assemblages support the hypothesis of diachronic changes unrelated to sampling hazards. Although this cannot be quantified, the quality of the raw materials and presence of fresh cortex suggests increasing use over time of R/CC and light-coloured cherts procured at or near the primary sources. This trend can be related to an increasing proportion of large bladelets and blades produced by indirect percussion or pressure flaking, which required high quality, homogeneous raw materials.

A second trend relates to the regular decrease, among the retouched tools, in sickle inserts. In Lithic Phase 1, sickle inserts predominate in the retouched toolkit, in proportions above those known in other settlements. In Lithic Phase 4, they represent only 1/5th of the tools, and even less in Lithic Phase 5, i.e. less than in any other published assemblage.

Parallel to this trend is a decrease in sickle inserts made on flakes. While they predominated in Lithic Phase 1, their proportion gradually diminishes. They have disappeared by Lithic Phase 4, with the exception of one unusual specimen in Lithic Phase 5. Since the production of flakes was considered local and domestic, whereas honey chert blades were imported as finished blanks, as well, most probably, as the best R/CC blades, this implies a shift from a partially domestic production of sickle inserts towards a stronger reliance on traded blanks.

This shift may be related to a change in the conception of the sickles themselves. According to the distribution of the polish, the small inserts on flakes or short blades from Lithic Phases 1–3 would have been inserted obliquely into the haft to create a denticulated edge, like the Karanovo sickles.⁴²⁰ Among the flakes, the thick-backed ones may have required a different haft than the thinner ones, but they, too, were inserted obliquely. The mode of insertion of the fewer long blades

⁴¹⁹ Demoule et al. 1988.

⁴²⁰ Gurova 2005.



Fig. V.1.18 Retouched tools directly associated with identified 'surfaces' ('floors'). a: PM0838, b: PM0833, c: PM0764, d: PM0723, e: PM0845, f: PM0836, g: PM0686, h: PM0652, i: PM0575, j: PM0502, k: PM0476, l: PM0497, m: PM0495, n: PM0498, o: PM0503, p: PM0506, q: PM0441 (C. Perlès)

Oblique hafting

PM0728



PM0743



PM0836



PM0867

**Parallel hafting**

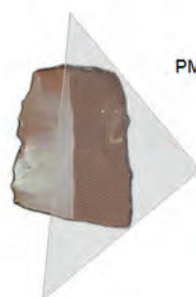
PM0342



PM0441



PM0453



PM0808

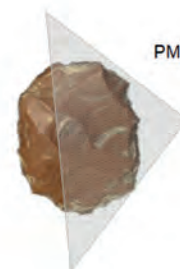


Fig. V.1.19 Oblique and parallel hafting of sickle inserts. The models represent the two modes of hafting for sickle elements. The visible part of the tool represents the active zone, whereas the part hidden behind the dotted triangle represents the hafted edge (L. Papagiannaki)

from these phases remains uncertain, but their bilateral use and the absence of backing suggest a different mode of hafting, possibly similar to the hafting found in the later phases. Indeed, in Lithic Phases 4 and 5, sickle inserts are mainly made on large blades, inserted parallel to or only slightly obliquely into the haft (Fig. V.1.19). They may belong to bigger sickles, still curved but with a straight working edge, as known in the Near East since the 8th millennium.⁴²¹ Different types of sickles would thus have been used at the beginning of the Middle Neolithic, with a predominance of denticulated sickles. The latter would have progressively disappeared in favour of the second type, with a straight working edge. Fewer inserts are required with this second type, possibly explaining why the number of sickle inserts diminishes regularly throughout the sequence. However, why sickle blades should become proportionally scarcer in PMZ by the end of the Middle Neolithic than in any other Thessalian site remains unexplained.

A last trend, directly related to the two preceding ones, is a slight diversification of the toolkit. Most notable is the introduction in Lithic Phase 3 of the first geometrics and transverse arrowheads. These artefacts were not studied microscopically, but suggest hunting or warfare activities. New tool types also appear in Lithic Phase 5, in particular borers and splintered pieces, whose quasi-absence in the earlier levels was particularly striking.

⁴²¹ Borrell – Molist 2007.

This typological trend towards diversification finds echoes in the activities identified. Lithic Phases 1–3 are dominated by harvesting tools, whereas other activities are essentially marginal. Although very small, the sample from Lithic Phase 4⁴²² would suggest more diversified activities: we identified four sickle inserts, two of which possibly bear traces of secondary activities, and three tools used on other materials (hide, wood and mineral). Lithic Phase 5 shows, finally, a more balanced and diversified toolkit. The three activities detected (cereal harvest, hide and plant working) are equally represented. The sample of nine used implements comprised three sickle inserts, two tools that worked both hide and wood, one that worked only hide, one that worked only wood, and a last one that was used on soft matter of vegetal or animal origin. Precisely because the sample is very small, this diversification appears significant, and implies either more varied activities or a change in the use of space during the Middle Neolithic/Late Neolithic transition.

Discontinuities: The Question of the Middle to Late Neolithic Transition

Investigating the nature of the Middle Neolithic/Late Neolithic transition from the flaked stone viewpoint was one of the major aims of our study. We wished in particular to establish whether the transition was gradual, or whether a break in technical traditions could be perceived.

The answer to this question raises a methodological problem: it depends indeed on which chronological framework is used as a reference. It will be recalled that in the original publication⁴²³ the levels now defined as BPh I–V were related to the Thessalian ‘Sesklo’ and those from BPh VI to BSPh VIIb to a late Middle Neolithic phase termed the ‘Zarko phase’. The transition between the Zarko phase and the Late Neolithic (Tsangli-Larissa) was set at ca. 5.10m, approximately at the limit between present-day BSPh VIIb and BSPh VIIc. The Tsangli-Larissa phase at PMZ, as originally defined, therefore encompassed BPh/BSPh VIIc, VIII and IX.

From a lithic point of view, however, BSPh VIIc cannot be attributed to the Late Neolithic. Our study revealed a strong technological and typological similarity between the material from BSPh VIIb and VIIc, which we grouped as Lithic Phase 4. Both, in addition, present a definite ‘Middle Neolithic’ character and were clearly related to the earlier Middle Neolithic phases. A significant change in the composition of the flaked stone assemblages only occurred with BPh VIII (Lithic Phase 5).⁴²⁴ This last phase revealed discontinuities in all aspects of the assemblage: the quasi-disappearance of obsidian in the raw materials, a marked increase in the proportion of bladelets, new techniques for the production of pressure-flaked blades, new tool types and the absence of the most emblematic Middle Neolithic tool types. ¹⁴C dates do not clarify this apparent discrepancy: BSPh VIIb was dated to the Middle Neolithic in the Thessalian absolute chronology, while the date of BSPh VIIc covers the late Middle Neolithic and early Late Neolithic.⁴²⁵ Both schemes could thus be supported by the radiocarbon chronology.

However, the validity of this original scheme must be questioned. The renewed analyses of the pottery assemblages by Pentedeka led her to a different phasing: BSPh VIIb and VIIc both belong to Ceramic Phase 6, as do BPh VIII and IX. Ceramic Phase 6 is considered Late Neolithic, when BSPh VIIb and VIIc are clearly of Middle Neolithic character for the flaked stone assemblages. Ceramic Phase 5 and 6, respectively correspond to Lithic Phase 4 and 5. The phasing for these later Neolithic levels is thus the same for the flaked stones and the pottery, but whereas some Late Neolithic features are already present in the ceramic assemblage of BSPh VIIb and VIIc, the flaked stones remain of Middle Neolithic character. Our study revealed several other discrepancies between the lithic and ceramic phases, especially in the middle part of the sequence (see chronological chart chapter III). The massive difference in the quantity

⁴²² The initial sample included four artefacts without wear traces.

⁴²³ Demoule et al. 1988.

⁴²⁴ There were no flaked stones in BPh IX.

⁴²⁵ Reingruber et al. 2017; but see n. 350.

of material available may explain some of these discrepancies, especially if the flaked stone material was too scarce to recognise subtle quantitative changes. However, during periods of continuous occupation of a settlement by the same community, there is no reason to expect concomitant variations in pottery and stone tools. The flaked stone assemblages vary according to the availability of different raw materials, to the technical traditions and know-how of the knappers, and to the tasks for which flaked stones are required. None of these variables would have any parallel in pottery production and decoration. As argued in a similar stratified context,⁴²⁶ concomitant changes in lithics and ceramics should only be expected in the case of occupational hiatuses in the sequence, or the arrival of new inhabitants with different technical and cultural traditions.

If one therefore focuses on the flaked stone sequence, without reference to external frameworks, the transition between the earlier and latest Neolithic levels become sharper and the change more abrupt: Lithic Phases 1 to 4 present many aspects of continuity and a Middle Neolithic character, while Lithic Phase 5 shows significant changes in the raw materials, methods and composition of the toolkit, with tool types that can be considered typical of the Late Neolithic. The contrast is admittedly not as marked as it could have been if other typical early Late Neolithic elements had been present, such as Late Neolithic obsidian pressure-flaked blades and Late Neolithic barbed and tanged arrowheads, but it is, nevertheless, stronger than between each of the Middle Neolithic phases. According to this scheme, the transition between the Middle Neolithic and the Late Neolithic in the flaked stone assemblages would not seem 'gradual' but abrupt, and would occur later than in the pottery assemblages.⁴²⁷ However, two observations lead us to nuance this view: as indicated above, the tendency towards a diversification of the toolkit and the activities represented is already perceptible in Lithic Phase 4, albeit more pronounced in Lithic Phase 5. Similarly, the predominance of sickles with a straight working edge appears already established during Lithic Phase 4. Lithic Phase 5 would therefore represent both the outcome of an internal dynamic anchored in the late Middle Neolithic, and the introduction of new techniques and tool types of exogenous origin.

The PMZ Flaked Stone Assemblages in the Thessalian Context

Among the different factors of variability of the lithic toolkits that we invoked, availability in raw material and blanks for tools may well have been prevalent at PMZ. Lithic Phase 1, in particular, shows signs of a real scarcity of raw material/blanks: a very high ratio of retouched pieces, an unusual rate of flakes in the retouched toolkit, and an unusual degree of curation of the tools. Lithic Phase 2 essentially differs from Lithic Phase 1 in the proportion of the different raw materials, the frequency of blades and the frequency of retouched material. Besides potential random variation, all these changes could be related to slight modification in the procurement of cores and blanks. Most of the differences between the following Middle Neolithic phases also pertain to the proportion of raw materials and laminar products. Again, slight shifts in their respective availability could account for these variations. If this was the case, the Middle Neolithic diachronic sequence brought to light at PMZ would reflect the problems and opportunities of a community deprived of local raw materials, and living at the margins of lithic trade networks. It is the story of a given Thessalian community and how it dealt with its flaked stone tools, and there is no reason to expect that the story be repeated elsewhere in the same terms.

Nevertheless, this community was not isolated. It participated in several lithic trade networks, even if sometimes marginally, and thus benefitted from repeated contacts with trading partners and itinerant specialists. As a consequence, all the tool types found at PMZ are known from other sites, either in Thessaly or in southern Greece, with the exception of the bifacially worked

⁴²⁶ Perlès 2004.

⁴²⁷ Unless one assumes important contaminations in the pottery assemblages.

microfoliate point from Lithic Phase 1 (Fig. V.1.1q) and the sickle insert on flake from Lithic Phase 5 (Fig. V.1.14c), for which we know of no equivalent anywhere else. Yet, several tool types present at PMZ are conspicuously rare in the other published Thessalian assemblages. The bifacially worked transverse arrowheads (Lithic Phases 3 and 4), known in southern Greece, have no equivalent in published Middle Neolithic Thessalian assemblages.⁴²⁸ The sickle blades shaped with an end-scraper front,⁴²⁹ the trapezes⁴³⁰ and truncated blades are rare or absent in most Thessalian series. The sickle inserts on thick-backed flakes are present in all published Thessalian assemblages, but at much lower frequencies than at PMZ.⁴³¹

The good representation of these rare tool types at PMZ, together with the absence of others, such as splintered blades, sets it apart from the other settlements and contributes to reinforce the impression of a marked idiosyncratic continuity, especially in the Middle Neolithic. The interplay between raw material availability, the activities performed at PMZ and the tool types that were chosen to perform these technical tasks gives a strong and distinct personality to the PMZ flaked stone tool assemblages, and shows that much remains to be learnt about Thessalian lithic assemblages.

⁴²⁸ They exist in small numbers in surface collections.

⁴²⁹ 3% of the sickle inserts in the Thessalian sites studied by Moundrea-Agrafioti (1981, 117).

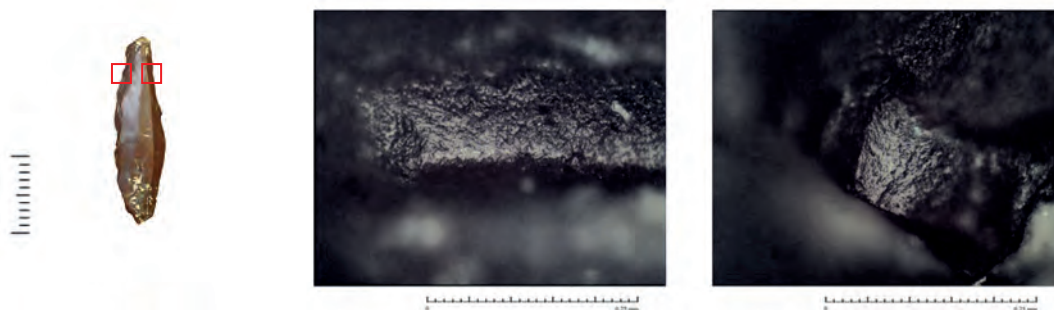
⁴³⁰ None is published from Thessaly proper. Two were found at Ag. Petros in the Sporades: Moundrea-Agrafioti 1981, 155.

⁴³¹ See above, 222.

V.1. Appendix 1: Table of Wear Traces

*Lygeri Papagiannaki – Sylvie Beyries**PM0334*: Rotary motion possibly on two materials, wood and hide

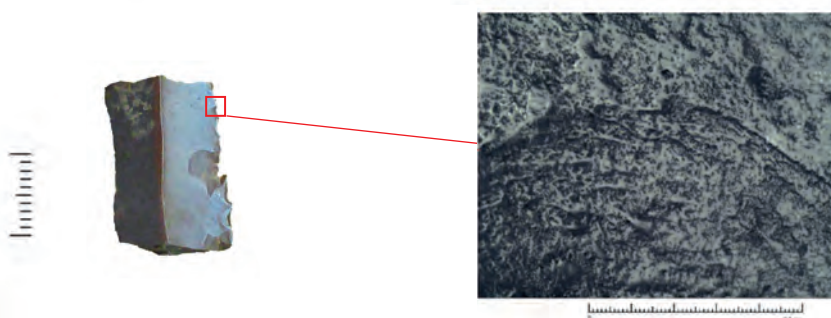
The point is the active zone, which is heavily rounded; rounding discontinuous and in some places flattened. A discontinuous but invasive polish was detected, with tight to open linkage, irregular and undulating-irregular microtopography, limited on the higher spots. Striations are rare, short and thin, some perpendicular to the edge, others parallel to it. Traces pointing to semi-hard or hard materials. The characteristics of the polish imply that two materials might have been worked, wood and hide.

*PM0338*: Transverse action on hide

The shaped front of this end-scraper is the active zone. It shows a poorly developed (or even non-existent) rounding, and some microflakes of use, mostly perpendicular to the edge. Discontinuous and marginal polish, with a semi-tight to open linkage and irregular microtopography limited to the high spots, suggesting working with a high angle. Few striations perpendicular to the edge, thin and superficial. Traces poorly developed, pointing to short-term activity.

PM0342: Sickle element

The right edge was the active zone. Characterised by a well-developed though discontinuous (due to microflakes) rounding, equally developed over both faces. Important microchipping: medium or large-sized microflakes, usually oblique with two directions. Continuous and invasive polish, bright, with a compact to open linkage and undulating microtopography and many striations parallel to the edge, some of them filled-in. Sickle element hafted parallel or very slightly oblique, according to the distribution of the polish (see Fig. V.1.19).



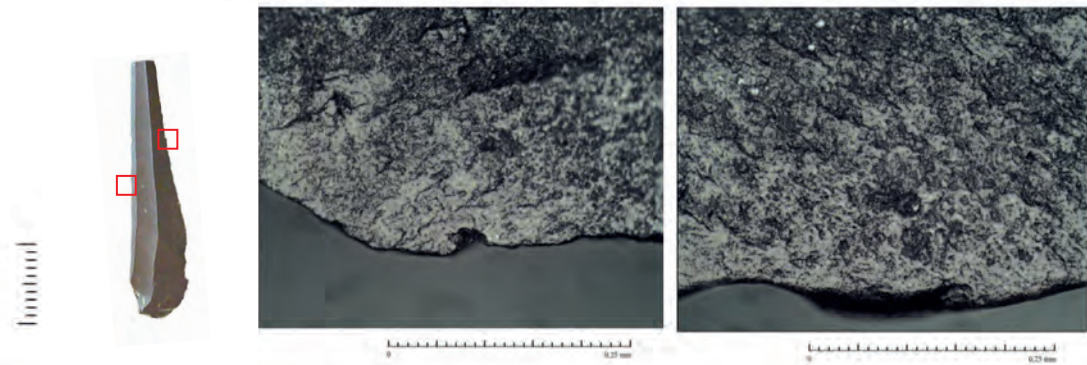
PM0366: Rotary motion on hard vegetal matter (dry wood)

The point was the active edge. Well-developed rounding, continuous and flattened on several spots, implying use on a hard material. The aligned microflakes, with feather or step termination, confirm this observation. Discontinuous and marginal polish, bright, with tight to open linkage and undulating or undulating-irregular microtopography, as well as rare striations, some parallel and others perpendicular to the point.

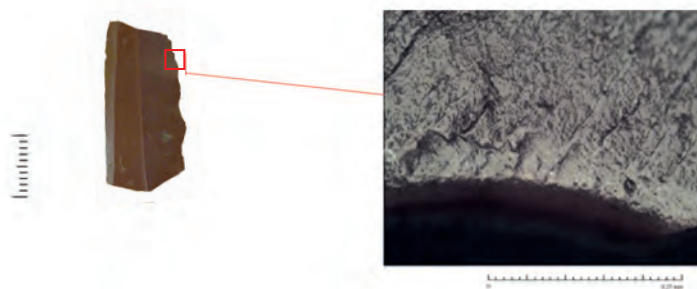
*PM0385: Left edge: longitudinal action on soft or semi-hard vegetal material (wood)*

Right edge: transverse action on soft animal matter (fresh hide)

Two active zones identified, the left and the right edge. Poorly developed but continuous rounding on the left edge, equally developed over both faces; continuous but marginal polish, bright, with tight to open linkage and irregular or sometimes domed (spots near the edge) microtopography and striations parallel to the edge, as well as some perpendicular ones, thin and superficial. The right edge also has a poorly developed rounding, sometimes equally developed over both faces; a discontinuous and marginal polish, with tight to open linkage and irregular or irregular-undulating microtopography, and many striations, short, thin and superficial, perpendicular to the edge. Characteristics of the polish similar on both faces, which is expected for these two materials, soft wood and fresh hide. The working motion, however, was clearly differentiated.

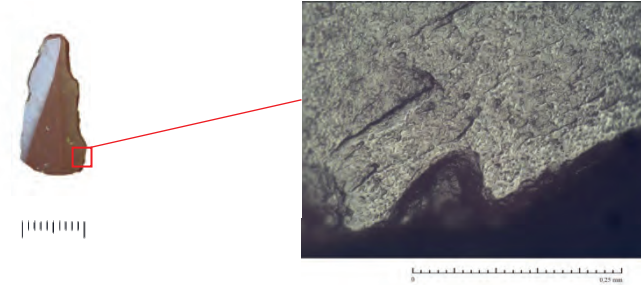
*PM0391: Transverse action on soft animal matter (dry hide)*

The right edge is the active zone. It bears no rounding/edge blunting but a discontinuous and marginal polish, bright, with tight or semi-tight linkage and irregular microtopography. Striations rare, short, thin and superficial, perpendicular to the edge.

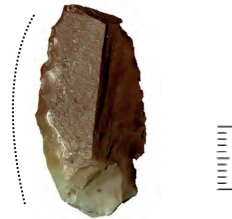
*PM0397: Without use-wear traces*

PM0399: Transverse action on a soft matter (of animal or vegetal origin)

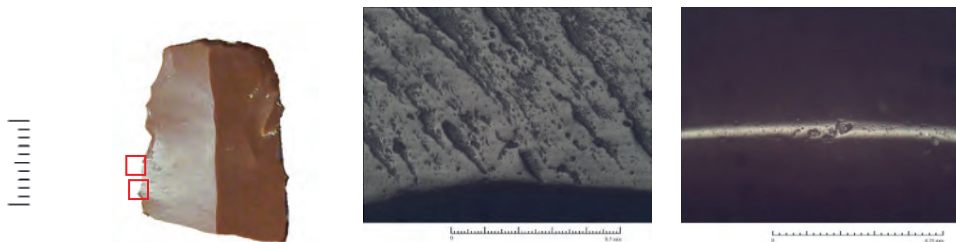
The proximal edge and proximal part of the right edge were used. Medium to well-developed rounding, sometimes more developed over the dorsal face and flattened on some spots; marginal polish, with compact to open linkage and a microtopography ranging from undulating to irregular. Few striations, short and perpendicular to the edge.

*PM0441*: Sickle element

Left edge used to harvest cereals. Medium and well-developed rounding, continuous and equally developed over both faces. A mostly continuous and invasive polish, bright, with compact to tight linkage and undulating microtopography, and many striations, parallel to the edge, some filled-in. According to N. Mazzucco (personal communication), both edges of the tool were afterwards used to work another material. Polish distribution indicates parallel or slightly oblique hafting (see Fig. V.1.19).

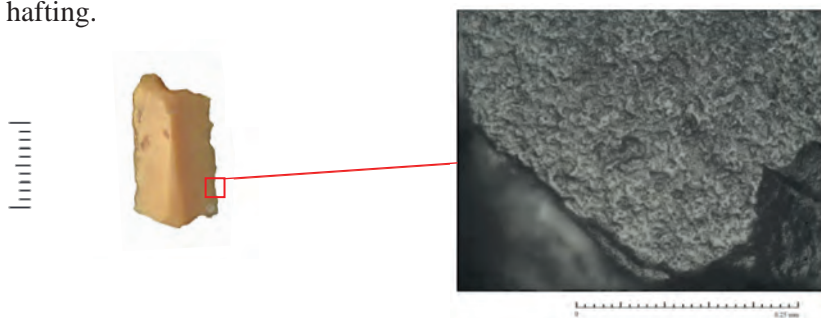
*PM0453*: Sickle element

The left edge constitutes the active zone. It bears a discontinuous and medium-developed rounding, equally developed over both faces; a continuous polish, invasive on the proximal part but marginal on the distal one, bright, with compact to open linkage and undulating microtopography; many striations on the ventral face, thin and large ones, parallel to the edge, as well as filled-in and comet-shaped striations. Distribution of the polish indicating a parallel or slightly oblique hafting (see Fig. V.1.19).

*PM0469*: Without use-wear traces

PM0489: Bidirectional longitudinal action on wood

The right edge is the active zone. It bears a poorly developed and discontinuous rounding, equally developed over both faces, small microflakes oblique to the edge and a poorly developed and discontinuous crushing of the edge. Polish discontinuous and marginal, with tight to open linkage and undulating microtopography, limited to the higher spots. Striations rare and short, parallel or oblique to the edge. The left edge shows well-developed though discontinuous rounding along with residues on both faces, present even far from the edge on the dorsal face, probably related to hafting.

*PM0490: Without interpretation*

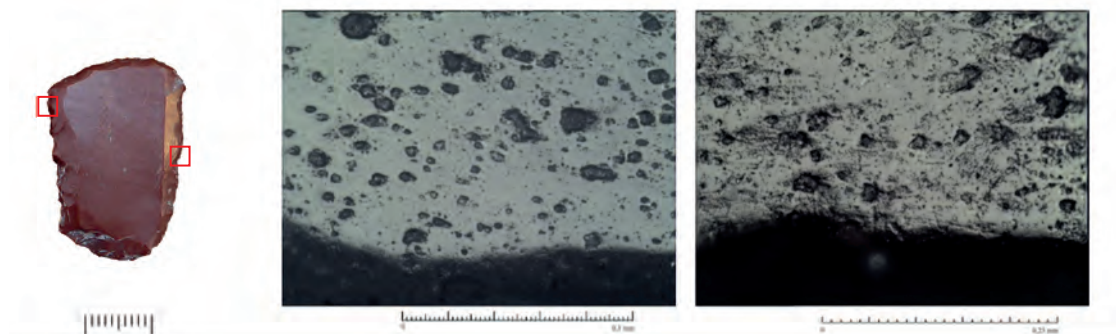
Discontinuous polish, poorly developed, with tight to open linkage and irregular or undulating-irregular microtopography. A few striations, some parallel and others perpendicular to the edge, might also be present.

*PM0495: Exhausted sickle element*

The right edge constitutes the active zone. It bears a well-developed but localised and discontinuous rounding, equally developed over both faces. A discontinuous polish, very well-developed on the mesial part, invasive on the mesial and proximal parts, but marginal on the distal part, bright, with compact to open linkage and undulating microtopography. Some striations parallel to the edge. The tool has been resharpened several times; its original width cannot be estimated, and it was finally resharpened before being abandoned – the fresh retouch flakes on the dorsal face do not bear traces of use. Finally, the left edge bears traces of use, according to N. Mazzucco (personal communication), possibly pointing to hide working.

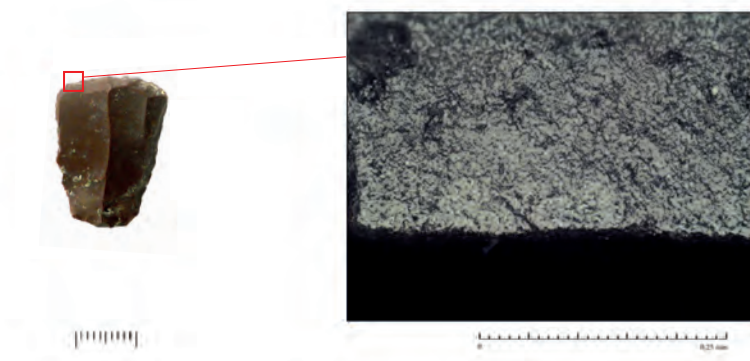
*PM0502: Without use-wear traces**PM0503: Sickle element*

The right and left edges were the active zones, both showing a well-developed rounding, very localised on the right edge and continuous on the left. Microscopically, they show typical traces of cereal harvest: a continuous and mostly invasive polish, bright, with compact to open linkage and undulating microtopography, and many striations, parallel to the edge or slightly oblique, as well as filled-in, dotted and comet-shaped striations. The right edge might have been the first to be used, it was resharpened, possibly several times, and abandoned after the last retouch, then hafted so that the left edge would be used in turn, resharpened, maybe several times, and abandoned later after use. This could explain the more abraded and striated right edge, hafted after use (see photo). According to N. Mazzucco (personal communication), both edges were also used on a different material after having served as sickle elements. Finally, he noticed traces of use on the scraper-shaped edge, corresponding to traces of hide working.



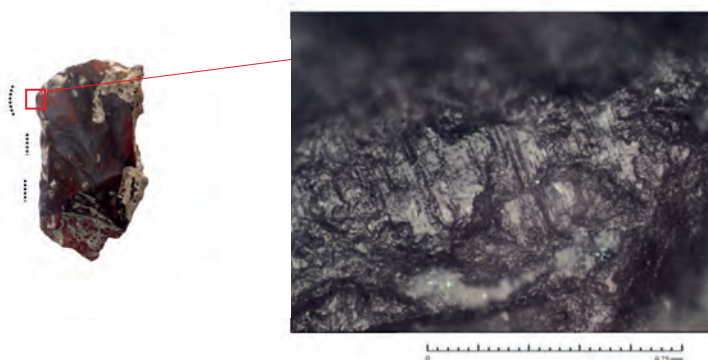
PM0514: Transverse action on dry hide

End-scraper bearing use-wear traces on the scraper-shaped edge. Shows medium to well-developed rounding, more developed over the dorsal face, and some microflakes, mostly perpendicular to the edge and with step section. Polish continuous but marginal on the ventral face, discontinuous but invasive on the dorsal one, quite bright, with tight to open linkage and irregular or undulating-irregular microtopography. Striations short, thin and superficial, perpendicular to the edge. Rounding pointing to scraping with a high angle.



PM0523: Transverse action on mineral matter

The side-scraper, and secondarily the rest of the left edge, are the active zones. The side scraper shows a well-developed but localised rounding, flattened, more developed over the ventral face; another two spots of medium and well-developed rounding on the mesial and proximal parts of the edge. Discontinuous polish, bright, with compact and tight linkage and smooth microtopography, with clear limits, covering the high spots. Many striations, oblique to the edge, long and mostly superficial and smooth-bottomed. Micro-traces mostly developed on the side scraper, but also some spots of functional striated polish along the edge, associated with the rounding. Traces typical of hard mineral matter, but the material could not be determined more precisely.

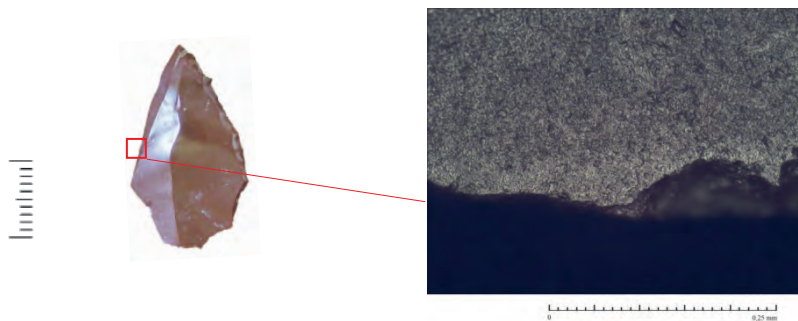


PM0530: Sickle element

Small blade fragment bearing wear traces on the left edge. Well-developed and continuous rounding, equally developed over both faces, and several microflakes, mostly oblique with two directions; continuous and invasive polish, bright, with compact to open linkage and undulating microtopography; many striations, parallel to the edge, some of them filled-in. The active edge was resharpened and reused, but not exhausted – the retouch flakes are not covered with wear traces.

*PM0541: Without use-wear traces**PM0556: Transverse action on soft animal material (fresh or remoistened hide) with a high angle*

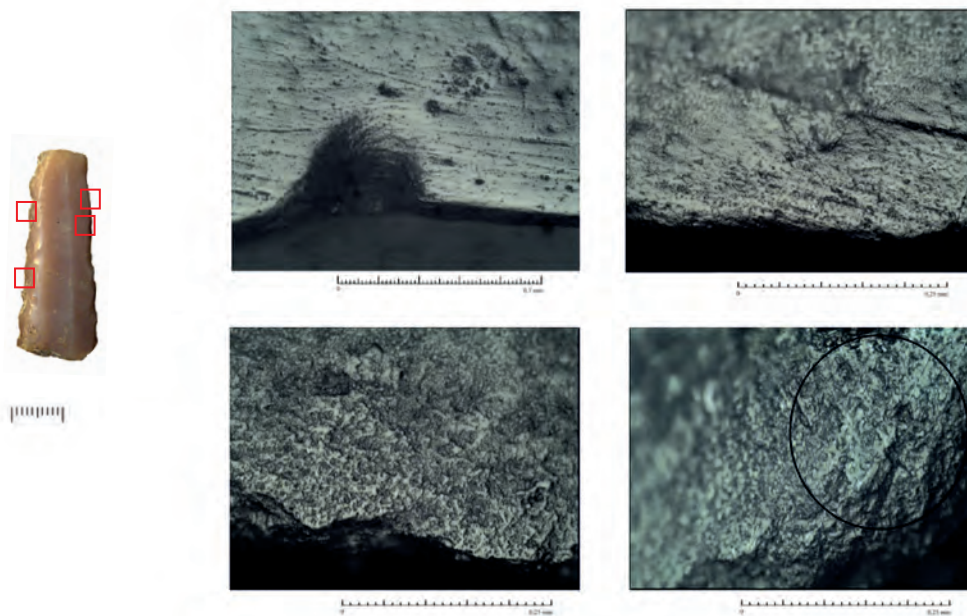
Traces of use on the unretouched left edge of the tool. Poorly developed and discontinuous rounding, equally developed on both faces, and some small microflakes, mostly perpendicular to the edge; discontinuous and marginal polish, bright, with a tight to open linkage and irregular microtopography. Striations are rare, short and perpendicular to the edge. The ventral face seems to be the contact face, according to the development of the traces (polish and striations).

*PM0622: Without use-wear traces*

PM0623: Left edge: Exhausted sickle element, Right edge-dorsal face: very localised oblique action on hard bone material, Right edge-ventral face: transverse action on semi-hard/hard vegetal material

Three active zones identified: the left edge and two active zones on the dorsal and ventral face of the right edge. Left edge: typical traces of cereal harvest, such as a medium-developed and continuous rounding on the mesial and proximal parts, equally developed on both sides; a continuous and invasive bright polish with a compact to semi-tight linkage and an undulating microtopography; many striations, parallel to the edge, as well as dotted and filled-in striations. Several spots of abraded polish with perpendicular and random striations, due to contact with the soil. Edge probably rejuvenated several times in order to be reused, until exhaustion. On the right edge, some spots of flat striated polish and residues, maybe linked to hafting. Right edge, dorsal face: very few and localised traces of hard osseous material – a spot of bright polish, with a compact to tight linkage and smooth or smooth-undulating microtopography and many long, large and deep striations, oblique to the edge, roughbottomed and smooth-bottomed alike, noticed far from the edge. Right edge, ventral face: no rounding, but a discontinuous invasive polish, bright with a tight to open linkage and undulating microtopography, only covering the high spots, and a few striations perpendicular to the edge. Traces probably pointing to a

semi-hard or hard vegetal matter. Distal fracture bearing spots of a red residue that have not been further analysed.



PM0652: Sickle element

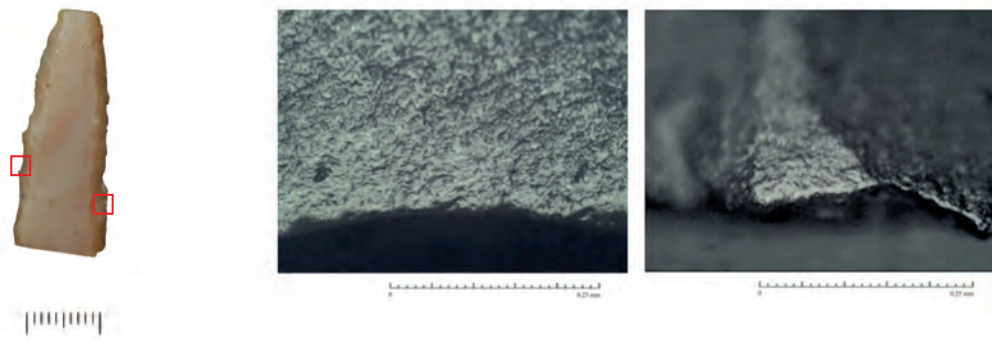
The left edge is the active zone. Traces characteristic of cereal harvesting: macroscopically a poorly developed, discontinuous rounding, equally developed over both faces; microscopically a discontinuous but invasive polish, with compact to open linkage and undulating microtopography, and many striations, long and short, parallel to the edge, mostly superficial, also filled-in and dotted striations. Polish becoming abraded on the proximal part of the flake, possibly indicating contact with abrasive matter, like the soil.



PM0686: Transverse action on semi-hard/hard material (dry hide) with a high angle

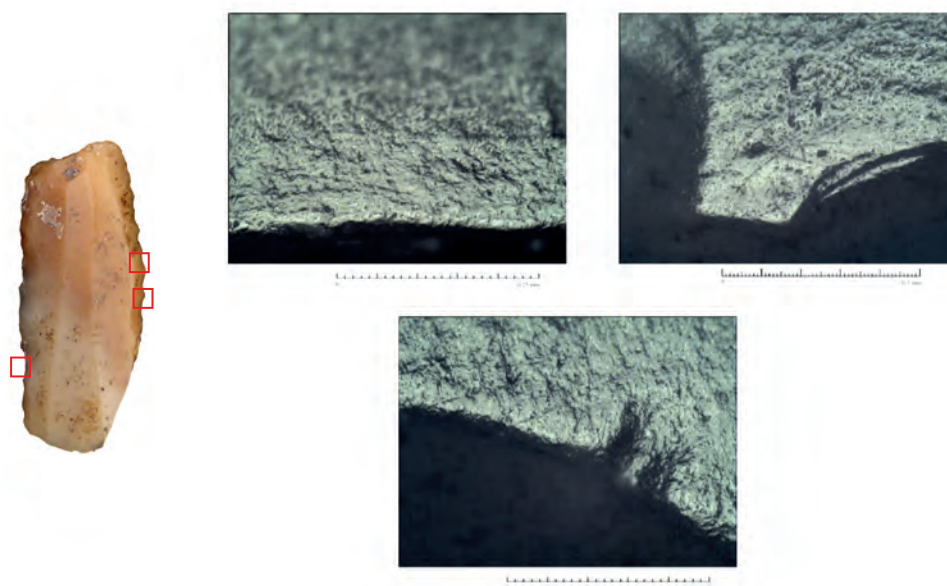
Three active zones identified on this honey flint blade: the right, left and distal edges. Traces similar on all three active zones. The right and left edges do not exhibit rounding (the left edge exhibits edge crushing), but show discontinuous polish, in some parts invasive and in others marginal, dull, with a tight to open linkage and irregular microtopography, and many striations, long and short, perpendicular to the edge, thin and large, superficial or deep. The distal edge shows a poorly developed to medium continuous rounding, more developed over the ventral face, microscopic polish, continuous and invasive, bearing the same characteristics as on the other edges, and

many striations, perpendicular and oblique to the edge. After use, rejuvenation of the right and left edges, which explains the limited striated polish on the dorsal face (very limited on the right edge), mostly evident on the ventral face.



PM0696: Right edge: sickle element, Right distal part: transverse action on semi-hard abrasive material (dry hide), with a high angle ($\sim 75^\circ$), Distal edge: transverse action on semi-hard abrasive material (dry hide), with a high angle ($\sim 75^\circ$), Left edge: first used as a sickle element then transverse action on semi-hard abrasive material (dry hide), with a high angle ($\sim 75^\circ$)

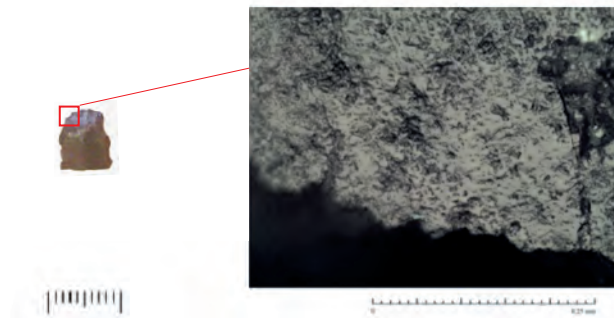
Three active zones were identified on this honey flint blade: the right, left and distal edges. Right edge: the proximal side shows medium to well-developed rounding, continuous and equally developed on both sides; continuous and invasive polish, with compact to semi-tight linkage and undulating microtopography; and many striations, long and parallel to the edge, as well as dotted striations. These are typical traces of cereal harvesting tools. On the dorsal face these traces extend towards the distal part of the tool; on the ventral face the distal part presents a set of different traces covering (and sometimes mixed with) the typical sickle traces. Right distal and left edges: medium to well-developed rounding, equally developed on both sides; continuous and quite invasive polish, dull and abraded, with tight to open linkage and irregular microtopography; and several striations, short and long ones, thin or large, perpendicular to the edge. The left edge also shows microscopic cereal gloss mixed and sometimes covered by the abraded irregular polish described above. Distal edge: traces similar to the left edge; no macroscopic traces indicating an active zone, but microscopically there is continuous and marginal dull/abraded polish, with



tight to open linkage and irregular microtopography, and several striations, short and long ones, perpendicular to the edge. We suggest that the right and left edges were first used for cereal harvest; then the blade was used to work dry hide with the right distal, left and distal edges, and the extent of the polish (slightly invasive) indicates scraping with a high angle. The proximal end of the blade was probably broken after the first task, since the striated undulating polish is interrupted. The left edge was resharpened after the first use, which explains why the harvest traces are scarce, and mostly preserved on the ventral face; the right edge was also resharpened, maybe more intensively on its distal half.

PM0723: Transverse action on soft plant material

The active zone is very localised – a part of the scraper-like edge. Well-developed but discontinuous rounding, more developed over the dorsal face; continuous and invasive polish, bright, with compact to semi-tight linkage and undulating microtopography; striations oblique to the cutting edge. The traces are very localised, perhaps pointing to microtechnical work.



PM0728: Sickle element

The right edge is the active zone. Continuous, medium to well-developed rounding that develops equally on both faces, and macroscopic gloss as first indicators of use. Microscopically, there is invasive though discontinuous polish, bright, with compact and tight linkage and undulating microtopography, and many striations, long or short, parallel or oblique to the edge. Tool hafted obliquely; left edge rounded towards the distal part, which, combined with the abrupt retouch, confirms that this edge was hafted (see Fig. V.1.19). Active edge possibly resharpened several times, but polish filling or entering most of the retouch flakes is present, thus the tool was reused after the last retouch. According to N. Mazucco (personal communication), the element is functionally complete, with the distal edge bearing wear traces and the proximal one having been hafted.



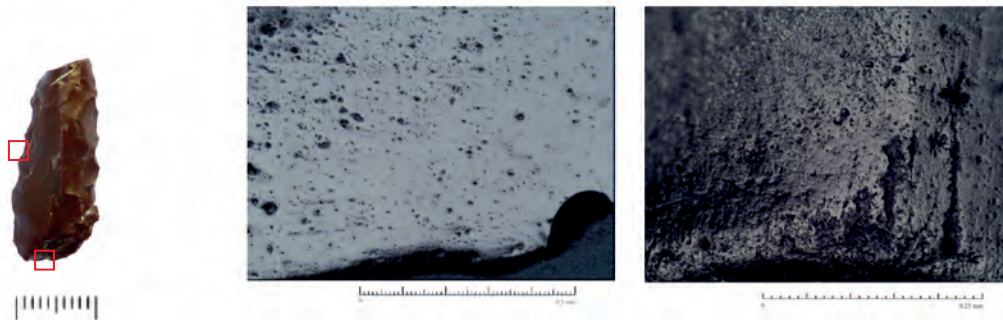
PM0742: Transverse action on hide/leather with a high angle

The active zone is the scraper-shaped edge. It shows a strong, continuous rounding, flattened in certain spots, sometimes more developed over the ventral face; a discontinuous, marginal polish, dull, with irregular microtopography, covering only the higher spots; rare striations, limited on the edge, short and thin, and perpendicular to the edge. The marginal polish and striations limited on the edge point to an activity performed with a high angle. The characteristics of the rounding imply that the ventral was the contact face. Lateral sides possibly retouched to fit the haft; a spot of striated polish on the dorsal face may be connected to hafting.

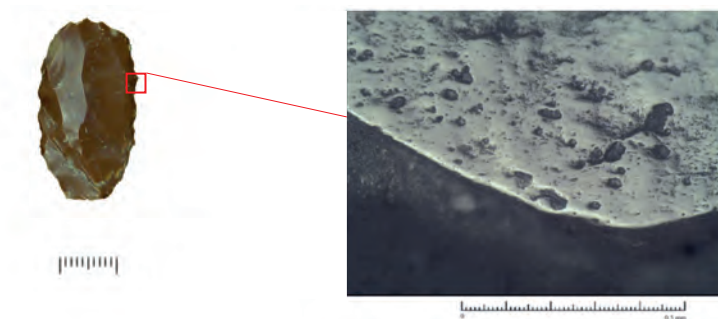


PM0743: Sickle element

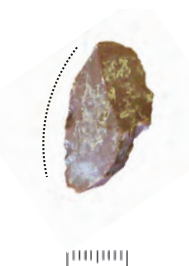
The left edge is the active zone. Shows a well-developed rounding, continuous and equally developed on both faces. Polish continuous on the ventral face, discontinuous on the dorsal face, invasive, bright, with compact to semi-tight linkage, and undulating or smooth-undulating microtopography. Many striations, long and shorter ones, parallel to the edge, as well as dotted and filled-in striations. An abraded cereal polish, heavily striated, was also observed on the proximal side, due to contact with abrasive matter. Active edge rejuvenated (maybe several times) on the dorsal side – the discontinuous polish shows that it has been reused briefly after the last retouch. The hafted right edge exhibits edge crushing, a few rounded spots and marginal and discontinuous polish with irregular microtopography in the mesial part of the ventral face. Tool hafted obliquely (see Fig. V.1.19).

*PM0751*: Sickle element

The right edge is the active zone. No rounding, due to the resharping of the edge on the dorsal face, which also removed the macroscopic gloss and the polish from this side. Ventral face presenting traces (polish, striations) typical of sickle elements (Id. PM0743). Element functionally complete with few polished spots on the right part of the distal edge. The absence of new wear traces on the dorsal face implies that the insert was not reused after having been resharpended.

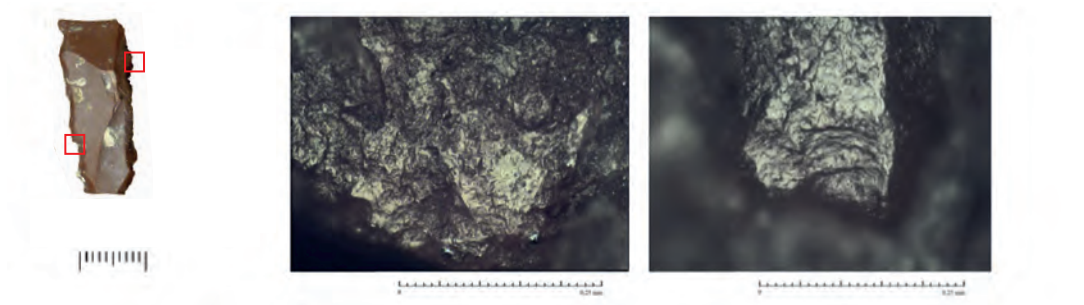
*PM0770*: Sickle element

The active zone is the left edge of the tool. It exhibits a well-developed and continuous rounding and macroscopic gloss. Polish discontinuous, invasive in the middle of the active zone, marginal towards the distal and proximal ends, bright, with a compact to open linkage and undulating microtopography. Many long and short striations, parallel and oblique to the edge, as well as dotted striations. The dorsal face was retouched after use, the microflakes being only partly or not at all polished, indicating limited use after having been re-sharpened.

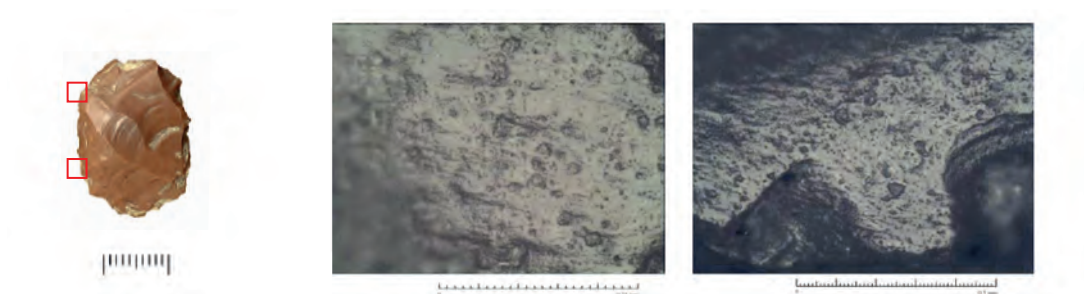


PM0773: Transverse action on semi-hard material (fresh hide)

Two active zones, the left and right edges. They both present similar traces: a medium, discontinuous rounding, that seems to develop equally on both faces on the left edge, while it develops more over the ventral face on the right edge; a discontinuous polish, invasive on the dorsal face, marginal on the ventral face, bright, with a tight to open linkage, and undulating or undulating-irregular microtopography; rare striations, short, oblique or perpendicular to the edge.

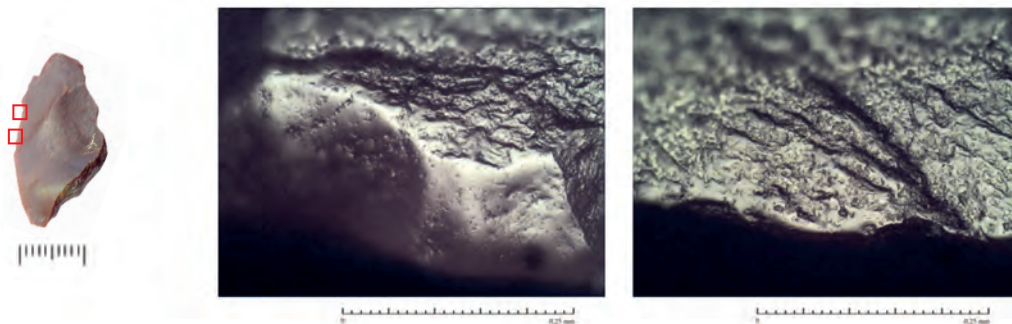
*PM0784*: Without use-wear traces*PM0808*: Sickle element

The active zone is the original distal edge (indicated in the picture). Medium to well-developed rounding, developed equally on both faces. Polish continuous and invasive, with typical characteristics (Id. *PM0743*); a second type of polish present on the dorsal face towards the right edge, irregular and abraded, due to contact with abrasive matter. The two types of polish observed do not correspond to different worked materials – the abraded polish implies contact with soil. Many striations, parallel and oblique to the edge, with characteristics typical of sickle elements. Distribution of wear traces implying that the element was hafted very slightly obliquely (see Fig. V.1.19).



PM0812: Semicircular action on soft plant material (reeds or cereals)

The left edge is the active zone. Shows a medium to well-developed rounding, continuous, present equally on both faces. The polish is continuous on the mesial part of the ventral face, less continuous on the mesial part of the dorsal face, marginal, bright, with compact to semi-tight linkage, undulating microtopography, and only covers the high spots of the microtopography. Many striations, short and rather large, mostly oblique on the edge, often in different directions. Traces pointing to a soft plant material. The distribution of the polish and the striations might indicate work on reeds, though its use as a sickle element cannot be ruled out (suggested by N. Mazzucco, personal communication). The distribution of the wear traces with clear limits imply that the element was hafted obliquely to the haft.

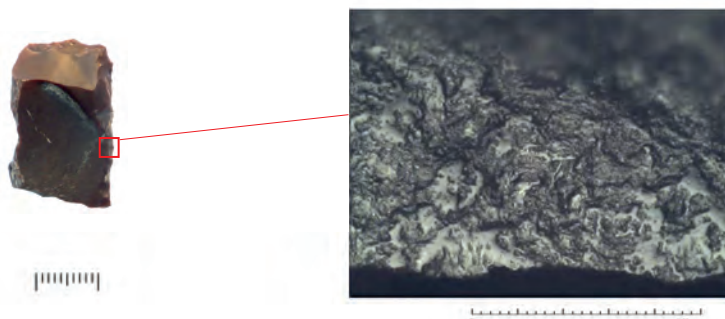
*PM0833*: Sickle element or longitudinal action on other plant material

Both edges of this long blade are active zones, possibly for the same activity. Medium to poorly developed rounding on the left edge, but medium to well-developed on the right one. The polish is discontinuous due to retouch flakes, the initial polish being present far from the edge on the dorsal face, invasive, bright, with compact to open linkage, undulating, undulating-irregular and occasionally irregular microtopography.

Characteristics of the polish not entirely typical for sickle elements, probably due to alterations, not allowing a firm conclusion on the tool's use. Striations are rare, short, thin and superficial, parallel to the edge. Element functionally complete, exhibiting polished spots on the distal edge of the ventral face. The chronology of use of each edge has not been determined. According to the traces, it was probably used for cutting vegetal materials, but we cannot assert that it was used for cutting cereals (observation by L. Papagiannaki and N. Mazzucco).

*PM0836*: Sickle element

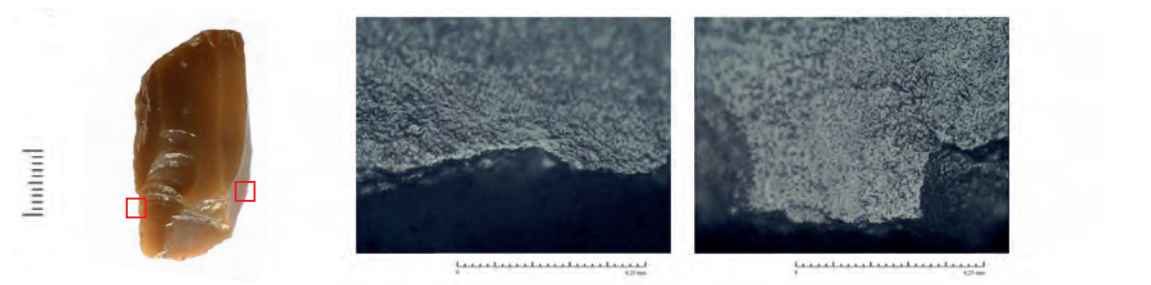
The active zone is the right edge. Poorly-developed rounding on the distal right extremity, continuous and slightly more developed over the ventral face. Discontinuous polish, invasive towards the right extremity, presenting the typical characteristics of sickle elements (Id. PM0743).



Many striations, parallel to the edge, short, thin and superficial, as well as filled-in striations and comet-shaped ones. The truncation on the proximal part probably facilitated the hafting, which may have left few traces, like striated polished spots on the proximal ventral face, implying that the element is functionally complete. Distribution of traces implying that the tool was hafted obliquely (see Fig. V.1.19).

PM0838: Transverse action on hard or semi-hard material (wood)

Both edges of this tool made on honey flint have been active. The right edge does not present rounding, while the left edge shows a medium to well-developed rounding, continuous, more developed over the dorsal face. Marginal polish, discontinuous on the right edge, continuous on the left one, bright, with tight to open linkage, irregular or undulating-irregular microtopography. Many striations, perpendicular or oblique to the edge, short, thin and rather superficial.



PM0840: Without interpretation

The right edge is an active zone, the activity has not been determined. Medium rounding, equally developed over both faces. Microchipping, with isolated small and medium microflakes, oblique or perpendicular to the edge. Discontinuous and marginal polish, bright, with tight or even compact linkage, and undulating-irregular microtopography. Rare striations (or even absent), maybe perpendicular to the edge.



PM0845: Sickle element

The left edge is the active zone. It shows a medium to well-developed rounding, continuous and leaning equally towards both faces. Continuous polish, becoming more and more invasive towards the proximal end, bright, with compact to semi-tight linkage and undulating microtopography; a second, more abraded and irregular polish is present, due to contact with abrasive matter, like soil, towards the proximal edge on the ventral face, also limited towards the distal edge on the dorsal face. Many striations, parallel to the edge, long, thin or large ones, some superficial and others deep, as well as several filled-in striations. Polish extending over the proximal end, implying that the element is functionally complete.



PM0848: Without interpretation

The point is the active zone. It may show a poorly developed but continuous rounding, small microflakes, aligned or superimposed, discontinuous and marginal polish, bright, with tight to open linkage, and irregular or occasionally domed (on the high spots) microtopography. No striations were seen.

PM0852: Transverse action on semi-hard or hard material – without further interpretation

The left edge is the active zone. It shows a medium to well-developed rounding, discontinuous and slightly more developed over the ventral face; small and isolated microflakes, oblique to the edge; discontinuous and marginal polish, bright, with tight to open linkage and irregular microtopography; rare striations, perpendicular to the edge, small, thin and superficial. The tool must have been used for a transverse action with a very high angle. It may not be functionally complete, but no wear traces clarifying this were detected.

*PM0867: Left edge: sickle element, Distal edge: transverse action on dry hide*

Two active zones are noted, the left edge and the distal edge, on different materials. Left edge: well-developed, continuous rounding, equal on both faces, a rather continuous polish, more invasive towards the distal end, typical of cereal harvest (Id. PM0743), and many striations parallel to the edge. Distribution of traces implying that it was inserted slightly obliquely into the haft (see Fig. V.1.19). Distal edge: shows a well-developed rounding, flattened on some parts, a continuous and marginal polish, bright, with compact to open linkage and undulating-irregular or irregular microtopography, and many short striations, perpendicular to the edge, some are rough-bottomed and others are smooth-bottomed. These traces coexist and interact with the traces of harvest.



V.1.10. Appendix 2: The Flaked Stone Assemblages – A Brief Note on Agricultural Tools

Niccolò Mazzucco

Complementarily to the study carried out by Catherine Perlès and Lygeri Papagiannaki, a use-wear analysis was carried out on the flaked stone tools from PMZ, mainly focusing on the stone tools related to agricultural tasks (i.e. cereal harvesting and/or processing). This study was carried out in the framework of a larger project focusing on the spread and change of the harvesting technologies in the Mediterranean Basin, a synthesis of which has recently been published.⁴³² PMZ took on a main role in the project, allowing us to acquire a detailed image of the change in the agricultural tools in the Thessalian Plain between the Middle and the Late Neolithic. In this brief note, a synthesis of the main results will be given, trying to complete the information already provided by the above-mentioned colleagues.

All flaked stone materials from the PMZ sequence have been observed via stereoscopy in order to detect possible tools used for plant harvesting, collecting or processing. This includes all Middle–Late Neolithic tools, but also a few pieces from the Early and Middle Helladic periods. A detailed study of the use-wear patterns was undertaken using an Olympus BH2 metallographic microscope, following a methodology close to that applied by Perlès and Papagiannaki.

An Overview of the Main Results

30 glossy tools from Middle and Middle/Late Neolithic phases have been detected and 15 glossy tools from later periods (two of which from survey collections). Of the 30 Neolithic glossy tools, 25 can be ascribed to the class of sickle inserts, while the remaining elements show different use-wear patterns. Three of them show marginal or insufficiently preserved use-wear traces, while the other two present much more abrasive wear. The main aspects that can be remarked upon are:

- The presence of two different types of sickle inserts. The first sickle type is characterised by flakes or blade fragments hafted diagonally into some type of wooden or antler haft, forming a coarsely serrated cutting edge. Despite the fact that the use of both flakes and blades may appear strange, given their variable morphology and dimensions, it is quite common in Neolithic assemblages from the Aegean and the southern Balkans.⁴³³ The other type of insert is made on wider and longer blades, often produced through more skilled flaking methods (i.e. different modes of pressure flaking), which show a gloss distributed along the entire used edge, with a parallel distribution. Parallel inserts are present from at least Lithic Phase II (BPh IV). All of them are broken or reused, and it is therefore impossible to assess their original size and morphology. However, they surely represent a different morphotype compared to diagonally glossed inserts. Another aspect to remark upon is that both morphotypes coexist in the same layers, suggesting that different types of harvesting tools were in use at the same time, as already observed for Achilleion (Trench D) and Franchthi.
- The possible presence of threshing inserts. The two above-mentioned inserts showing abrasive use-wear traces (Fig. V.1.20) may have been used as inserts in a threshing board. The type of macro- and micro-wear traces, such as the dulled edge and the presence of striations all over the used margin, partially resemble experimental threshing inserts. At the same time, they differ from experimental inserts, because of the presence of smooth spots of cereal polish. The mixed nature of this type of trace has already been discussed by Patricia C. Anderson.⁴³⁴

⁴³² Mazzucco et al. 2020.

⁴³³ Gurova 2014.

⁴³⁴ Anderson 1992; Anderson – Whittaker 2014.

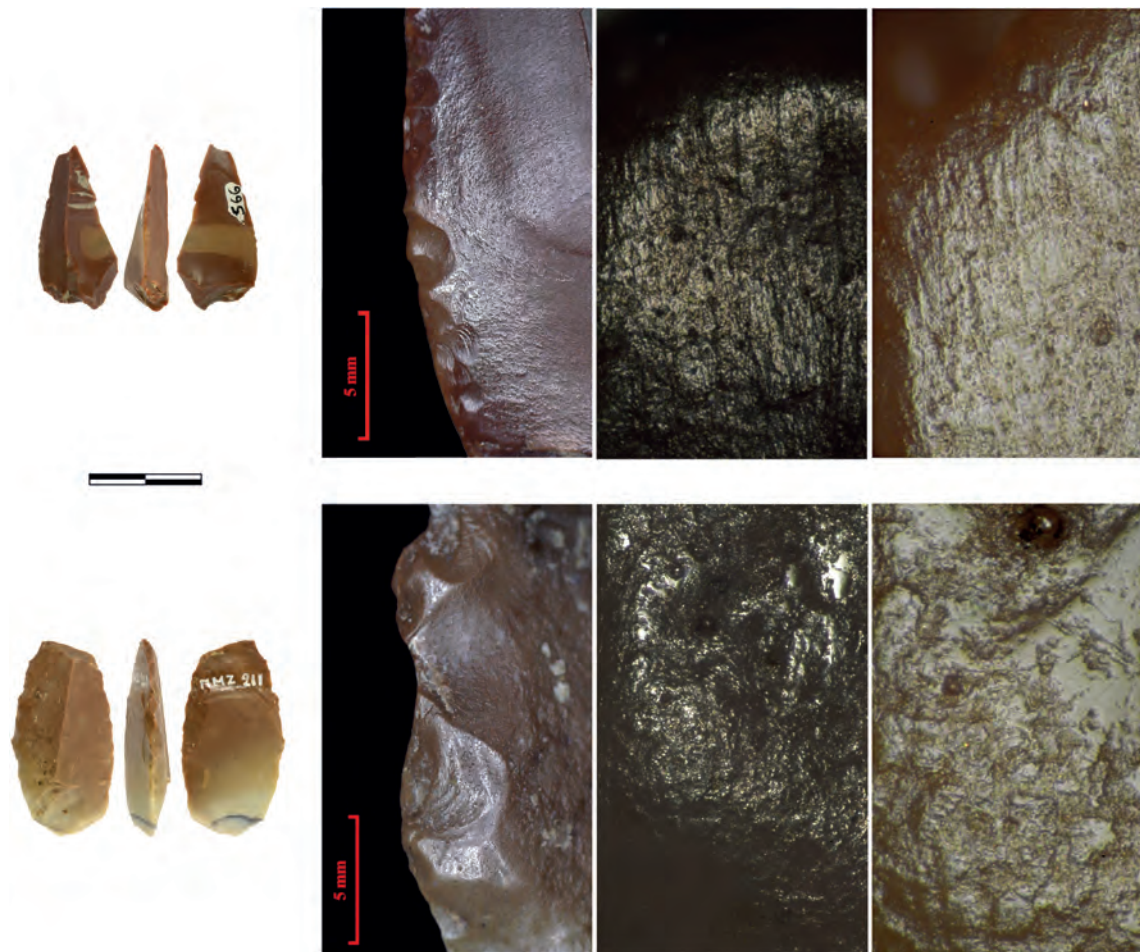


Fig. V.1.20 Two possible threshing inserts from PMZ. On the top PM0845, below PM0441. Note the dulled edge and the use-wear pattern characterised by abrasions and striations (N. Mazzucco)

- A new experimental study is currently ongoing, including confocal microscopy in order to quantitatively discern use wear from cereal harvesting from that produced by cereal threshing. The presence of such innovation may be associated with the increased amount of grain to be processed, possibly in relation to the need for massive quantities of chopped stems (i.e. architecture, fodder, etc.). This data would fit with the presence of training pathologies in cattle, as at least demonstrated for the site of Knossos, from the Early to the Late Neolithic phases (7000–6000 BP).⁴³⁵ In addition, the use of fodder for feeding sheep and goats has recently been demonstrated for the Middle–Late Neolithic site of Kouphovouno.⁴³⁶

⁴³⁵ Isaakidou 2008.

⁴³⁶ Vaiglova et al. 2020.

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