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# Harvesting tools during the Pre-Pottery Neolithic in Cyprus

Laurence Astruc, François Briois

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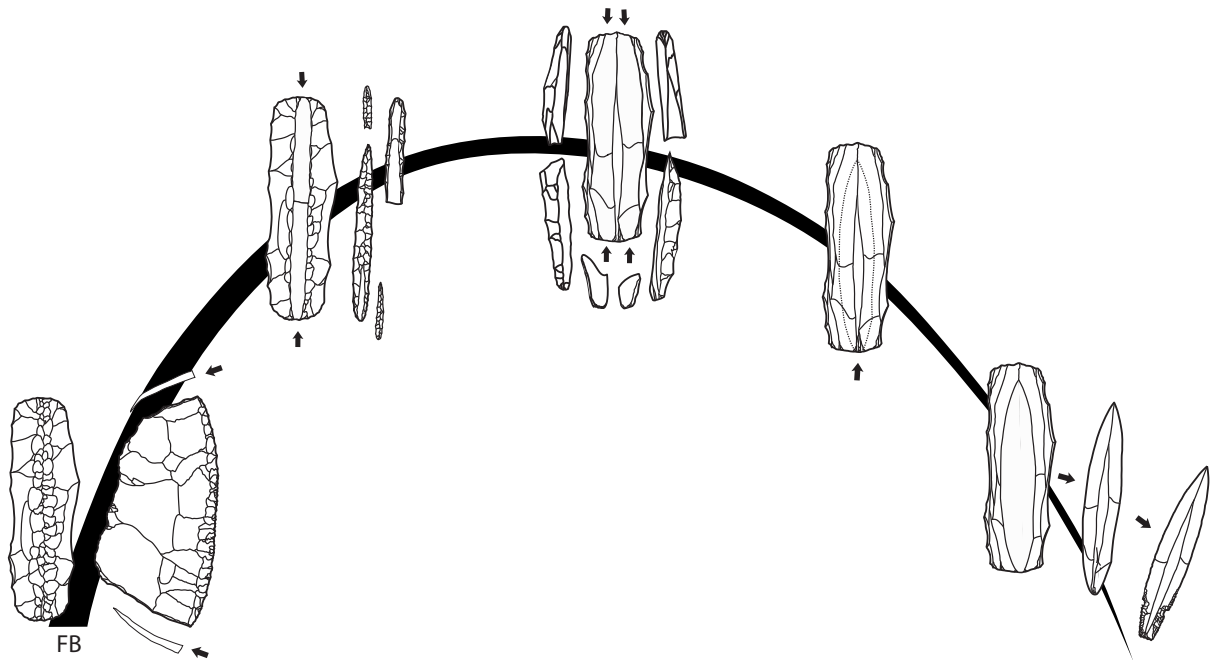
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# NEAR EASTERN LITHIC TECHNOLOGIES ON THE MOVE. INTERACTIONS AND CONTEXTS IN NEOLITHIC TRADITIONS

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

edited by

Laurence Astruc, Carole McCartney, François Briois  
and Vasiliki Kassianidou



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

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



# Contents

Table of contents	v
Editors' preface	ix
List of contributors	xi
<b>Cyprus focus</b>	
1. Jean-Denis Vigne, François Briois and Jean Guilaine <i>Klimonas</i> , the oldest Pre-Pottery Neolithic village in Cyprus	3
2. Alain Le Brun Khirokitia on the move: a Late Aceramic Neolithic site in Cyprus	13
3. Jean-Denis Vigne, François Briois and Jean Guilaine To what extent has insularity played a role in the Cyprus Neolithic transition?	19
4. Alan H. Simmons No chipped stone is an island: a reimagining of the role of early Cyprus within the Neolithic world	31
5. François Briois and Laurence Astruc Introduction, adaptation and development of the first Pre-Pottery Neolithic communities in Cyprus: the contribution of lithic industries in the Amathus area	45
6. Laurence Astruc and François Briois Harvesting tools during the Pre-Pottery Neolithic in Cyprus	53
7. Carole McCartney and Giusi Sorrentino <i>Ayia Varvara Asprokremmos</i> —a preliminary analysis of stone tools used in pigment processing and tanning with ochre	63
8. Jérôme Robitaille and Vasiliki G. Koutrafourì 'Message in a wall': macrolithic tools within PPNA constructions at <i>Klimonas</i> in the light of ethnoarchaeological evidence	79
9. Jérôme Robitaille and François Briois Pebbles used as retouchers/compressors during the PPNA at Ayios Tychonas <i>Klimonas</i> , Cyprus	95
10. Renée Corona Kolvet <i>Ais Giorkis</i> : reflections on an upland Cypro-PPNB ground stone assemblage	103
11. Shaun Murphy, Peter Bikoulis and Sarah T. Stewart Finding the way: predictive modelling and the Early Neolithic in the eastern Troodos foothills of Cyprus	111
12. Theodora Moutsiou Raw material circulation and the Early Holocene social landscape of Cyprus	119

### **Lithics in social and economic contexts**

- |     |  |     |
|-----|--|-----|
| 13. | Dana Shaham and Leore Grosman<br>Engraved stones from Nahal Ein Gev II—portraying a local style, forming cultural links  | 133 |
| 14. | Michal Birkenfeld, Lena Brailovsky-Rokser and Ariel Vered<br>'Ein Dishna, a new PPNA site in the Jordan Rift Valley, Israel                                    | 143 |
| 15. | Sam Smith, Bill Finlayson and Steven Mithen<br>The end of the PPNA in southern Jordan: insights from a preliminary analysis of chipped stone from WF16         | 159 |
| 16. | Dörte Rokitta-Krumnow<br>The chipped stone industry of Mushash 163: a PPNA/EPPNB site in the Badia/northeastern Jordan   | 173 |
| 17. | Sumio Fujii, Takuro Adachi and Kazuyoshi Nagaya<br>Harrat Juhayra 202: an Early PPNB flint assemblage in the Jafr Basin, southern Jordan                       | 185 |
| 18. | Cristoph Purschwitz<br>The lithological landscape of the Greater Petra Region, Southern Levant. Availability of chert and other abiotic resources              | 199 |
| 19. | Cristoph Purschwitz<br>Socio-economic changes in flint production and consumption among the PPNB lithic economies of the Greater Petra Region, Southern Levant | 213 |
| 20. | Nurcan Kayacan and Çiler Algül<br>A knapping area in an 8th millennium BC building at Aşıklı Höyük, east-central Anatolia                                      | 227 |
| 21. | Semra Balcı<br>The obsidian industry of Pre-Pottery Neolithic levels at Tepecik-Çiftlik, central Anatolia  | 235 |

### **Technology and specialisation**

- |     |  |     |
|-----|--|-----|
| 22. | Osamu Maeda and Cinzia Pappi<br>Bladelet production by pressure-flaking at the Proto-Neolithic site of Satu Qala in Iraqi Kurdistan                          | 249 |
| 23. | Ferran Borrell, Juan José Ibáñez, Juan Muñiz and Luís Teira<br>The PPNB chipped stone industries from Kharaysin (Zarqa Valley, Jordan): preliminary insights | 257 |
| 24. | Frédéric Abbès<br>Production de lamelles et de microlithes dans le Bal'as : un nouveau faciès du PPNA en Syrie   | 267 |
| 25. | Christoph Purschwitz<br>A MPPNB bidirectional blade workshop at Shkârat Msaied, Southern Levant  | 277 |
| 26. | Maya Oron, Ron Lavi and Joel Roskin<br>Mitzpe Ramon: a flint quarry and blade production workshop from late PPN to early PN in the Negev, Israel             | 287 |

### **Innovative stone technologies in the development of agricultural practices**

- |     |   |     |
|-----|---|-----|
| 27. | Itay Abadi and Leore Grosman<br>Sickle blade technology in the Late Natufian of the Southern Levant | 295 |
|-----|---|-----|

28.	Fiona Pichon	
	Utilisation des outils en silex pour l'exploitation alimentaire et artisanale des végétaux à Dja'de el-Mughara durant le PPNB ancien (Syrie, 9ème millénaire)	305
29.	Lena Brailovsky-Rokser and A. Nigel Goring-Morris	
	Pre-Pottery Neolithic B sickle blades in regional context: evidence from Galilee	323
<b>Continuities and discontinuities</b>		
30.	Iris Groman-Yaroslavski	
	The emergence of a blade-oriented industry during the PPNA—technology embedded in a Natufian concept	343
31.	Tobias Richter and Maria Mawla	
	Continuity and discontinuity in the Late Epipalaeolithic (Natufian): the lithic industry from Shubayqa 1	359
32.	Theresa Barket	
	Flaked-stone assemblage variation during the Late Pottery Neolithic B at 'Ain Ghazal: what could it mean?	369
33.	Ferran Borrell, Fanny Bocquentin, Juan Francisco Gibaja and Hamoudi Khalaily	
	Defining the Final PPNB/PPNC in the Southern Levant: insights from the chipped stone industries of Beisamoun	381
34.	Stuart Campbell and Elizabeth Healey	
	The obsidian from Umm Dabaghiyah, a Proto-Hassuna site in northern Mesopotamia	401
35.	Danny Rosenberg, Iris Groman-Yaroslavski, Rivka Chasan and Ron Shimelmitz	
	Additional thoughts on the production of Chalcolithic perforated flint tools: a test case from Tel Turmus, Hula Valley, Israel	415
<b>Interactions and diffusion beyond the PPN</b>		
36.	Nigel Goring-Morris and Anna Belfer-Cohen	
	Packaging the Levantine Epipalaeolithic: a view from the Negev and Sinai	429
37.	Makoto Arimura	
	Some reflections on the obsidian 'Kmlu tools' of the Early Holocene culture in Armenia	449
38.	Bastien Varoutsikos and Arthur Petrosyan	
	Blade-making in Aknashen, Armenia, and the origins of the Neolithic in the southern Caucasus (7th–6th millennium cal. BC)	461
39.	Yoshihiro Nishiaki and Farhad Guliyev	
	Neolithic lithic industries of the southern Caucasus: Göytepe and Hacı Elamxanlı Tepe, west Azerbaijan (early 6th millennium cal. BC)	471
40.	Bogdana Milić	
	An addendum to the PPNB interaction sphere. The lithic package from 7th millennium BC Çukuriçi Höyük in western Anatolia	485
41.	Denis Guilbeau and Burcin Erdoğu	
	Chipped stones from the earliest Neolithic occupation in the northern Aegean (Uğurlu, Gökçeada Island, ca 6800–6600 cal. BC)	503
42.	Denis Guilbeau and Catherine Perlès	
	Please help us find the origins of Greek and Italian Early Neolithic lever pressure-flaking!	511



# Harvesting tools during the Pre-Pottery Neolithic in Cyprus

Laurence Astruc and François Briois

## Abstract

Agricultural practices are central to our understanding of the Neolithisation process in the Fertile Crescent. They are visible in the archaeological record through the study of both botanical remains and lithic tools. Indeed, these categories of remains provide data specifically on cereal management from collection to post-harvest processing. In this chapter, we present the harvesting tools used in Cyprus during the Pre-Pottery Neolithic from the end of the 10th to the middle of the 6th millennium cal. BC. The periods studied are known as the Cypriot PPNA, the Cypriot PPNB and the Culture of Khirokitia. Data were collected from three sites excavated in the Limassol and Larnaca districts: Ayios Tychonas *Klimonas* (hereafter *Klimonas*), Parrekklissha *Shillourokambos* (hereafter *Shillourokambos*) and Khirokitia *Vouni* (hereafter *Khirokitia*).

The inhabitants of the island imported plant taxa that were not native to Cyprus, along with the techniques and knowledge to grow, harvest and process the crops. Sickle elements were used to harvest cereals from the beginning of the PPNA sequence at *Klimonas*. Based on techno-typological and use-wear analyses, we define the morphology of the sickles, which varies through time. These analyses also show the major role played by the cereals in the subsistence strategies of the settlements studied. During each phase of the island's Pre-Pottery Neolithic, the blanks used to produce tools for harvesting cereals were chosen from among the existing lithic production. There is only one exception, with the specialised production of inserts during two phases of the Cypriot PPNB at *Shillourokambos*. As a rule, we can say that sickles reflect the lithic assemblage as a whole. In addition, we argue that the investment in the production of sickles decreases through time. This is for us the result of an overall technological simplification of the lithic industries. During this time span, botanists suggest that agriculture was fully developed from a probable 'pre-domestication' stage to a cereal-based agriculture. Our data show in which way a truly insular specificity comes to light in Cyprus.

## Introduction

The evolution of subsistence strategies is a key element for understanding the phenomenon of Neolithisation in the Near East. In this regard, the populating of Cyprus offers new insights into this process. Indeed, except for the wild barley which is native to the island, the faunal and plant species exploited all had to be imported from the mainland by human populations (Vigne *et al.* 2013). For instance, the groups of hunter-gatherer/fishermen of Akrotiri *Aetokremnos* (Simmons 1988 *et al.* 1999; Vigne *et al.* 2009), who arrived around 10,500 cal. BC, reached this new territory bringing wild boars, which they then hunted. The same behaviour is also recognised with the hunter-farmers of *Klimonas* after a hiatus of nearly one and a half millennia. It is during this period, the PPNA, that agriculture started on Cyprus. On the basis of the excavations conducted in the Limassol district at *Klimonas* and *Shillourokambos*, and, in the Larnaca district at the site of *Khirokitia*, we follow the development of subsistence patterns from the end of the 10th to the middle of the 6th millennium cal. BC. The changes in the lithic industries over this sequence are also documented. The knapped lithic industry and heavy ground-stone tools, such as querns, grinders and pestles etc., allow us to gather valuable data on agricultural practices from harvesting to the post-harvesting processing of the collected plants. In this chapter, we present an assessment of a class of tools closely related to agricultural practices, namely, sickles employed to harvest cereals. Techno-typological and functional characteristics are described here to obtain a detailed understanding of these tools used for harvesting.

## Analyses and results

The site of *Klimonas* dates from the end of the 10th to the first half of the 9th millennium cal. BC (Vigne *et al.* 2017). The lithic industry of this Cypriot PPNA settlement is considerable and exhibits specific characteristics (Briois & Astruc 2017; Briois & Astruc

this volume). The production of artefacts was carried out *in situ*, using cherts of the Lefkara formation, primarily the translucent type, and secondarily the opaque type (see Astruc 2002 for chert type definitions). The *débitage* is unipolar and the average length of blades in the *plein-débitage* is between 4 and 5cm. The tool typology is dominated by burins and projectile points, but also has significant numbers of scrapers, blades with lateral retouches and notches. The removal of small blades or bladelets using a burin-blow down the lateral edge of thick flakes (burin cores) was done preferentially to manufacture micro-drills.

In this techno-typological context, sickles are also common as they represent 14% of the retouched pieces (US 10.6, Briois *et al.* 2013). Sickles, during this period, were composite tools made using a rectilinear or slightly curved haft and flint inserts selected from within the common lithic stock (Fig. 1). Selected blades were used to create elements with a remaining length of 30–70mm. The smallest units may be the results of accidental or intentional fractures or shaping through retouching. Several pieces simply were used without modification whereas others were retouched to fit better into the haft groove using lateral retouches, truncations or backing retouch. In some cases, the sickle elements were rejuvenated (using micro-denticulation, for instance) or recycled into another tool class (notably, with burins). The active edge can be equally situated on the left or right lateral, and their angle is normally 25–40°. The rejuvenated edges tend to be more obtuse.

We conducted use-wear analysis on a sample of 19 inserts. Within this sample, none of the tools were used on both sides. The only complete item measures 28mm in length. In every case, the gloss is parallel to the edge suggesting a longitudinal hafting. One of the pieces has been rejuvenated and four were recycled: two burins, one convex back and one bi-point were manufactured secondarily following utilisation for harvesting. The use-wear traces due to plant cutting

are homogeneous (Fig. 2a). The working edge is completely polished and rounded. The polish is very bright, and the reticulation is compact or sometimes slightly domed near the edge. The boundary between polished and unpolished surfaces is distinct. The striations are well developed; but the dotted striae are superficially marked. All these characteristics allow us to interpret these traces as resulting from the cutting of silica-rich vegetal material, most likely cereal harvesting.

At *Shillourokambos*, the archaeological remains date from the middle of the 9th millennium to the end of the 7th millennium cal. BC (Guilaine *et al.* 2011a) thus belonging to the Cypriot PPNB period (Fig. 3). The ancient phase extends from 8600 to 7600 cal. BC, and can be subdivided into three phases, A, B and C, determined by changes in the typology of projectile points and the types of sickle elements. Translucent chert was the main raw material used during ancient phase A. Several *chaînes opératoires* were identified: careful bipolar production used to produce predetermined blades on large cores with anterior and posterior-lateral crests; bidirectional production on short cores and bidirectional production using the thickness of large flakes; and, finally, unipolar blades made on conical cores. Major tool types are notches, denticulates, burins, projectile points and glossed pieces. Glossed elements represent up to 11% of the retouched pieces. During the ancient phase A, they were manufactured from unipolar or bipolar unretouched blades and, on the rare occasion, small flakes. The gloss was parallel to the edge. Two different kinds of tools co-existed; namely, a harvesting knife (hafted as a unique long blade) and composite sickle elements. Both of these types bear continuous gloss indicating that all inserts were hafted longitudinally (Philibert 2003, 2011). Rejuvenation using micro-denticulation occurred only rarely.

During the ancient phases B and C, the raw material exploited was predominantly translucent; nevertheless, the opaque variety is well attested and

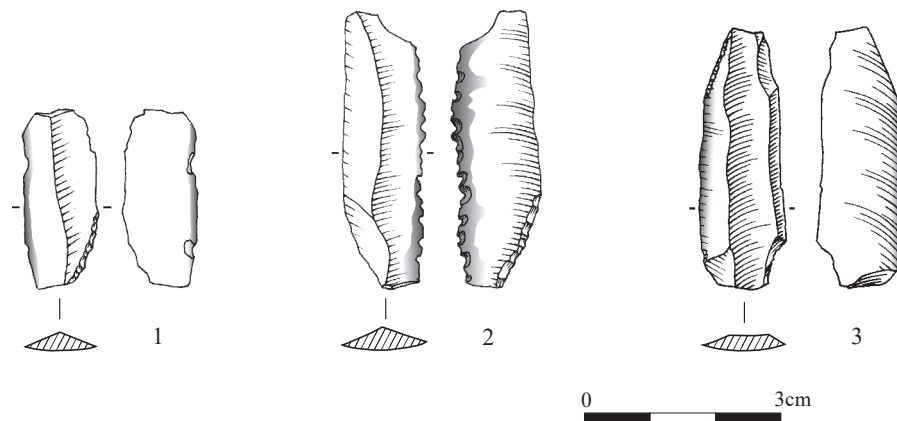


Figure 1. Sickle elements from Klimonas

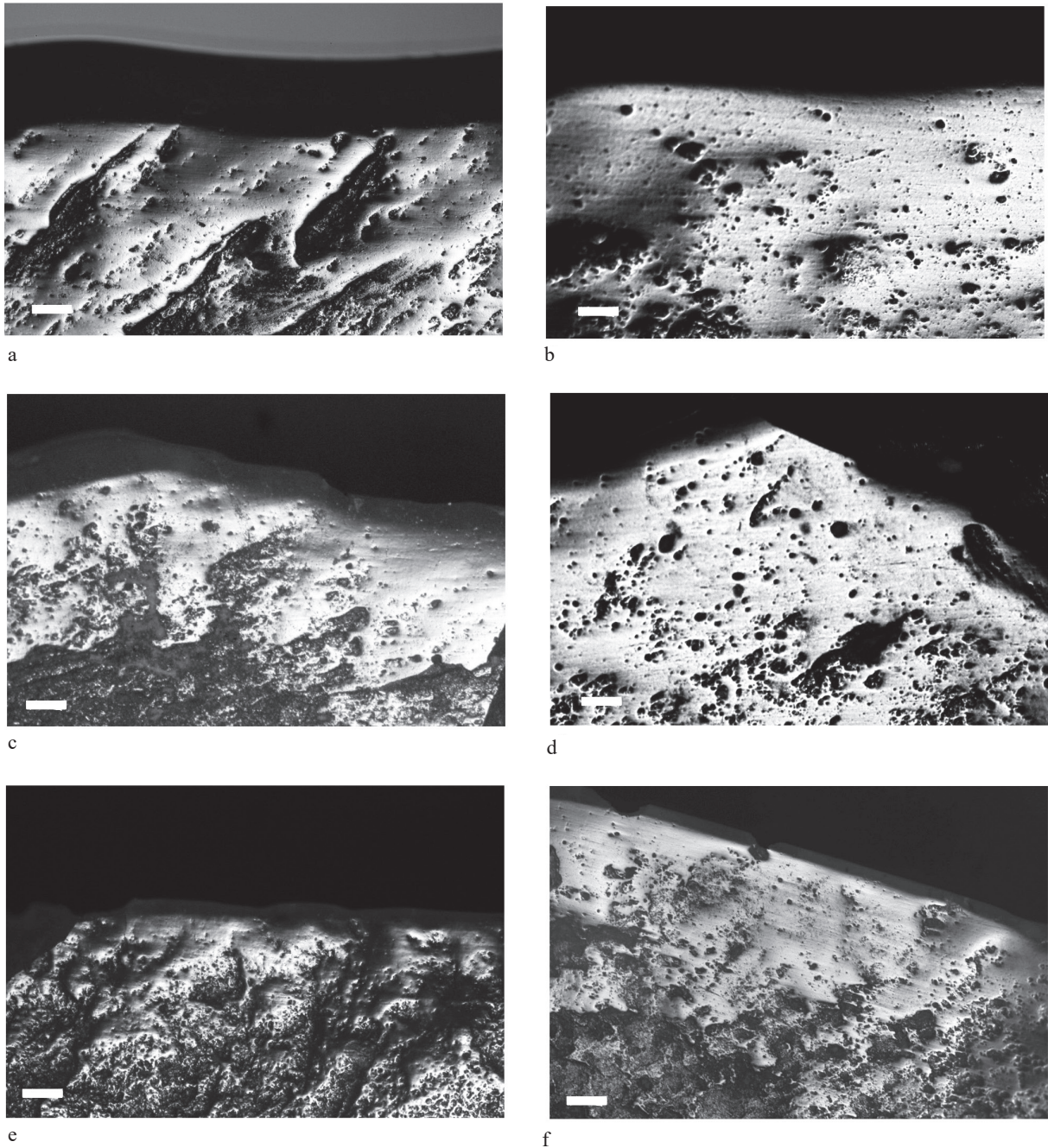


Figure 2. Use-wear traces on sickle elements of Klimonas, Shillourokambos and Khirokitia: a. Klimonas, b. Shillourokambos, ancient phase A, c. Shillourokambos, ancient phase B, d. Shillourokambos, middle phase, e-f. Khirokitia, level C and 3

the granular chert type appears rarely. Production methods were less diverse, and the sizes of the blanks were generally smaller. Typological tool groups are similar to the earlier phases, but for two differences. Square base points disappear from the projectile class while Byblos points appear, and the sickle elements are very different from those of ancient phase A. During ancient phases B and C, the production of unidirectional or bidirectional bladelets from burin cores appeared, and these blanks were used to manufacture glossed pieces (Guilaine *et al.* 2011b: figs 16, 17, 26). The inserts were shaped with a

convex back and were hafted, not longitudinally but obliquely to the haft (Philibert 2011: fig. 6). Therefore, the distribution of the gloss on these pieces is oblique.

Further data collected in the course of the study of the material from sector three confirm the results obtained in sector one. A sample of 36 glossed elements has been analysed. They were manufactured using different raw materials; predominantly translucent (n=30), but also opaque (n=3), granular (n=2) or mixed cherts (n=1). The blanks used were either flakes (n=16) or blades (n=20). Within the typology one can distinguish backed pieces (n=29), bi-truncations (n=4),

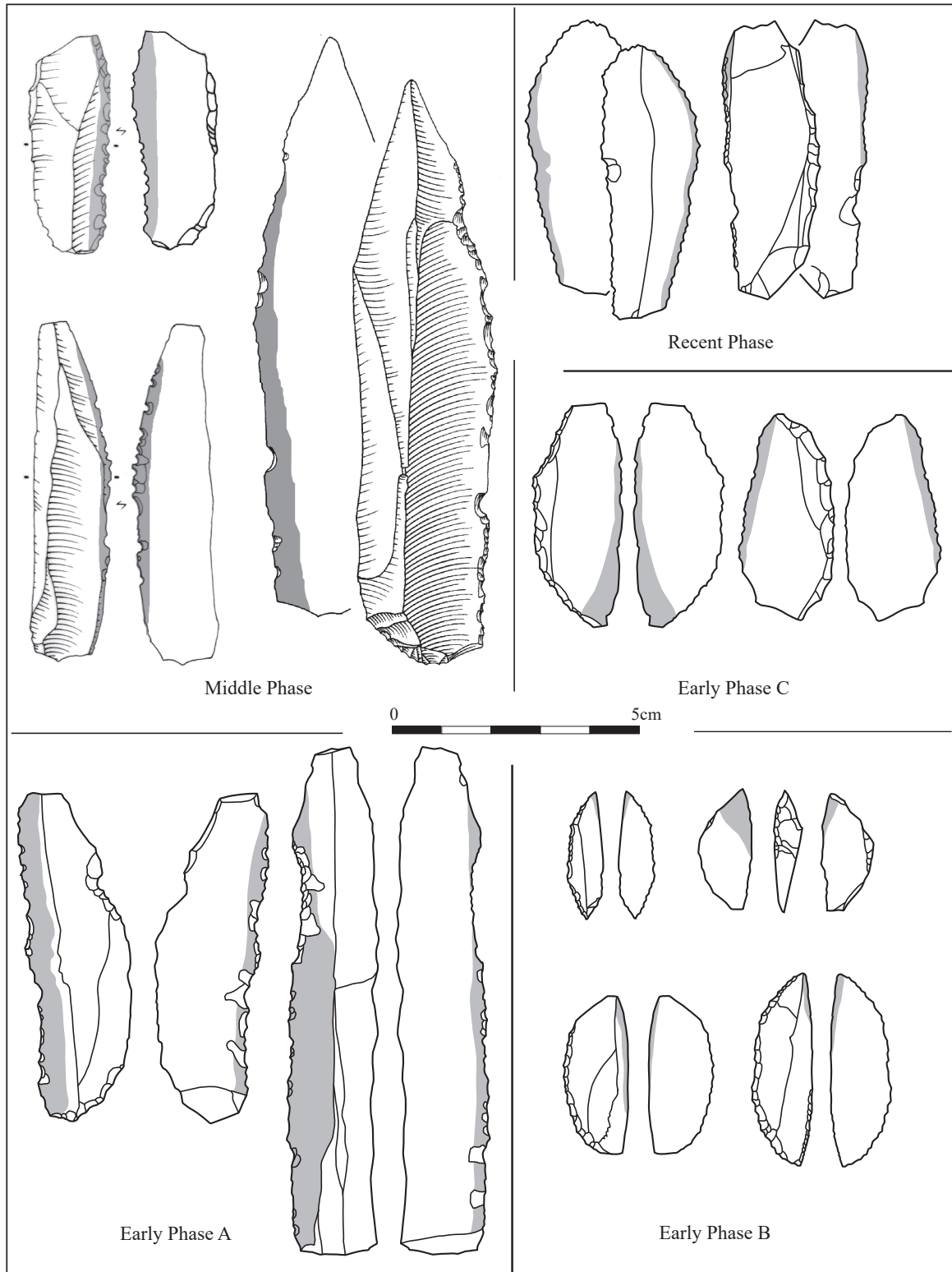


Figure 3. Sickles elements from Shillourokambos: ancient phases A, B, C, middle phase, recent phase

lateral retouches (n=2) and one unretouched blank. Either left or right edges were used. The size of the blanks varies from 24 to 56mm in length, from 10.6 to 21.3mm in width and 2.5 to 7.3mm in thickness. The angles of the use edges were in general 25–30° (but

sometimes up to 40°). With this way of hafting, the surfaces in contact with the plants are limited and use-wear traces are well marked (Fig. 2c). The polish is compact and bright. It decreases gradually towards the interior of the tool segment. Its microtopography

is flat and the striations, mostly dotted, are parallel to the tool edge. When identical backed pieces that do not show gloss are studied, they are simply unused (n=13). This suggests that shaped sickle elements were stored before being used. Finally, one sickle element in the sample exhibits longitudinal gloss on both edges; it is most probably an intrusion coming from the underlying level of ancient phase A.

There is a clear continuity between the ancient phases B and C. The amount of translucent chert decreases, but sickle elements continued to be hafted obliquely and the typology stayed the same; they were also characterised by backed pieces and bi-truncations. The only difference is in the size of the blanks: they are slightly larger.

During the middle phase at *Shillourokambos*, between 7600 and 7300 cal. BC, the lithic industry differs from the ancient phases. In particular, the use of opaque chert becomes dominant (more than 70%), followed by translucent chert and small quantities of granular chert. The bipolar blades are larger, and the blanks are in general more diverse and less standardised. The typological groups are wedges, notches, denticulates, burins, scrapers, drills and glossed pieces. The last represents 8% of the retouched pieces.

Use-wear analysis was conducted on 37 pieces of the middle phase A and 11 items of the middle phase B. Glossed pieces (Fig. 2d) assigned to both middle phases A and B were heavily dominated by sickle elements hafted longitudinally, while only two examples were harvesting knives. An additional four inserts, exhibiting oblique gloss, were also identified in the middle phase A sample. It is difficult to know if the oblique inserts typical of the ancient phase B sample are part of this later assemblage; or if they come from the underlying level.

The two harvesting knives are bipolar blades made of opaque chert. One of them is unretouched, and the second is a scraper with the retouch playing the role of a truncation. The former is 148mm long and the latter 117mm in length. In both cases, the gloss is distributed longitudinally. The wear matches that of other examples used to cut silica-rich plants such as cereals. The lengths of these tools are important; these implements could have been used as unique blades deliberately selected for use as harvesting knives.

The main glossed pieces belonging to the middle phase are sickle elements hafted longitudinally in either a rectilinear or slightly curved haft. The raw materials used were opaque, translucent or occasionally granular. The blank types selected were more varied; including bipolar blades, upsilon blades, unipolar blades and flakes. The dimensions of the inserts are the following: 32–77.6mm in length, 12.8–26.4mm wide, 2.6–10.5mm thick. Typologically, there are unretouched pieces, backed pieces, truncated pieces and examples with lateral retouches. Left or right edges were used indifferently, and the average

angle of the working edge(s) is around 35°. Three of these inserts have been rejuvenated by semi-abrupt retouch to denticulate (or micro-denticulate) the working edge, while six have been used on both edges. The use-wear traces are homogeneous (Fig. 2d). Macroscopic glosses are parallel to the edge and their extension towards the interior of the blank varies from 2.7 to 10mm. All the edges are heavily smoothed and polished; the rounding of the cutting edge is standardised. The scaling is not very developed as it is the result of cutting soft materials. Edge removals are regular, continuous and alternating; they are in the shape of half-moons or have thin extremities. The polish is bright, reticulation compact, with a flat or slightly domed topography; and there are numerous dotted striae inside the polished surfaces.

The recent phase of *Shillourokambos* is dated to 7300–6900 cal. BC following on from the middle phase. Opaque chert was dominant and the *chaînes opératoires* were simplified in comparison to the previous phases. Blades are more robust and irregular; the predetermined blades are no longer found in the assemblage. The typological groups include: lateral retouches, notches, denticulates, scrapers, wedges and glossed pieces. The last represents 7% of the retouched pieces and they were backed or used without retouch. As in the middle phase, the inserts were fitted longitudinally into the groove of the haft.

At Khirokitia, we reach the last phase of the aceramic Neolithic in Cyprus (Culture of Khirokitia) dated from the end of the 7th millennium cal. BC to the middle of the 6th millennium cal. BC (Le Brun 1984, 1989, 1994, this volume). If we pay attention to technology (Astruc 2002: fig. 4), the *débitages* appear simplified, and blank production as well as the retouch were not as standardised. The main raw materials exploited were also Lefkara formation cherts, although 60–70% of them were of the coarser granular type. The *chaînes opératoires* are heavily influenced by the morphology of the raw material, which is found mainly as tabular blocks that require minimal shaping of the core prior to blank production. The blades produced were unipolar, often variable in size and irregular in shape. Several bidirectional blanks have been identified; but they were produced in the course of the reshaping of unipolar cores from the distal end. Bipolar blades are, otherwise, nearly absent. Retouched pieces are not frequent (11% of the whole assemblage) and include the typological groups, backed pieces, lateral retouches, truncations, wedges and small quantities of pieces with a proximal shaping, pointed tools, burins, scrapers and drills. There are no projectile points and the glossed pieces represent 10–12% of the retouched tools (cf. Astruc 2002 for levels C and III). Numerous glossed pieces (n=52) have been analysed for level C and a further eight for level III. There were no clear differences between the two samples. The selected blanks were elongated flakes or blades. Thinner granular and opaque cherts were selected as they

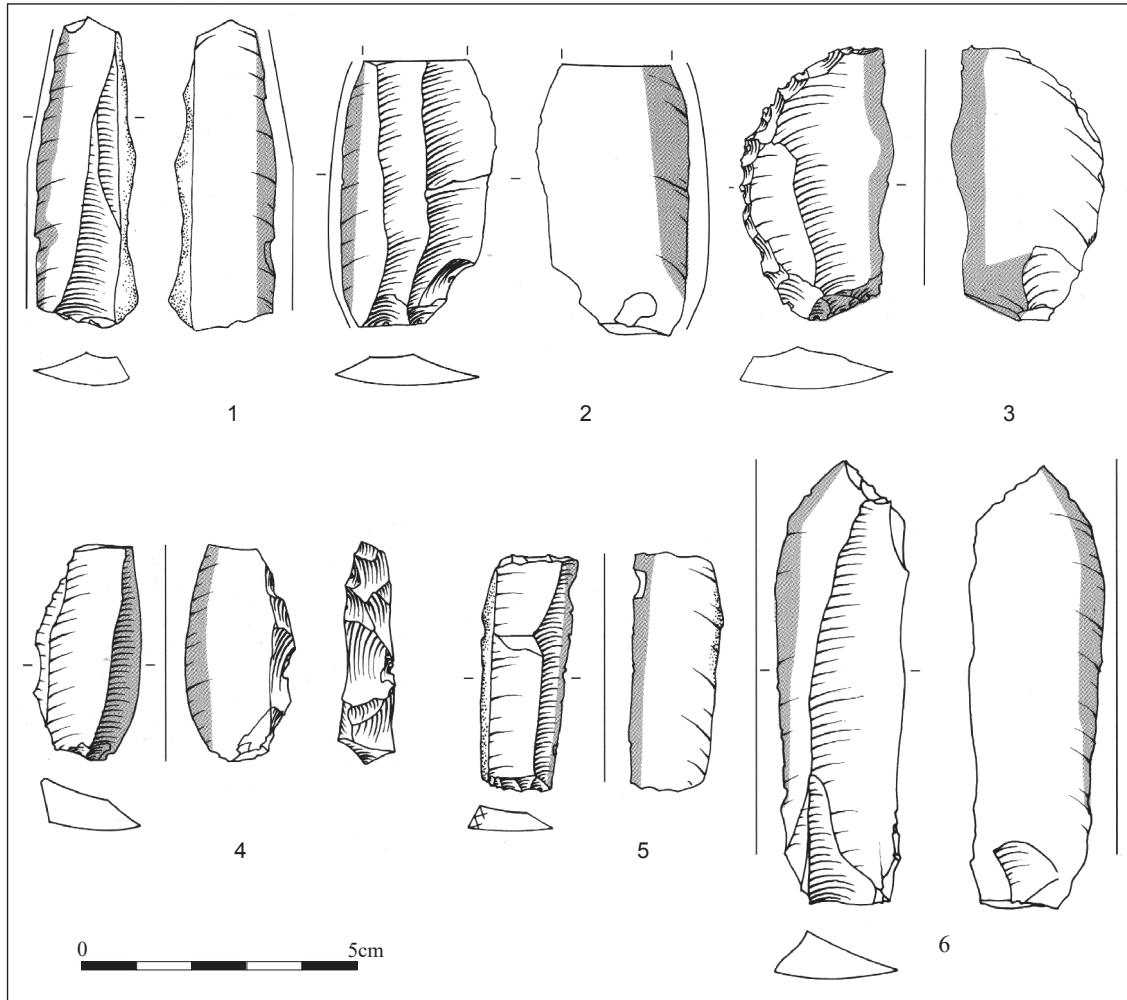


Figure 4. Sickles elements from Khirokitia

offered the most efficient cutting edges. Unretouched blanks sometimes exhibited gloss, but retouched tools are more frequent, including backed examples or other lateral retouches. The retouch was implemented without care: it could be continuous or not, direct, inverse or crossed, semi-abrupt or abrupt. In most cases, the use edges are rectilinear or slightly sinuous, with angles from 20° to 55°. Tool lengths were 45mm on average, and the gloss typically opposite to a retouched or cortical back. Left and right edges were used equally.

Use-wear traces are homogeneous (Fig. 2e, f) with slight variations due only to raw material differences (Astruc *et al.* 2001) or variations in the intensity of use. Macroscopic glosses are distributed longitudinally to the polished and calibrated edge. The polish has a compact reticulation, a flat microtopography and a high brightness. It is well delimited in a particular zone. The scaling is not very developed. Striations run parallel to the edge and comprise thin or dotted striae. These traces have been interpreted as the result of cereal harvesting with the help of a sickle with longitudinal hafting; the haft being rectilinear or

slightly curved as is the case, for instance, at Nahal Hemar, Israel, during the 7th millennium cal. BC (Bar Yosef 1987).

## Discussion

The use-wear data extracted from the collections studied in this analysis are rather homogeneous over the sequence. Sickles were used to harvest cereals from the Cypriot PPNA onwards. Further distinction between cereal species (wheat and barley) or between wild or domestic varieties are beyond the scope of this research. Such differentiation could also be misleading as mixed fields were common during these ancient times. Additionally, we need to increase our sample size, particularly for the sickles from *Klimonas*, as this study is in an incipient stage and the site is still under excavation. Botanical studies have demonstrated that the crops of the Aceramic Neolithic of Cyprus varied through time. Even if the botanical remains at *Klimonas* and *Shillourokambos* are poorly preserved, observations conducted on plant imprints

found on building materials have provided useful information. At *Klimonas* (Vigne *et al.* 2012, Vigne *et al.* 2017), wild barley (*Hordeum spontaneum/disticcon*) and emmer wheat (*Triticum dicoccoides/dicoccum*, wild or domestic) are attested. Wild barley is native to Cyprus, but emmer wheat was introduced. Botanists argue, using comparisons with the mainland, that this early stage of cereal exploitation in the Cypriot PPNA should be viewed as a 'pre-domestication' of cereals. Later on, at *Shillourokambos*, einkorn (*Triticum monococcum*), emmer wheat (*Triticum dicoccum*, wild or domestic) and domestic barley (*Hordeum vulgare*) are attested from the beginning of the 8th millennium cal. BC (Willcox 2011). At Khirokitia, the preservation of botanical remains is optimal and allows detailed reconstruction of agricultural practices. Agriculture was based on cereals. Crops were mainly einkorn, emmer and domestic barley, together with small quantities of tetraploid wheat (*Triticum tétraploide*) and two-grained einkorn (*Triticum monococcum-2 grains*). All of these taxons were domesticated and probably cultivated in a mixed-field system. Harvesting took place during the spring with the help of sickles, though uprooting might have been used in complement (Pares & Tengberg 2017). These data collected in Cyprus support a scenario of a mainland inheritance of crops and a truly continuous sequence stemming from the early Pre-Pottery Neolithic phase (Pares & Tengberg 2017: 243).

Lithic tools used for cereal harvesting vary in morphology from the end of the 10th millennium to the middle of the 6th millennium cal. BC. No traces of bitumen were observed on the artefacts. **Figures 1, 3 and 4** show the main characteristics of sickles for each chronological phase. In general, over the sequence, inserts were fixed longitudinally into the haft; at *Klimonas* and Ayia Varvara *Asprokremnos* during the Cypriot PPNA (McCartney 2011), at *Shillourokambos* during the Cypriot PPNB (ancient phase A, middle phases A and B, recent phase) and at Khirokitia during the Late Aceramic Neolithic. Similar sickle specimens were found at Nahal Hemar, Israel, in the 7th millennium cal. BC (Bar Yosef 1987; Astruc 2002), Halula, Syria, between 7600 and 7300 cal. BC (contemporary with the middle phase of *Shillourokambos*) or Gücürtepe, Turkey, during the late PPNB (Borrel & Molist 2007). The sickles of the ancient phase B and C of *Shillourokambos* stand apart as the only exception; they were composite elements inserted obliquely into the haft. For all but this one type, the inserts were selected from the common lithic stock: sickle elements, therefore, reflect the broader lithic assemblage. Incidentally, we have shown that obsidian blanks, amounting to less than 0.1% of the assemblages of *Shillourokambos* and Khirokitia, were also used for this activity (Astruc 2011; Astruc *et al.* in preparation) and were hafted longitudinally. Technological and typological characteristics of the flint tools vary. Overall, a certain amount of flexibility

occurs as the main criteria of blank selection were the cutting edge characteristics (straightness and acute edge angle) as well as the need for the elements to fit easily into the groove of the haft. The harvesting knives are attested during the ancient phase A and the middle phases A and B at *Shillourokambos*. Thus, during the middle phase A we might have a more variable sickle assemblage with harvesting knives and sickles hafted either longitudinally or obliquely, although intrusion coming from underlying levels might have occurred.

It is difficult to find any material for comparison, in Cyprus or in the mainland, as relevant detailed data are not always available (but see Anderson 1999; Ibáñez *et al.* 2016). Some of the Mureybetian sickles are similar to those of *Klimonas* (Ibáñez *et al.* 2008: fig. 10.1) while others are not (Cauvin & Abbès 2008: fig. 24). In Cyprus, the only other site with sickle elements indicating oblique hafting is Kalavassos *Tenta*, levels five and four, contemporaneous with those of the ancient phase B and C of *Shillourokambos* (McCartney & Todd 2005: figs 12.1, 19.1–3). Sickle elements with oblique hafting appear on the mainland much later during the late PPNB: on the Euphrates at Halula (Borell & Molist 2007), in the Balikh valley at Assouad and Sabi Abyad II (Cauvin 1973; Copeland 2000; Astruc 2004), or even later in the Orontes Valley at the end of the PN during the 7th millennium cal. BC at Tell Ain el-Kerkh (Arimura 2007). These sickle elements are not only very late in the chronology, but are also different: they are often made of regular unretouched blades with longer cutting edges. M.C. Cauvin (1973: 103, fig. 2) published drawings of several backed pieces or bi-truncations from the ancient levels of Tell Assouad; these are, 'à dos convexe ou anguleux imitant de grands segments (nos 11, 12) ou de grands triangles (nos 9, 10, 13). Ils sont taillés sur lames (nos 9, 10, 13), mais aussi sur éclats, le dos épais étant alors retouché sur enclume (nos 11, 12)'. The sickle elements of the ancient phase B–C at *Shillourokambos* are slender in comparison. The sickle elements of ancient phase B–C are also an exception, since a specific chaîne opératoire devoted to the production of the unidirectional or bidirectional bladelets struck from burin cores was used (Briois 2011: 173). Similar blank types in the *Klimonas* assemblage were used mainly for micro-drills. Thus, the functional objective for producing diminutive blade/bladelet blanks changed through time, as they were progressively devoted to the manufacture of sickle elements, and to that extent could be considered a specialised production. The only other example of specialised manufacture of sickle elements known so far is rather different. It is attested at Tell Ain el-Kerkh from the late PPNB to the middle PN (Arimura 2011), using unipolar blades knapped with the help of punches. These blades were often bi-truncated and hafted longitudinally. Thus, the sickle elements of ancient phases B and C on *Shillourokambos* stand out as an anomaly.

## Conclusion

Over the past 30 years, archaeologists working in Cyprus have collected first-hand evidence on the process of Neolithisation that occurred on the island between the end of the 10th and the middle of the 6th millennia cal. BC. This insular pre-Pottery Neolithic finds its roots in the Near East as most animal and botanical species exploited during this time had to have been imported from the mainland. The first wave of farmers moving to Cyprus dates back to the 10th millennium or the beginning of the 9th millennium cal. BC (Vigne *et al.* 2012). Since then, cereals played an important role in the development of agriculture. The Cypriot PPNA phase is seen by palaeobotanists as a stage of 'pre-domestication' that gradually led to a fully established agriculture. At the end of this process, several millennia later, the inhabitants of Khirokitia were practicing an agriculture mainly based on cereals. This study of the lithic industries provides specific data on the tools used to harvest these cereals. Sickle elements are identified through macroscopic glosses, and our study indicates that these tools varied through time. As early as the Cypriot PPNA, it seems that the inhabitants of Cyprus brought with them not only the taxa, but also the knowledge and know-how related to their exploitation, consisting of both harvesting and post-harvesting treatments.

Recently (Maeda *et al.* 2016), lithic industry specialists and archaeobotanists focusing on the period 12,000–5000 cal. BC in the Fertile Crescent, have identified a strong correlation between the increased investment in sickle production and increased reliance on cereals crops. This study does not include Cyprus, since the authors argue that the Cypriot data are not comparable to those of the mainland. Our study shows that investment in the production of sickles actually decreases progressively as the economy relies more and more on domestic cereal crops. Sickles simply reflect the general development of lithic industries produced by the inhabitants of the island, who were first farmer-hunters and later farmer-herdsmen.

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