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# PRODUCTION AND STRUCTURAL TENDENCY OF LEVALLOIS POINTS IN THE LATE MIDDLE PALAEOOLITHIC OF THE NEAR EAST STEPPE ZONES AND ARABIA

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**Abstract.** *During the Middle Palaeolithic, the inland regions of the Near East were a crossroads of lithic technical influences based on a specific model of human mobility. This paper presents a study of Levallois points from the site of Umm el Tlel in Syria, specifically from archaeological level VI3d' dated to around 71,000 BP (isotopic stage 5a/4). While variable production strategies are employed, the bidirectional-divergent method is notable for its resemblance to Nubian technology which is present in the wider region. We examine the production methods and structural diversity of Levallois points in level VI3d' and question the possible wider cultural interactions between the Near East and its southern peripheral regions. We attempt to determine whether this particular configuration results from the local evolution of a population and culture indigenous to the Syrian Plateau or reflects intrusive cultural phenomena associated with a new population wave coming from the Levantine coastal zone or even the Arabian Peninsula.*

**Résumé.** *Reposant sur un modèle spécifique de mobilité humaine, les régions steppiques du Proche-Orient sont un carrefour d'influences techniques lithiques au cours du Paléolithique moyen. Notre article repose sur l'étude des pointes Levallois issues du site d'Umm el Tlel en Syrie, plus précisément du niveau archéologique VI3d' daté aux alentours de 71 000 BP (stade isotopique 5a/4). Parmi l'ensemble des schémas de production mis en œuvre dans la réalisation de pointes de diverses structures et bien que présents en proportion modérée, certains de ces schémas sont bipolaires divergents. Nous examinerons les méthodes de production des pointes Levallois ainsi que leur diversité structurelle tout en interrogeant les éventuelles interactions culturelles au cours du Paléolithique moyen entre le Proche-Orient et ses régions périphériques septentrionales. Nous essaierons de déterminer si cette configuration particulière est le résultat de l'évolution locale d'une population et d'une culture indigène du Plateau syrien ou si elle reflète des phénomènes culturels intrusifs associés à une nouvelle vague de population provenant de la zone côtière levantine ou même de la péninsule Arabique.*

**Keywords.** *Near-East, Levallois points, bidirectional-divergent, Umm el Tlel, Levant, South Arabia.*

**Mots-clés.** *Proche-Orient, péninsule Arabique, pointes Levallois, bipolaire divergent, Umm el Tlel.*

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## INTRODUCTION

During the Late Middle Palaeolithic period (OIS 4 and 3, ~70-50 ka), a significant proportion of lithic assemblages in the Near East exhibit a production trend characterised by a high frequency of convergent blanks, such as points and triangular flakes<sup>1</sup>. Technological analyses and chronostratigraphic data, in combination with absolute dating methods, have facilitated the development of a dependable chrono-cultural framework for studying the diversity of Middle Palaeolithic stone industries in the Near East (Mercier et al. 1995; Bar-Yosef 1998; Mercier and Valladas 2003; Mercier et al. 2007; Valladas et al. 2013; Zaidner et al. 2014; Goder-Goldberger and Bar-Matthews 2019). The study of lithic assemblages from various phases of the Middle Palaeolithic has identified the existence of common technological patterns (Bar-Yosef 1994, 1998, 2000; Goren-Inbar and Belfer-Cohen 1998; Bar-Yosef and Meignen 2001; Shea 2003; Hovers 2009; Meignen 2019; Meignen and Bar-Yosef 2019). The unidirectional convergent method of Levallois point production is one of the prominent trends during the end of the Middle Palaeolithic. This method involved the creation of *débordant* and backed flakes, connected to lateral convexities resulting in the production of short Levallois points, mostly from a single striking platform (Meignen 1995, 2019). The production of short, convergent lithic blanks (points) has been documented at multiple archaeological sites in the Near East, both in caves and open-air sites. In the steppe ecoregion of the Syrian semi-desert zone, short convergent blank production is reported at Hummal (Hauck 2011), Umm el Tlel (Boëda et al. 1998, 2001; Bonilauri 2015) and in northern Syria at Dederiyeh (Nishiaki et al. 2012). In the mountains north of Damascus, it is also present at Yabroud I (Pagli 2015), Yabroud II—layer 9 (Pastoors et al. 2008), and Ouadi Muskhuna (Bretzke et al. 2012). In the Lebanese littoral zone, it is documented in Keoue (Nishiaki and Copeland 1992), Ksar ‘Akil (Meignen and Bar-Yosef 2004, Pagli 2014) and Nahr Ibrahim (Solecki 1970; Dockall 1997). In the southern Near East, the short points are attested at Kebara (Meignen 1995, 2019), Amud (Hovers 1998), Tor Faraj (Henry 2003) and Rosh Ein Mor (Goder-Goldberger and Bar-Matthews 2019; fig. 1).

One can discern variations in both production and structural characteristics among Levallois convergent blanks created through different methods. For example, Kebara IX-X assemblages feature short points with a wide proximal part and a longitudinal profile of “en Concorde”. This is the result of a sequence of specific gestures involving strongly lateralised negative removals from a single striking platform (Meignen 1998, 2019). On the other hand, points characterised by a narrow proximal end and a more elongated, slender shape, produced through a recurrent method of manufacture in which the series of blanks exhibit low convergence, are indicative of other lithic assemblages, such as Amud B1 (Hovers 1998: 146), Hummal HM-A2 (Hauck 2011), Rosh Ein Mor (Goder-Goldberger and Bar-Matthews 2019), and Tor Sabiha (Henry 2003; Meignen 2019: 106).

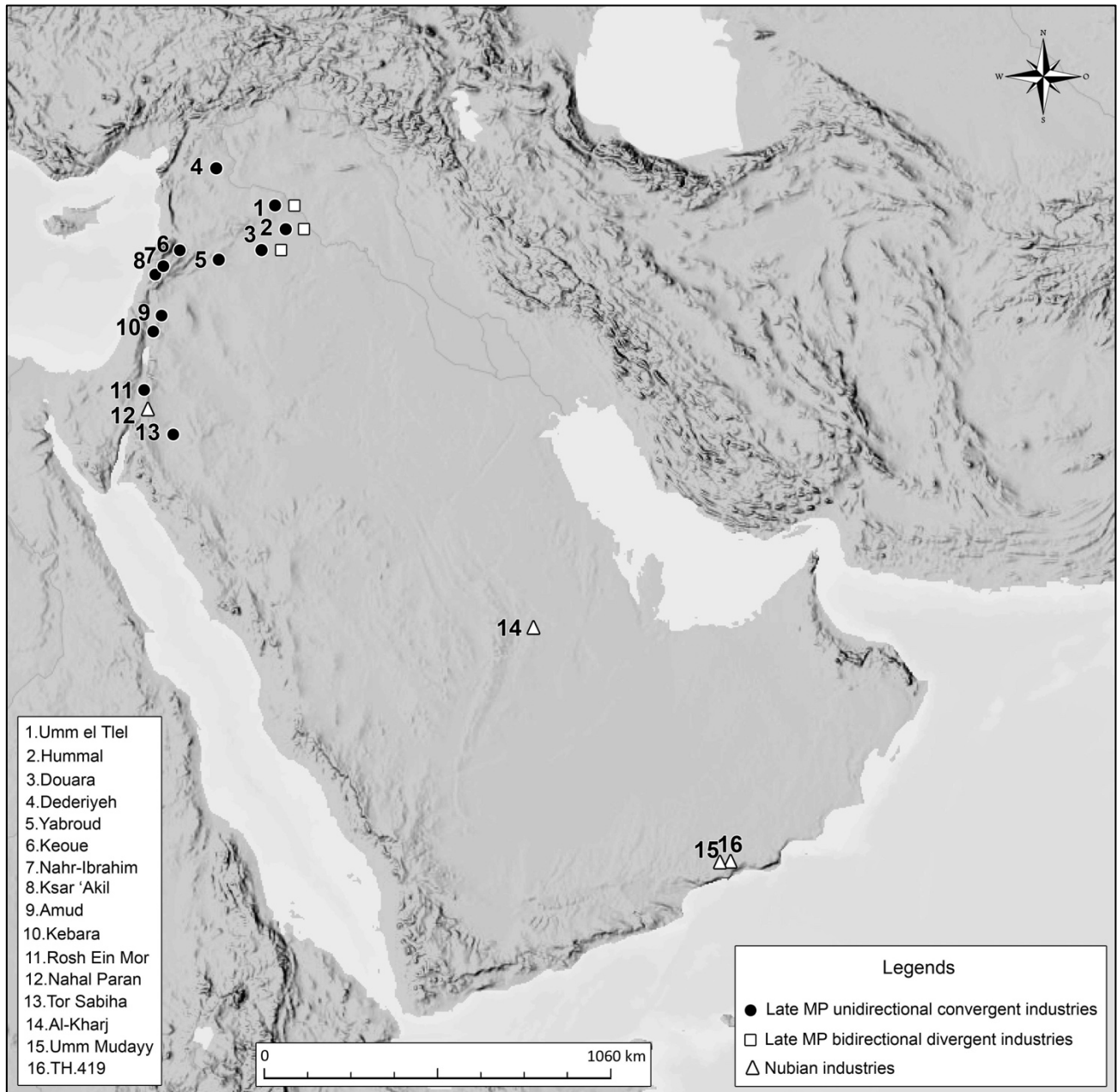
Lithic assemblages in the Syrian steppe show evidence of the application of both unidirectional convergent production (aiming to obtain 3-shot points or three-negative points) and more diversified bidirectional methods, notably the bidirectional-divergent method during the late Middle Palaeolithic. We are persuaded it was to achieve structurally diversified Levallois points with varied “silhouettes”, as evidenced particularly at Umm el Tlel (Boëda et al. 1998, 2001; Al Sakhel 2004; Bourg 2007; Lourdeau 2011; Bonilauri 2015), Douara Cave (Al Sakhel 2004), and Hummal HM-A1 (Hauck 2011).

Our study of archaeological materials from level VI3d’ at Umm el Tlel revealed a moderate frequency of bidirectional-divergent Levallois point production, which is unique to the Middle East steppe ecoregion. However, this reduction sequence seems similar to the Nubian industries found in large areas such as Nahal Paran 9 in the Negev desert (Goder-Goldberger et al. 2016), Al-Kharj 22 in central Saudi Arabia (Crassard et al. 2019), and even the small Nubian cores from the south of Arabia, like Umm-Mudday or TH.419 (Rose et al. 2019: 71). Nubian technology is a specific type of triangular core configuration (Beshkani 2020) developed during the Middle Stone Age in Northeast Africa and

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<sup>1</sup> The importance of convergent products was highlighted very early in the Middle Paleolithic research history of this region. In the sequence from the Tabun site, D. Garrod observed a predominance of products with triangular morphologies in layer D, which she classified under the “Lower Levallois-Mousterian” and, in layer B, under the “Upper Levallois-Mousterian” where triangular flakes are more abundant than oval flakes (Garrod and Bate, 1937). These observations opened the history of interpretations of the variability of this Mousterian in which Levallois debitage plays an important role. During the 1970s, L. Copeland, F. Hours and O. Aurenche proposed the inter-variability of lithic assemblages based on the intrinsic characteristics of Levallois debitage (Hours et al. 1973; Copeland 1975, 1981).

South Arabia (Guichard and Guichard 1965; Marks 1968; Clark 1988; Van Peer 1992; Wendorf et al. 1994; Van Peer and Vermeersch 2007; Smith et al. 2007; Chiotti et al. 2009; Olszewski et al. 2010). This technology is distinguished from other Levallois methods by its use of a bidirectional divergent flaking technique that creates a distal median ridge. This ridge is a distinctive feature and some studies have suggested that there may be some variation in the angle of the median ridge across different probable phases of the Nubian Complex (Rose et al. 2011; Usik et al. 2013). It appears the interior angle of the distal median ridge or steep distal in earlier Nubian assemblages tends to be more acute compared to later assemblages which are obtuse (Hallinan et al. 2022).



**Fig. 1** – Distribution of some Late Middle Palaeolithic sites with unidirectional-convergent and bidirectional-divergent industries, and Late Nubian lithic assemblages cited in the text (S. Bonilauri)

The emergence of the bidirectional-divergent or Nubian(ish) point production method in the Syrian Plateau could be attributed to a combination of technological convergence (Groucutt 2020), the development of local culture, and/ or the influence of non-local cultures from adjacent regions such as the Arabian Peninsula, or the Negev Desert where Nubian technology is present. The aim of our analysis of the assemblage from level VI3d' is to characterise point production at the site, which will allow us

to test our hypothesis regarding the search for a specific type of silhouette by the past individuals. Specifically, we aim to examine the presence and role of bidirectional-divergent point production strategies and to explore the implications of our findings for understanding human behavior, dispersals, and techno-cultural interactions in the region.

## THE SITE OF UMM EL TLEL AND COMPLEX VI3

### THE SITE OF UMM EL TLEL

Located in central Syria in the middle of the semi-arid Middle East steppe ecoregion (fig. 1), between Palmyra and the Euphrates, the site of Umm el Tlel (Boëda and Muhesen 1993; Boëda 2005) is one of many open-air Palaeolithic sites in the El Kowm Basin such as El Meirah (Boëda et al. 2004), Hummal and Nadaouiyeh Aïn Askar (Le Tensorer et al. 1993; Le Tensorer et al. 2001; Le Tensorer 2004). The presence of permanent springs in the heart of this steppe area and diverse environmental resources such as fauna and stone raw materials are among the main reasons the region saw continuous Palaeolithic occupation since the Lower Pleistocene.

The site comprises two palaeo-dunes of different heights (10 and 8 m) and areas (208 and 168 m wide), oriented north-south, delimiting a slight depression with a west-east flow axis. The combined action of gypsum-type aeolian deposits and human occupation formed the north mound. The south mound is the old well of the Umm el Tlel village (Boëda and Muhesen 1993). These two palaeo-dunes are connected to the west by a sand bar delimiting a depression in the center of the site, open to the east, where a spring was still active at the beginning of the 20th century (Al Sakhel 2004; fig. 2).

Umm el Tlel's unique stratigraphic sequence, about 23 m deep, includes more than a hundred archaeological levels, ranging from the Lower Palaeolithic (Acheulean) up to the Byzantine and pre-Islamic periods (Boëda 2005). Among all the archaeological levels, 75 belong to the Middle Palaeolithic. The latter are divided into 10 complexes (complexes I to X), subdivided into several archaeological levels according to the lithic assemblages' typo-technological character and the nature of sediments. The site's exceptional chrono-cultural sequence for the Near East and the very good preservation of layers and archaeological remains allows precise and interdisciplinary approaches concerning the region's palaeo-environmental changes and the evolution of human technical behaviours, both diachronically and synchronously.

### ARCHAEOLOGICAL COMPLEX VI3

Complex VI3, attributed to Umm el Tlel's Late Middle Palaeolithic (isotopic stage 5a/4) is dated to around 60,000 BP and 71,000 BP<sup>2</sup> (Mercier et al. 1995; fig. 2d). Faunal and palynological data attest to an arid steppe environment dominated by camels and then equines (Boëda et al. 1998, 2001; Griggo 1999), as well as steppe herbaceous species (Chenopodiaceae and Artemisia; Emery-Barbier 1998). This complex, excavated over a surface of 60 m<sup>2</sup> but probably extending over an area greater than 2,000 m<sup>2</sup>, includes eight extremely rich and relatively well-preserved levels that are labelled as VI3a', VI3a'1, VI3b', VI3b'1, VI3c', VI3d', VI3d'1 and VI3e', respectively from the latest to the earliest. Each of these archaeological layers is clearly separated by a few centimeters of sterile sediment. The archaeological layers are strictly identical, both in terms of the lithic and faunal evidence, which attests to their belonging to the same techno-cultural group (Boëda et al. 1998; Boëda et al. 2001).

The various studies carried out testify to a specialised and similar technical behaviour from one layer to another, suggesting a repetitive seasonal occupation pattern by the population who specialised in butchery activities at the site. During this period, Umm el Tlel seems to have functioned as an

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<sup>2</sup> The Climate and Environmental Sciences Laboratory/PSL, CEA-CNRS-UVSQ, 91198, Gif sur Yvettes, carried out some thermoluminescence dating of some archaeological layers of the VI3 complex. Layer VI3b' has been dated between 65 and 50,000 BP (Mercier et al. 1995; Boëda et al. 1996) and layer VI3d' around 71,000 years BP (Mercier et al. 2006).

intermediate place for meat preparation between animal slaughter areas and other sites (Boëda et al. 1998; Griggo 1999; Boëda et al. 2001). The environmental context corresponds well to an arid steppe with a site on the edge of a lake or near a large body of water (Emery-Barbier 1998; Griggo 1999, 2000; Boëda et al. 2001).

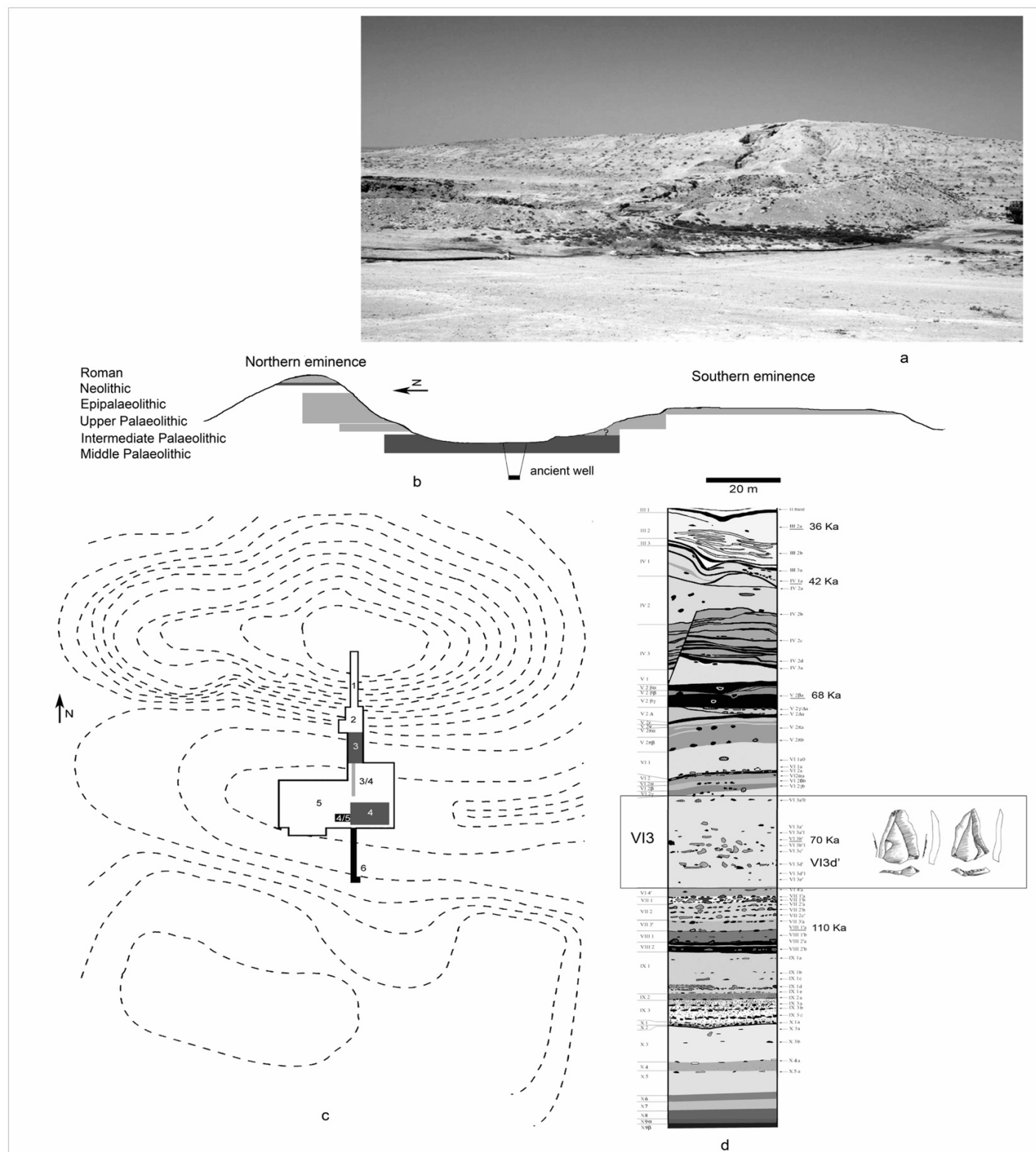


Fig. 2 – The Umm el Tlel site: view (a), section (b), topography (c), and stratigraphy (after Boëda 2005)

Technological studies carried out on lithic assemblages from layers VI3a' (Bourg 2007; Lourdeau 2011), VI3b' (Boëda et al. 1998), VI3b'1 (Boëda et al. 2001), VI3c' (Al Sakhel 2004) and VI3d' (Bonilauri 2010, 2015) all attest to a single debitage concept: the Levallois system mainly focused on obtaining points, representing more than half of the removals produced. The other removals including diverse flakes also belong to the point production sequences. Although the preferential and recurrent modes of production are both present in the VI3 layers, the recurrent mode for wide and elongated flakes production is predominant. The preparation methods are essentially unidirectional and bidirectional, and the production methods are mainly oriented towards obtaining Levallois points constructed by three or by several removals, sometimes slightly retouched (Boëda et al. 1998; fig. 5d). These different Levallois points include unidirectional, bidirectional-convergent, and bidirectional-divergent.

Examining raw material procurement at the site has shown that some of the main Levallois products, and particularly the large points, were produced off-site and subsequently transported to the site (Boëda et al. 1998; Bonilauri 2010; Lourdeau 2011). For all the lithic assemblages of Complex VI3, the raw material used is a good quality Tertiary flint present in large quantities and accessible near the site (Boëda and Muhesen 1993).

## THE LEVALLOIS POINTS FROM ARCHAEOLOGICAL LEVEL VI3D'. MATERIAL, METHOD AND OBJECTIVES

The definition of Levallois points as an end-product in most of the literature rests on the presence on its “upper face of a central part or triangle proximal and two lateral parts [...] with a straight edge creating a ridge at the distal end. Each of these parts is obtained by removals [...] following precise and specific operating schemas” (Boëda 1982: 24). This end-product, thus characterised by a triangular proximal part and two convergent lateral facets (Bordes 1980; Inizan et al. 1995) and regardless of the operating schemes implemented (Boëda 1982), is generally considered in most of the studies as unique on a morpho-technical and structural level. However, our analytical study postulates that the Levallois points in Complex VI3 are not uniform and the production methods cover multiple and varied structural realities.

The lithic material selected for the study comes from excavations in layer VI3d' undertaken between 1999 and 2001 in sector 4 at Umm el Tlel, over an area of 40 m<sup>2</sup>. The sampling includes 1,041 artifacts, representative of the entire lithic industry of level VI3d'. This set comprises blocks, cores, predetermining (by-products) and predetermined blanks (end-products) including for the latter, Levallois points, elongated and wide Levallois flakes. Among end-products (n=606/1041), there are 122 Levallois points thus representing 20.13% of the end-products (n=122/606). Despite the low representativeness of the points compared to the other Levallois flakes (wide, elongated; table 1), previous studies show not only that the production of Levallois points or flakes with laterally converging edges was at the center of the *chaîne opératoire*, but also that the other lithic by-products are linked to the production of points (Boëda 1982).

These 122 points are all related to the final product of the point production operational sequence, which corresponds well to the classic definition of the Levallois point mentioned above. In the text below, we highlight the diversity of production patterns involved in point production, probably rooted in their structural diversity as reflected in their silhouettes.

Several related technical elements can constitute fundamental technical parameters in the manufacturing of the points. These examinations aim to determine whether or not these technical elements were ultimately intended in the search for one or more particular point structures. They provide an insight into their preponderance or technical hierarchy as well as their interaction in manufacturing the Levallois point. To understand and demonstrate the structural and production diversity of the Levallois points we retain some technical elements including:

**Table 1** – Number and frequency of artefacts constituting the selected lithic assemblage from archaeological layer VI3d' at Umm el Tlel. Among this set, the 122 analysed Levallois points are indicated (selected box).

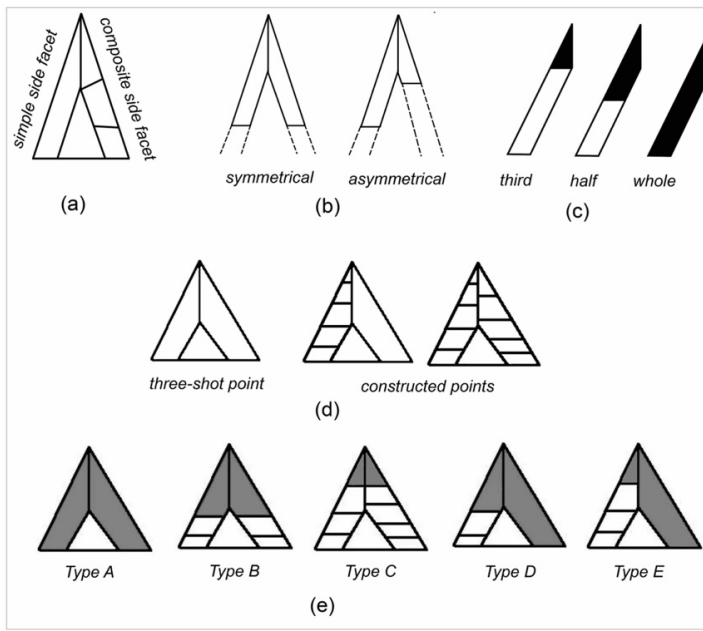
TYPES CLASSES	NUMBER	FREQUENCY
Blocks	5	0,48
Cores	69	6,63
Byproduct flakes	333	31,99
Predetermined flakes	606	58,21
Levallois points	122	20,13
Levallois triangular flakes	96	15,8
Elongated Levallois flakes	155	25,5
Levallois flakes (diverse)	233	38,4
Undetermined flakes	28	2,6
Total	1041	100

The techno-type of the converging lateral facets (simple or composite) which can constitute fundamental technical parameters in the manufacturing of the points. The study of convergent lateral facets comprises three technical elements. The first concerns the number of negatives of the removal forming each of the lateral facets. The latter can be produced by a single elongated removal which consists of only one negative (simple lateral facet). The convergent lateral facets can also consist of a series of smaller removals from different directions, like lateral or distal divergent. This type of lateral facet is named “composite side facet”, of which there are from two to six removals (fig. 3a). The second element concerns the combination of lateral facet types creating convergence, divided into ‘symmetrical’ and ‘asymmetrical’ categories. Symmetrical lateral facet is whenever two identical removal negatives, either single or composite, form a converging part. An asymmetrical lateral facet is a convergent mixed piece, joining in its distal part a composite facet on one side and the whole of a single facet on the other (fig. 3b). The third technical element applied to each of these symmetrical and asymmetrical categories is the length or extension of the removals’ negatives, creating the convergence (fig. 3c). Based on this technical character, two constructions can be distinguished for the points: on the one hand, a three-shot point made exclusively by three removals and, on the other hand, points made following the preparation of several removals (Boëda et al. 1998; fig. 3d). According to the technical characteristics presented above, including the types of convergent lateral facets, we propose six types of convergent lateral facets: type A, B, C, D and E (fig. 3e).

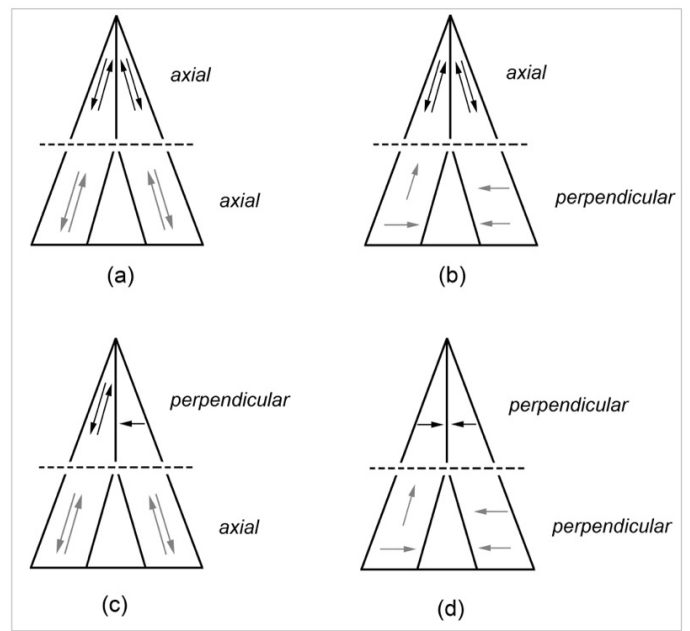
We have incorporated an additional technical element: **the directions of the removal forming the convergent lateral facets** (or the diacritical schemes). These can be unidirectional, bidirectional, lateral and indeterminate. Levallois points are also analysed from the following perspective, divided into two distinct parts: a basal zone or proximal part, including the base triangle, and a convergent zone creating a pointed distal end. Each part can be oriented:

- A. along the morphological axis of the Levallois point. The point’s convergent and/or basal parts show negatives in unidirectional, bidirectional convergent, and bidirectional-divergent directions (fig. 4a-4c);
- B. perpendicular to the morphological axes of the Levallois point. The point’s convergent and/or basal parts are formed by negatives in lateral-perpendicular directions (fig. 4b-4d).



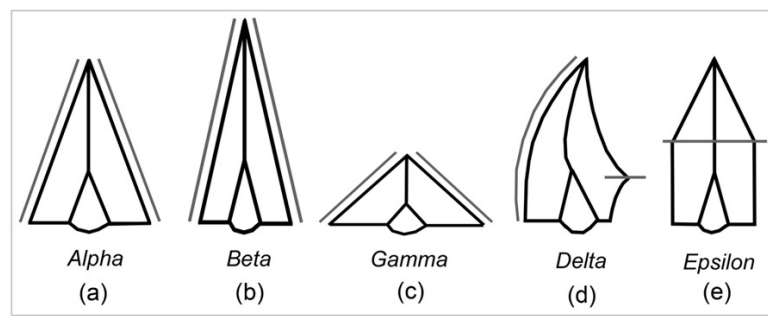


**Fig. 3** – Construction of the convergent lateral facets of Levallois points from level VI3d' (S. Bonilauri). a. Diagram of the point formed by a simple lateral facet (one removal negative) and a composite lateral facet (several removal negatives); b. Convergence of points consisting of negatives of symmetrical or asymmetrical removals; c. Negatives of removals forming the convergence of a point and corresponding to a third, one half, or the whole of a lateral facet's length; d. Patterns of three-shot and constructed points; e. Types of convergent lateral facets



**Fig. 4** – Orientation of the convergent and basal parts of Levallois points from level VI3d' (S. Bonilauri). a. Convergent and basal parts oriented axially, formed by unidirectional or bidirectional negative removals; b. A convergent part oriented axially formed by unidirectional or bidirectional negatives and a basal part oriented perpendicularly, made up of negatives with a partially or totally lateral-perpendicular direction; c. A convergent part oriented perpendicularly consisting of negatives of lateral and uni- or bidirectional removals and a basal part oriented axially, having uni- or bidirectional negative removals; d. Convergent and basal parts oriented perpendicularly, formed by negative removals with a partially or totally lateral-perpendicular direction

Finally, we considered an additional technical element into our analysis and discussion to provide a complete presentation of the Levallois points. This involves **the points' silhouette or the Levallois points' solid shape**. The silhouette differs from a simple outline, which represents the edge of an object in a linear form, whereas the silhouette is its shape as a solid form. The silhouette as a solid shape includes the delineation of the lateral edges and their tendency to be straight or deviated (continuous or discontinuous), as well as the delineation of the cutting edges between the distal and proximal parts (fig. 5). We have identified seven groups of points with distinct silhouettes presented as follows: Alpha, Beta, Gamma, Delta, Epsilon and Pi silhouette points (fig. 5).



**Fig. 5** – Silhouettes of Levallois points from level VI3d' (S. Bonilauri). a. Alpha; b. Beta; c. Gamma; d. Delta; e. Epsilon

## MAIN RESULTS

### TECHNO-TYPE OF THE CONVERGING LATERAL FACETS, SIMPLE OR COMPOSITE

According to the technical characteristics presented above, including the types of convergent lateral facets, we propose six techno-types in the following three categories:

1. Levallois points composed of two symmetrical converging lateral facets (fig. 5b);
2. Levallois points composed of two asymmetrical converging lateral facets (fig. 5b);
3. Indeterminate Levallois points.

#### **Levallois points composed of two symmetrical converging lateral facets**

This group includes three techno-types:

1. Type A points, consist of two convergent lateral facets, each consisting of a single negative of the removal (simple facet; fig. 3e) corresponding to the total length of the edges (fig. 3c). This type A includes 34/122 pieces representing 27.9% of the point production (fig. 6). These points are produced by mainly unidirectional and bidirectional methods. Consequently, they points are formed of two convergent and basal, axially oriented parts (fig. 4a).
2. Type B points are the result of two convergent lateral facets, each consisting of several removal negatives (composite facets; fig. 3e). The removal negatives creating the convergence correspond to half the length of the edges (fig. 3c). This type B is composed of 19/122 pieces representing 15.6% of the point production (fig. 6). Points are produced mainly by bidirectional-divergent methods and thus structured of two convergent and basal, axially oriented parts (fig. 4a).
3. Type C points consist of two convergent lateral facets, each created by several removal negatives (composite facet; fig. 3e). The removal negatives participating in the convergent part correspond to one-third of the length of the edge (fig. 3c). This type C includes 26/122 pieces, representing 21.31% of the point production (fig. 6). Points are produced by bidirectional and lateral methods and structured of a convergent part oriented axially and a basal part oriented axially or perpendicularly (fig. 4a-4b).

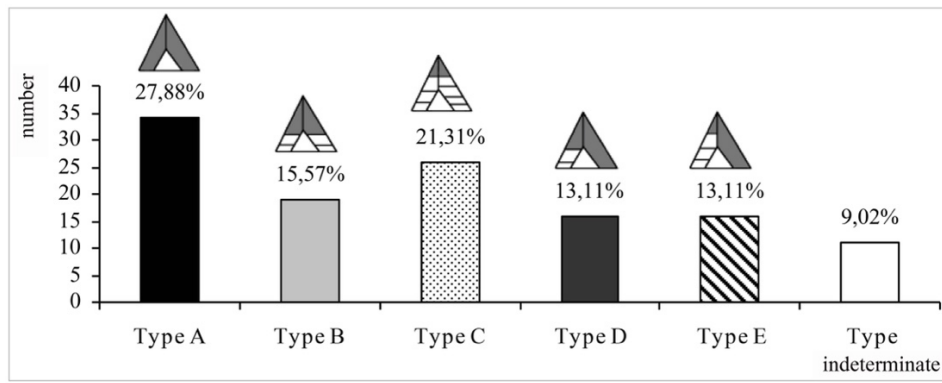
#### **Levallois points composed of two asymmetrical converging lateral facets**

This group includes two techno-types:

1. Type D points represent two convergent lateral facets composed respectively of a composite facet on one edge and a simple facet or a single removal negative on the other (fig. 3e). The removal negatives creating the convergence correspond, for the composite facet, to half the length of the edge and, for the simple facet, to the total length of the edge (fig. 3c). This group includes 16/122 pieces, representing 13.1% of the point production (fig. 6). Points are mainly produced by bidirectional method and to a lesser extent by unidirectional and lateral methods. These pieces are mainly structured by two convergent and basal parts oriented axially (fig. 4a).
2. Type E points, in terms of structure, are the same as type D points (fig. 3e), but the negatives creating the convergence of the composite facet correspond to one-third of the length of the edge, and for the simple facet, to the total length of the edge (fig. 3c). This group includes 16/122 pieces, representing 13.1% of the point production (fig. 6). Points are mainly produced by the bidirectional and lateral methods and structured by two convergent and basal, perpendicular or axially oriented parts (fig. 4a-4c).

#### **Points of indeterminate type**

These points (n=11/122) cannot be grouped within the categories presented above. In most cases, the natural fractures prevent a technical reading. In this group, we find a variety of the points listed above, although as mentioned, these are broken points.



**Fig. 6** – The comparative distribution of Levallois points from level VI3d' based on their convergent lateral facets (S. Bonilauri)

## THE POINTS SILHOUETTE

In the following synthesis, we classify the Levallois points found in archaeological level VI3d' under the main silhouettes determined and according to their production attributes explained above. The aim is to demonstrate the structure of each silhouette by classifying the lateral facets that reveal the possible production patterns in this layer of Umm el Tlel.

### Alpha silhouette points (Lateral edge delineation with a rectilinear tendency between the convergent and basal parts)

Alpha silhouette points are formed by convergent edges that are frequently rectilinear and continuous along the distal, mesial, and proximal parts. The basal and convergent distal ends are in line with the debitage axis and the point is almost symmetrical on both sides of the axis (fig. 5a). Among the 122 Levallois points, four have the Alpha silhouette (fig. 7), measuring between 50 and 90 mm in length. The silhouette is achieved by simple convergent facets (three-shot points) (type A), simple and composite convergent lateral facets (type D), or exclusively composite convergent lateral facets (type B). We note that types E (points formed of two convergent facets (simple and composite) and C (points formed of two composite convergent facets) are absent. The removal negatives contributing to edge convergence are either symmetrical (presence of two identical convergent negatives, simple or composite facets) as can be seen in types A and B, or asymmetrical (presence of two different negatives: simple on one facet and composite on the other) as classified under type D. The convergent zones are essentially axially-orientated (3/4 pieces). These Levallois points are manufactured by bidirectional recurrent production methods including bidirectional-divergent (2/4 pieces) and lateral (or bidirectional—lateral method; 2/4 pieces), but never according to a unidirectional recurrent pattern (table 2; figs. 8-9).


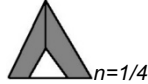
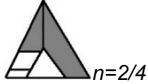
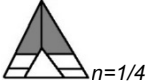


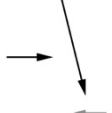

### Beta silhouette points (elongated lateral edge delineation with a rectilinear tendency between the convergent and basal parts)

Beta silhouette points are classified in a separate group, first because of their elongation<sup>3</sup> and second due to the shape of convergent lateral edges that are both 'rectilinear/continuous' or 'not-rectilinear/discontinuous'. Their convergent zone (distal end) is either strictly in line with the debitage axis or slightly *déjeté* (fig. 5b). The four Beta silhouette points (fig. 7), with lengths between 50 and 80 mm, consist of two points with simple facets (type A), one point with simple and composite facets (type D), and one point with two composite lateral facets (type B). Similarly, concerning their manufacture, there is no clear preference of converging facet types, although types C and E are absent. The negatives








<sup>3</sup> The length of the point is about three times the width of its platform. This ratio for the alpha group is 2.

involved in edge convergence are the same as those of the Alpha silhouette, i.e. either mutually symmetrical (types A and B) or mutually asymmetrical (type D). Three of these points have an axially oriented convergent zone, while a single piece has a convergent zone oriented perpendicular to its debitage axis. Levallois points with the Beta silhouette are often produced by the bidirectional method, including bidirectional-divergent (3/4 pieces) and lateral (1/4 piece) scar patterns. Our study shows that the unidirectional recurrent method was never used for this silhouette (table 3; figs. 8-9).

**Table 2** – Diagrams of production, construction and types of lateral facets related to the Alpha silhouette Levallois points. Black arrows represent the convergent parts, and grey arrows the basal parts. Selected boxes indicate the bidirectional-divergent production method.

		Types of lateral facets			
		The 3-shot points	Constructed points		
 N=4/122 points		Type A Simple Facets  $n=1/4$	Type D Simple and Composite Facets  $n=2/4$	Type B Composite Facets  $n=1/4$	
	PRODUCTION SCHEMES		Bidirectional	Bidirectional	Lateral/Distal
					
		$n=1/4$	$n=1/4$	$n=1/4$	$n=1/4$


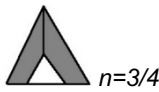
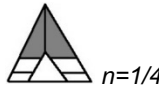



**Table 3** – Diagrams of production, construction and types of lateral facets related to the manufacturing of Beta silhouette Levallois points. Black arrows represent the convergent parts, and grey arrows the basal parts. Selected boxes indicate the bidirectional-divergent production method.

		Types of lateral facets		
		The 3-shot points	Constructed points	
 N=4/122 points		Type A Simple Facets  $n=2/4$	Type D Simple and Composite Facets  $n=1/4$	Type B Composite Facets  $n=1/4$
	PRODUCTION SCHEMES		Bidirectional	Lateral/Distal
				
		$n=2/4$	$n=1/4$	$n=1/4$

### Gamma silhouette points (straight, continuous lateral edge delineation between the convergent and basal parts)

Gamma silhouette points, short in length and broad-proximal, are formed of strongly convergent edges and straight and continuous delineation. The convergent distal ends are in line with the debitage axis (fig. 5c). The four Gamma silhouette Levallois points (fig. 7), with lengths between 20 and 40 mm, are mostly three-shot points consisting of two simple convergent lateral facets (type A), although one piece has two composite convergent lateral facets (type B). Facet types C, D, and E are absent, perhaps reflecting a choice favouring the production of short convergent facets. In contrast to the previous groups, the negatives through which the convergence zone was achieved are exclusively symmetrical to each other (types A and B). Three points have an axially oriented convergent zone, and one piece is perpendicularly oriented to its debitage axis. These points are produced using the unidirectional recurrent production method (3/4 pieces) and unidirectional-lateral method (1/4 piece). Another difference compared with the two above-mentioned silhouettes is the absence of bidirectional methods, including bidirectional-divergent production (table 4; fig. 8).


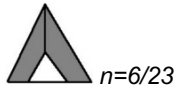

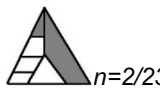


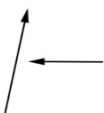

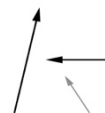

**Table 4** – Diagram of production, construction and types of lateral facets related to the manufacturing of Gamma silhouette Levallois points. Black arrows represent the convergent parts, and grey arrows the basal parts.

		Types of lateral facets		
		The 3-shot points		Constructed points
 N=4/122 points		Type A Simple Facets		Type B Composite Facets
		 n=3/4		 n=1/4
PRODUCTIO N SCHEMES	Unidirectional	Lateral	Unidirectional	
				
	n=2/4	n=1/4	n=1/4	






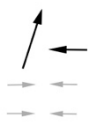

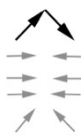
### Delta silhouette points (curved lateral edge delineation between the convergent and basal parts)

Delta silhouette points are identified by a convergent distal end that is *déjeté* regarding the debitage axis. The shape of the convergent lateral edges is "concave-convex" or "straight-convex". In most cases, one of two edges display a break in the edge's delineation, located between the mesial and proximal parts. To a lesser extent, there are also *déjeté* points formed by two edges of continuous delineation along the proximal up to the convergent distal end (fig. 5d). Among the 122 Levallois points, 23 have the Delta silhouette (fig. 7), with lengths ranging between 30 and 100 mm. These Levallois points mostly have a constructed structure (n=13). They are formed of convergent composite lateral facets (types B and C). In smaller numbers, some points are made of simple and composite (types D and E) or exclusively simple (type A) convergent lateral facets (3-shot points). All types of lateral facets (A, B, C, D, and E) are used despite a certain preference for constructed points with mutual composite convergent facets. The negatives at the distal convergence zone are symmetrical (types A, B, and C) as well as asymmetrical (types D and E). The convergent zones are, in most cases, axially oriented, whether they are points with simple and/or composite convergent lateral facets. Nevertheless, three of them have a convergent part perpendicularly-oriented to their debitage axis. All production schemes are represented since the Delta silhouette points are produced using unidirectional recurrent, bidirectional-lateral, and bidirectional-divergent methods (table 5; figs. 8-9).

**Table 5 – Production diagrams, construction and types of lateral facets related to the manufacturing of Delta silhouette Levallois points.** Black arrows represent the convergent parts, and grey arrows the basal parts. Selected boxes indicate the bidirectional- divergent production method.

		Types of lateral facets					
		The 3-shot points			Constructed points		
		Type A Simple Facets			Type B Simple and Composite Facets		Type E Simple and Composite Facets
 N=23/122 points		 n=6/23			 n=2/23		 n=2/23
	PRODUCTION SCHEMES	Unidirectional	Bidirectional	Lateral	Bidirectional	Lateral	Bidirectional
							
n=4/23		n=1/23	n=1/23	n=1/23	n=1/23	n=2/23	


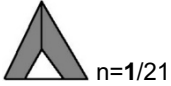




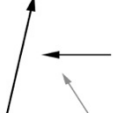

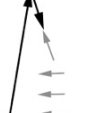
		Types of lateral facets				
		Constructed points				
		Type A Simple Facets			Type C Composite Facets	
		 n=4/23			 n=9/23	
PRODUCTION SCHEMES	Unidirectional	Bidirectional	Lateral		Bidirectional	Lateral
						
	n=1/23	n=1/23	n=2/23		n=6/23	n=3/23

**Epsilon silhouette points (non-linear/angled lateral edge delineation between the convergent and basal parts)**


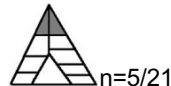




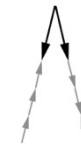
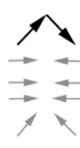
Epsilon silhouette points are characterised by a juncture in the delineation of the cutting edge between the proximal-basal part and the convergent distal end. The juncture or breakage is rooted in the production method. Their convergent distal end can be strictly in line with the debitage axis (fig. 5e) or slightly *déjeté* from the debitage axis. Among the 122 Levallois points, 21 have an Epsilon silhouette (fig. 7), with lengths ranging between 30 and 100 mm. With the exception of one point classified as Type A, the remaining 20 Epsilon silhouette Levallois points (20/122 points) have a constructed structure due to the use of single and composite converging lateral facets (Types D and E—8/21 pieces) and mutual composite lateral facets (Types B and C—12/21 pieces). The removal negatives forming the convergent part are symmetrical (Types A, B, and C) and asymmetrical (Types D and E). The convergent zones are often oriented along the debitage axis, but in some cases, a perpendicular orientation is also

observed. These points occur in equal proportions for each production method, including bidirectional recurrent production methods, notably bidirectional-divergent (10/21 products) and later- al-perpendicular (11/21 products). Our examination has high- lighted that the unidirectional recurrent method of production was not used for manufacturing this silhouette (table 6; figs. 8-9).

**Table 6** – Production diagrams, construction and types of lateral facets related to the manufacturing of Epsilon silhouette Levallois points. The convergent parts are represented by black arrows and the basal parts by grey arrows. Selected boxes indicate the bidirectional-divergent method of production.

		Types of lateral facets				
		The 3-shot points		Constructed points		
 N=21/122 points		Type A Simple Facets  n=1/21	Type D Simple and Composite Facets  n=4/21	Type E Simple and Composite Facets  n=4/21		
	PRODUCTION SCHEMES	Bidirectional	Bidirectional	Lateral	Bidirectional	Lateral/Distal
						
n=1/21		n=3/21	n=1/21	n=1/21	n=3/21	

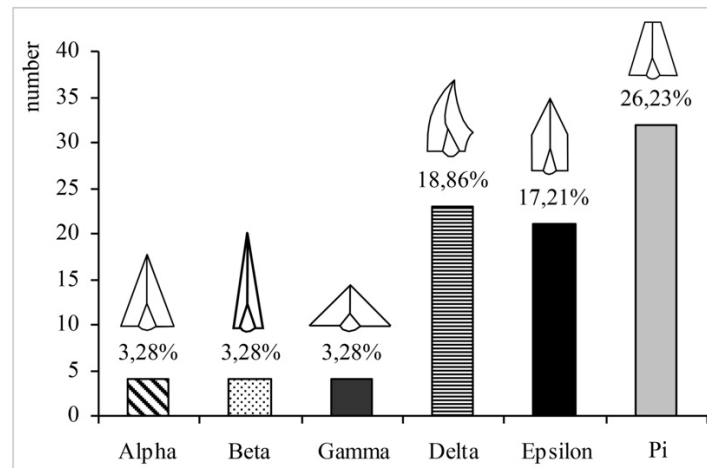
  

		Types of lateral facets				
		Constructed points				
PRODUCTION SCHEMES		Type B Simple Facets  n=7/21			Type C Composite Facets  n=5/21	
		Bidirectional	Lateral		Bidirectional	Lateral
						
	n=3/21	n=4/21		n=2/21	n=3/21	

### Pi silhouette points

Pi silhouette points that include Levallois points with hinged or overpassed termination at the distal end. These points are almost complete. The delineation of their edges is often rectilinear and continuous, and almost all follow the axis of debitage. The convergent distal end, however, is absent, but these points show skillful preparation. Although the Levallois points representing a Pi silhouette (32/122 points; fig. 7), whose lengths range between 30 and 80 mm, are characterised by a near-absence of the convergent distal end (fractured or overpassed), we can nevertheless understand the composition of their lateral facets as well as their production schemes, applying the same methodology as the previous categories.

This category includes a wide range of convergent lateral facets, notably the three-shot points (type A) with exclusively simple convergent facets and points with a combination of simple and composite (types D and E) or even exclusively composite (types B and C). Due to the relatively large number of samples, we see here most of the production methods, including unidirectional recurrent, bidirectional-divergent and bidirectional-lateral (table 7).



**Fig. 7** – The comparative distribution of Levallois points from level VI3d' based on their silhouette (S. Bonilauri).

## SUMMARY

The Levallois points from level VI3d' at Umm-el Tlel were the result of two main production methods: bidirectional and lateral-perpendicular. In this layer, the unidirectional method is also used to a lesser extent. In this assemblage, the great diversity of production patterns plays a fundamental role in the general construction of the points and the structuring of their convergent and basal parts and, consequently, in the creation of various silhouettes. The production schemes put in place depend on:

**Dimensions (length of the Levallois points).** The unidirectional recurrent scheme produces the smaller points in the studied collection, while the bidirectional and lateral production methods achieve the larger ones.





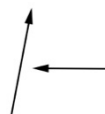
**“Constructions” through three-shot or composite structures.** While one might have expected specific patterns to obtain different types of convergent lateral facets (types A, D, E, B, and C), cross-analysis of the technical characteristics shows that the various types of convergent lateral facets, represented in almost equal proportions, do not constitute fundamental structuring elements. This is in contrast to three-shot or composite point constructions, whereby production schemes do indeed seem to be set up according to specific constructions: unidirectional schemes favour the production of three-shot points, and the bidirectional and lateral production schemes seem oriented towards producing constructed points.

**Types of convergent and basal parts.** Convergent parts with axial orientation are put in place by unidirectional or bidirectional removals, and lateral removals create convergent parts with perpendicular orientation. The Levallois points in this assemblage are mostly made up of convergent parts with axial orientation (created by uni- or bidirectional removals) and basal parts with both axial and lateral orientations.










**Continuous or discontinuous shape tendencies of the lateral cutting edges.** Points with a rectilinear and continuous edge shape between the two parts of the point, convergent and basal (Alpha, Beta, and Gamma silhouettes), are manufactured mainly by unidirectional or bidirectional recurrent production. While points with a non-rectilinear delineation, with a juncture between the basal and convergent parts (Delta and Epsilon silhouettes) are produced by the bidirectional and lateral production schemes.







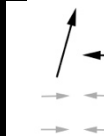


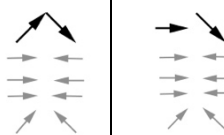
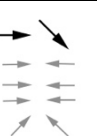
**Table 7** – Diagrams of production, construction and types of sides related to the manufacturing of Levallois points of Pi silhouette. Black arrows represent the convergent parts, and grey arrows the basal parts. Selected boxes indicate the bidirectional-divergent production method.

		Types of lateral facets		
 N=32/122 points	The 3-shot points			
	Type A Simple Facets			 n=11/32
PRODUCTION SCHEMES	Unidirectional	Bidirectional	Lateral	
				
	n=4/32	n=3/32	n=4/32	

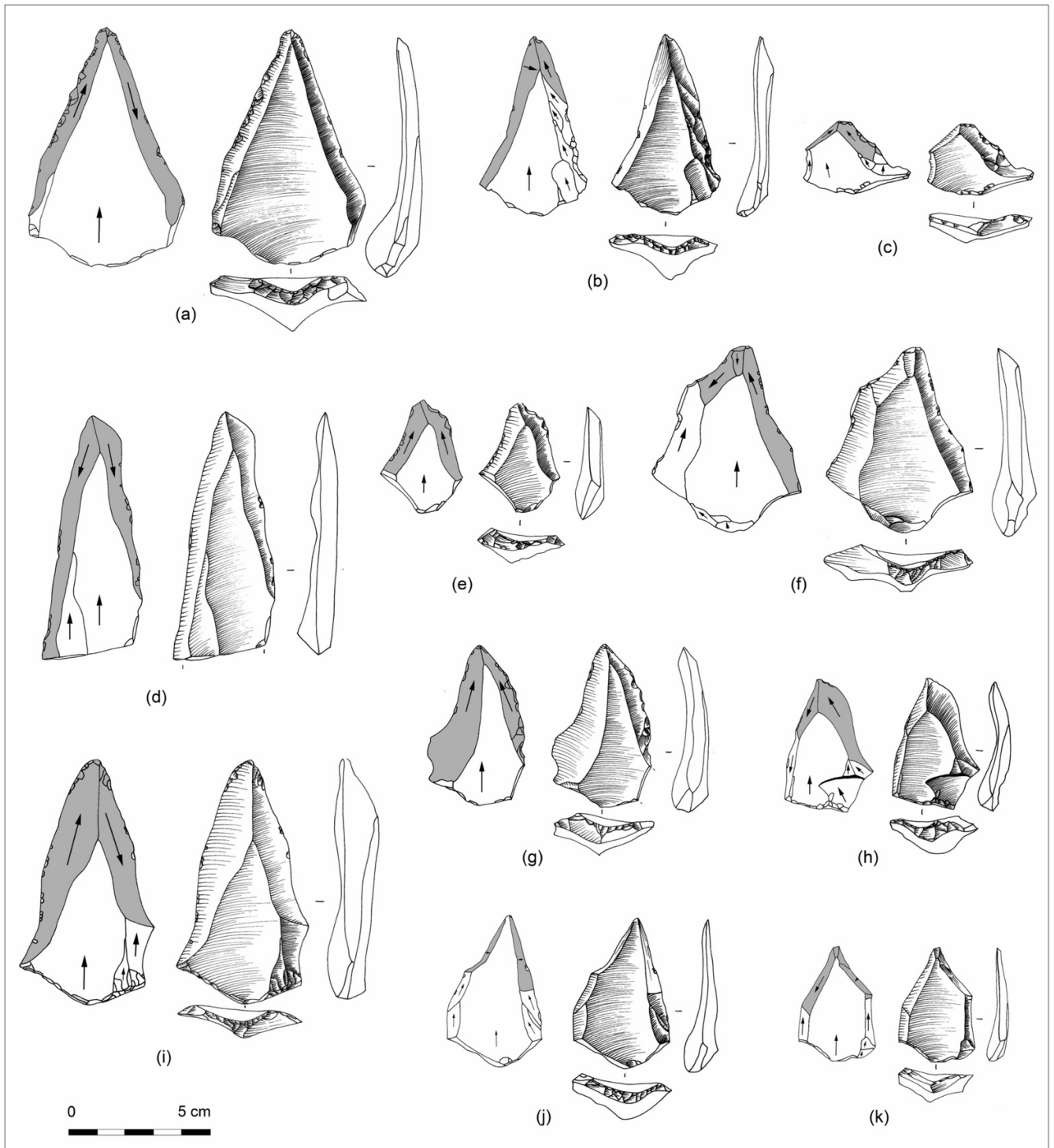
  

		Types of lateral facets					
		Constructed points					
		Type D Simple and Composite Facets			Type E Simple and Composite Facets		
		 n=4/32				 n=6/32	
PRODUCTION SCHEMES	Unidirectional	Bidirectional	Lateral	Unidirectional	Bidirectional	Lateral/Distal	
							
	n=1/32	n=2/32	n=1/32	n=1/32	n=2/32	n=3/32	

		Types of lateral facets					
		Constructed points					
		Type B Simple Facets			Type C Composite Facets		
		 n=3/32				 n=8/32	
PRODUCTION SCHEMES	Unidirectional	Bidirectional	Lateral	Unidirectional	Bidirectional	Lateral	
							
	n=1/32	n=1/32	n=1/32	n=1/32	n=4/32	n=3/32	

**Silhouettes.** Different organisational strategies of the converging facets produce specific silhouettes. Therefore, their presence in varying frequencies suggests the use of unidirectional, bidirectional and lateral production schemes is related to the desired end shape of the basal and convergent zones. This study shows the production of Alpha, Beta, and Gamma silhouette points using preferentially peripheral production patterns such as unidirectional-lateral and bidirectional strategies. Specifically, a bidirectional-divergent flaking strategy creates an Epsilon silhouette that resembles Nubian Levallois blanks as described elsewhere (Van Peer and Vermeersch 2007; Chiotti et al. 2009; Usik et al. 2013; Rose et al. 2019).









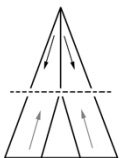











**Fig. 8** – Levallois points from level VI3d', manufactured using different production and silhouette schemes (S. Bonilauri). A-B. Alpha; C. Gamma; D. Beta; D-H. Delta; I-K. Epsilon.

## CONCLUSION: THE BIDIRECTIONAL- DIVERGENT LEVALLOIS POINTS OF UMM EL TLEL

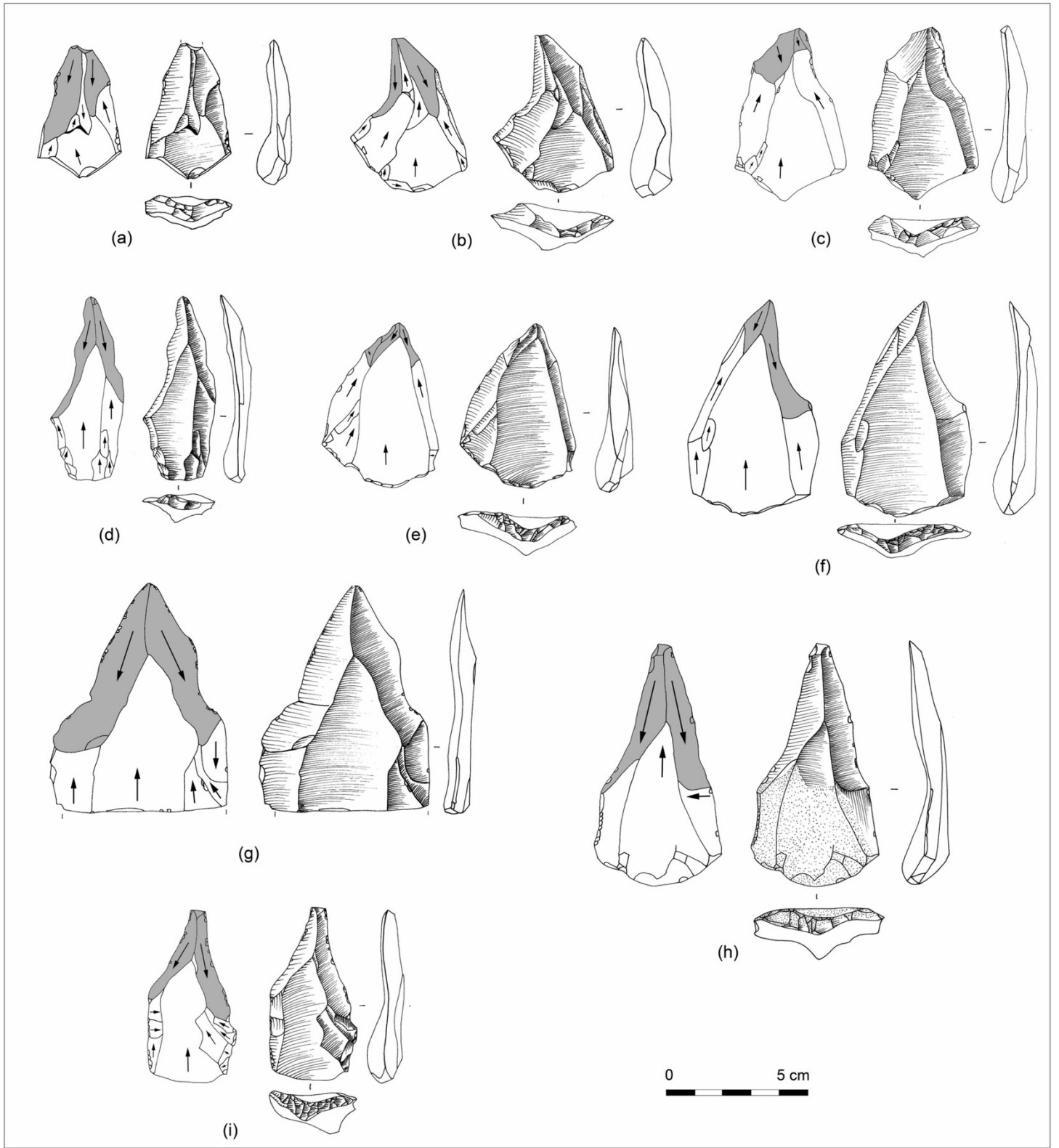
Our analysis of the Levallois points from layer VI3d' shows how the production process impacted the silhouette and visible characteristics of the point structure, such as the continuity/discontinuity of lateral facets. The creation of points through three-shot or constructed compositions is linked to different production processes, wherein varied silhouettes are sought along with distal-convergent transformative parts and proximal axial or lateral prehensile parts. The 'bidirectional- al-divergent' method (n=29/122 Levallois points) which is the focus of this paper, is particularly related to the production of constructed points with relatively large Delta and Epsilon silhouettes (table 8; fig. 9).

**Table 8** – Structural technical consequences of bidirectional- divergent production methods.

SCHEMES BIDIRECTIONAL- DIVERGENTS	CONSTRUCTION ET TYPES OF LATERAL FACETS	SILHOUETTES	CONVERGING AND BASAL PARTS
	 The 3-shot points - Type A	 Beta  Delta	
	 Constructed – Type C	 Alpha  Epsilon	
	 Constructed – Type D  Constructed – Type E	 Delta  Epsilon	
	 Constructed – Type C	 Delta  Epsilon	

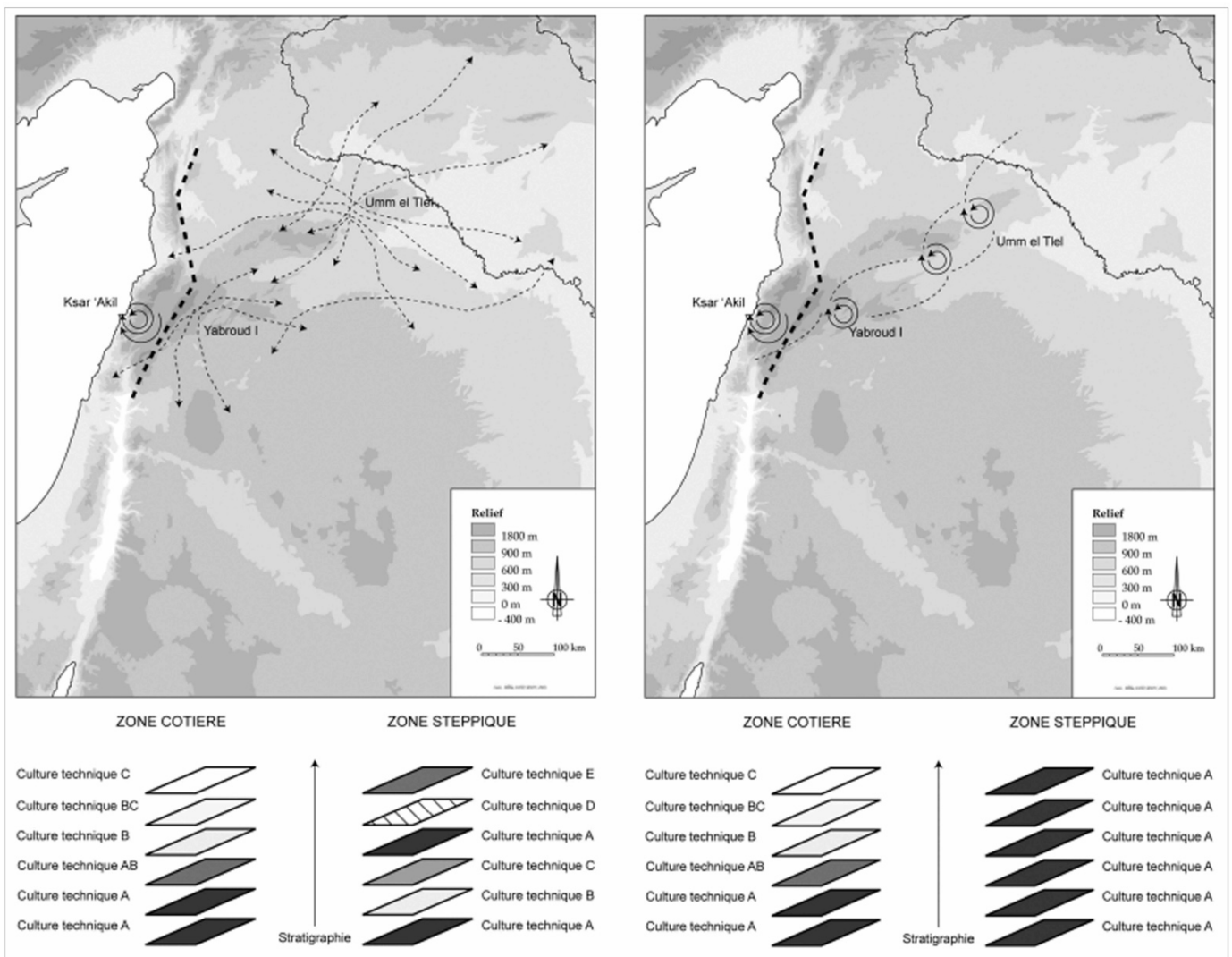
Layer VI3d' at Umm el Tlel offers insights into the technical diversity of Palaeolithic occupations found in semi-arid inland regions in the Syrian Plateau. At the site, each sedimentary change is associated with a distinct technical culture (Boëda 2005; Rasse and Boëda 2006), meaning a succession of identical technical cultures is observed when there is no sedimentary change. This leads to the interpretation of a fixed relationship between human groups and their landscape, implying a linear mode of mobility (Bonnemaison 2000), from point to point and from oasis to oasis (Boëda et al. 2004).

In the coastal zone of the Levant, inversely, a succession of human groups with similar, relatively stable technical traditions and no drastic change is observed over time (Hovers 2001, 2009; Meignen et al. 2006). It probably indicates a series of human populations that inhabited an area over time and shared similar cultural and technological practices. This suggests that these groups maintained a relatively stable pattern of occupation in the area and passed down their traditions from one generation to the next. Based on the archaeological observations, in the Syrian steppe zone to the East, there is significant variability in the traditions seen over time, indicative of different populations that moved through the area, making it a unique space with its own pattern of occupation characterised by high mobility and large-scale exploitation (Hauck 2011; Pagli 2013, 2014, 2015).



**Fig. 9** – Levallois points from level VI3d' produced by different divergent and bidirectional silhouette production schemes (S. Bonilauri). A. Alpha; B-C, E-F. Delta; D. Beta; G-I. Epsilon.

Given the wider regional presence of Nubian Levallois technology, we propose that the specific strategy of producing Levallois points with the comparable bidirectional-divergent method in layer VI3d' could have resulted from increased mobility and cultural interaction between the Middle Palaeolithic populations of the Syrian Plateau and those in the Southern Levant or even central Saudi Arabia during MIS 5a and early MIS 4 (fig. 10). The latter-mentioned geographical zones might have, in turn, been affected by the possible expansion of MSA populations from the south of the Arabian Peninsula or the Nile Valley into the Sinai Peninsula, the Negev desert and the adjacent region, as a nexus between two cultural macro zones (Wurz and Van Peer 2012; Rose and Marks 2014; Goder-Goldberger et al. 2016). Human dispersal can vary depending on the region and time period in question. Many factors, such as climate, availability of resources, and interactions with other human groups, could have influenced the direction of human dispersal. Other possible directions of lithic technology expansion have also been proposed during early MIS 5, from the eastern Mediterranean zone into the Negev desert region (Barzilai et al. 2022).



**Fig. 10** – Two models of mobility proposed by Marina Pagli (2013) to explain human population dynamics in the steppe and coastal zone during the late Middle Palaeolithic (M. Pagli, after Pagli 2013: 675–676; map background H. David-Cuny, IFPO 2003)

The evidence from Umm el Tiel layer VI3d' adds another layer to our knowledge about Middle Palaeolithic inter-regional interactions during MIS 4. The absolute dating of the site can potentially assist in providing a chronological framework for undated lithic technologies from open-air localities in

the northern and eastern Arabian Peninsula and the southern Levant (Schiettecatte et al.2013; Beshkani et al. 2017; Hilbert et al. 2017; Crassard et al. 2019). The origins of Nubian technology in Northeast Africa have been dated back to approximately 130 ka through various studies (Wendorf et al. 1994; Mercier et al. 1999; Van Peer et al. 2003; Smith et al. 2007). The use of this technology in the Dhofar region is believed to have emerged during a similar time frame based on the absolute date obtained from the Aybut Auwal site on the Nejd Plateau (Rose et al. 2011). Furthermore, the Ummal-Sha'al (AK-31) site in central Saudi Arabia has been dated to  $89 \pm 10$  ka (Crassard and Hilbert 2013). The Umm el Tlel level VI3d' has been dated to approximately 71 ka using OSL dating methods. This date, when considered alongside the most recent age for Nubian technology in Northeast Africa, which is estimated to be around 60 ka (Masojć et al. 2017), supports the probability of a possible late phase of Nubian technology. Based on available evidence from the Umm el Tlel level VI3d', it is possible to argue the Syrian Plateau was influenced by a probable recent phase of Nubian technology.

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## BIBLIOGRAPHY

AL SAKHEL H.

2004 *Le Paléolithique moyen dans des oasis du Proche-Orient*. Thèse de 3<sup>e</sup> cycle non publiée. Université Paris X – Nanterre.

BAR-YOSEF O.

1994 The contribution of southwest Asia to the study of the origin of modern humans. *In: NITECKI M.H. and NITECKI D.V. (eds.) Origins of Anatomically Modern Humans: 23-66*. New York: Plenum Press.

1998 The Chronology of the Middle Paleolithic in the Levant. *In: AKAZAWA T., KENICHI A. and BAR-YOSEF O. (eds.), Neandertals and Modern Humans in Western Asia: 39-56*. New York: Plenum Press.

2000 The Middle and Early Upper Paleolithic in Southwest Asia and Neighboring Regions. *In: BAR-YOSEF O. and PILBEAM D. (eds.), The Geography of Neandertals and Modern Humans in Europe and the Greater Mediterranean: 107-197*. Cambridge Massachusetts: Peabody Museum of Archaeology and Ethnology Harvard University.

BAR-YOSEF O. and MEIGNEN L.

2001 The chronology of the Levantine Middle Paleolithic period in retrospect. Analyse rétrospective de la chronologie du Paléolithique moyen du Levant. *Bulletin et Mémoires de la Société d'Anthropologie de Paris* 13,3/4: 269-289.

BARZILAI O., ORON M., PORAT N., WHITE D., TIMMS R., BLOCKLEY S., ZULAR A., AVNI Y., FAERSHTEIN G., WEINER S. and BOARETTO E.

2022 Expansion of eastern Mediterranean Middle Paleolithic into the desert region in early marine isotopic stage 5. *Scientific Reports* 12: 4466.

BESHKANI A., BEUZEN-WALLER T., BONILAURI S. and GERNEZ G.

2017 The first evidence of Middle Paleolithic Nubian technology in north-central Oman. *Antiquity* 91 356, -1. 1–5. DOI: <https://doi.org/10.15184/aqy.2017.4>

BESHKANI A.

2020 The Net of Nubian Core and foldability: An Attempt to individualize the Lithic Technology in Palaeolithic. In: BRETZKE K., CRASSARD R. and HILBERT Y.H. (eds.), *Stone Tools of Prehistoric Arabia*: 65-82. Oxford: Archaeopress.

BOËDA E.

1982 Étude expérimentale de la technologie des pointes Levallois. In: CAHEN D. (ed.), *Tailler! pour quoi faire? Préhistoire et technologie lithique II*: 23-56. Tervuren: Koninklijk Museum voor Midden-Afrika (*Studia Praehistorica Belgica* 2).

2005 Le site d'Umm el Tlel (Syrie central). In: *Archéologies, vingt ans de recherches françaises dans le monde* : 442-445. Paris, Ministère des Affaires Étrangères: Maisonneuve et Larose – ADPF.ERC.

BOËDA E., BOURGUIGNON L. et GRIGGO C.

1998 Activités de subsistance au Paléolithique moyen: couche VI3 b' du gisement d'Umm el Tlel (Syrie). In: BRUGAL J.P., MEIGNEN L. and PATHOU-MATHIS M. (eds.), *Économie Préhistorique: les comportements de subsistance au Paléolithique. XVIIIe Rencontres internationales d'Archéologie et d'Histoire d'Antibes*: 243-258. Sophia Antipolis: APCDA.

BOËDA E., COURTY M. A., FEDOROFF N., GRIGGO C., HEDLEY I. G. et MUHESEN S.

2004 Le site Acheuléen d'El Meirah, Syrie. *BAR International Series*, 1263: 165–201.

BOËDA E., GRIGGO C. et NOËL-SORIANO S.

2001 Différents modes d'occupation du site d'Umm el Tlel au cours du Paléolithique moyen (El Kowm, Syrie centrale). *Paléorient* 27,2: 13-28.

BOËDA E. et MUHESEN S.

1993 Umm-El-Tlel (El Kowm, Syrie) : étude préliminaire des industries lithiques du Paléolithique moyen et supérieur. 1991-1992. *Cahiers de l'Euphrate* 7: 47-91. Paris: Recherche sur les civilisations.

BONILAURI S.

2010 *Les outils du Paléolithique moyen: une mémoire technique oubliée? Approche technofonctionnelle appliquée à un assemblage lithique de conception Levallois provenant du site d'Umm el Tlel (Syrie centrale)*. Thèse de doctorat non publiée. Université de Paris Ouest Nanterre La Défense.

2015 Le débitage Levallois: un concept de préhension normalisé et varié? Exemples de productions levalloiso-moustériennes issues du site d'Umm el Tlel, Syrie centrale. *Paléorient* 41,1: 83-115.

BONNEMAISON J.

2000 *La géographie culturelle*. Paris: Éditions du CTHS.

BOURG H.

2007 Economie de production au Paleolithique moyen proche-oriental: la couche VI 3 a' d'Umm el Tlel (Syrie centrale). *L'Anthropologie* 111,3: 367–399.

BRETZKE K., DRECHSLER P. and CONARD N.J.

2012 Water availability and land use during the Upper and Epipaleolithic in Southwestern Syria. *Journal of Archaeological Science* 39,7: 2272-2279.

- CHIOTTI L., DIBBLE H.L., MCPHERRON S.P., OLSZEWSKI D.I. et SCHURMANS U.A.
- 2009 Prospections sur les plateaux désertiques du désert libyque égyptien (Abydos, Moyenne Egypte). Quelques exemples de technologies lithiques. *L'Anthropologie* 113 : 341-355.
- CLARK J.D.
- 1988 Middle Stone Age of East Africa and the beginnings of regional identity. *Journal of World Prehistory* 2: 235-305.
- COPELAND L.
- 1975 The Middle and Upper Paleolithic of Lebanon and Syria in the Light of Recent Research. In: WENDORF F. and MARKS A.E. (eds.), *Problems in Prehistory: North Africa and the Levant*: 317-350. Dallas: Southern Methodist University Press.
- 1981 Chronology and distribution of the Middle Paleolithic, as known in 1980, in Lebanon and Syria. In : CAUVIN J. and SANLAVILLE P. (eds.), *Préhistoire du Levant - Chronologie et organisation de l'espace depuis les origines jusqu'au VIe millénaire*: 239-264. Paris: Éditions du CNRS.
- CRASSARD R, HILBERT Y.H., PREUSSER F., WULF G. and SCHIETTECATTE J.
- 2019 Middle Palaeolithic occupations in central Saudi Arabia during MIS 5 and MIS 7: new insights to the origins of the peopling of Arabia. *Archaeological Anthropological Sciences* 11: 3101–3120.
- CRASSARD R. and HILBERT Y.H.
- 2013 A Nubian Complex site from central Arabia: implications for Levallois taxonomy and human dispersals during the Upper Pleistocene. *PLoS One* 8: 69221.
- DOCKALL J.E.
- 1997 *Technological and functional variability of convergent tools from Nahr Ibrahim, Lebanon: Behavioral Implication for Levantine Mousterian Technological Organization*. Thèse de 3e cycle. Texas A and M University.
- EMERY-BARBIER A.
- 1998 Analyses palynologiques du site d'Umm-el-Tlel (El Kowm, Syrie). In : OTTE M. (dir.) : *Préhistoire d'Anatolie, Genèse de deux mondes*: 765-774. Liège : ERAUL.
- GARROD D.A.E. and BATE D.M.A.
- 1937 *The Stone Age of Mount Carmel, I : excavations at the Wad-el-Mughara*. Oxford: Clarendon Press.
- GUICHARD J. and GUICHARD G.
- 1965 The Early and Middle Paleolithic of Nubia: a preliminary report. In: WENDORF F. (ed.), *Contributions to the Prehistory of Nubia*: 57-116. Dallas: Fort Burgwin and Southern Methodist University Press.
- GODER-GOLDBERGER M. and BAR-MATTHEWS M.
- 2019 Novel chrono-cultural constraints for the Middle Paleolithic site of Rosh Ein Mor (D15), Israel. *Journal of Archaeological Science* 24 : 102-114.
- GODER-GOLDBERGER M., GUBENKO N. and HOVERS E.
- 2016 “Diffusion with modifications”: Nubian assemblages in the central Negev highlands of Israel and their implications for Middle Paleolithic inter-regional interactions. *Quaternary International* 408: 121-139.



GOREN-INBAR N. and BELFER-COHEN A.

1998 The technological Abilities of the Levantine Mousterians: Cultural and Mental Capacities. *In: AKAZAWA T., KENICHI A. and BAR-YOSEF O. (eds), Neandertals and Modern Humans in Western Asia: 107-125.* New York: Plenum Press.

GRIGGO C.

1999 Les occupations moustériennes du complexe VI3 d'Umm el Tlel (Syrie): taphonomie en milieu steppique. *Anthropozoologica* 29: 3-12.

2000 Adaptations environnementales et activités de subsistance au Paléolithique moyen en Syrie. *Annales de la fondation Fyssen* 15: 49-62.

GROUCUTT H. S.

2020 Culture and Convergence: The Curious Case of the Nubian Complex. *In: Culture History and Convergent Evolution: Can We Identify Populations in Prehistory?: 55–86.* Cham: Springer International Publishing.

HALLINAN E., BARZILAI O., BICHO N., BESHKANI A., CASCALHEIRA J., DEMIDENKO J., GODER-GOLDBERGER M., HILBERT Y.H., HOVERS E., MARKS A.E., NYMARK A., OLSZEWSKI D., ORON M., ROSE J.I., SHAW M. and USIK V.

2022 The nature of Nubian: Developing current global perspectives on Nubian Levallois technology and the Nubian complex. *Evolutionary Anthropology* 31: 227-232.

HAUCK T.

2011 Mousterian technology and settlement dynamics in the site of Hummal (Syria). *Journal of Human Evolution* 61,5: 519-537.

HENRY D.O.

2003 *Neanderthals in the Levant. Behavioral Organization and the Beginning of Human Modernity.* London/New York: Continuum.

HILBERT Y.H., CRASSARD R., and CHARLOUX G.

2017 Technological analysis of the Al-Jawf Middle Paleolithic assemblages. *Quaternary International* 435: 77–93.

HOURS F., COPELAND L. et AURENCHÉ O.

1973 Les industries paléolithiques du Proche-Orient, essai de corrélation. *L' Anthropologie* 77,3/4: 229-280.

HOVERS E.

1998 The lithic assemblages of Amud Cave. Implications for understanding the end of the Mousterian in the Levant. *In: AKAZAWA T., KENICHI A. and BAR-YOSEF O. (eds), Neandertals and Modern Humans in Western Asia: 143-163.* New York: Plenum Press.

2001 Territorial behavior in the middle Paleolithic of the southern Levant. *In: CONARD N.J. (ed.), Settlement Dynamics of the Middle Paleolithic and Middle Stone Age: 123-152.* Tübingen: Kern Verlag.

2009 *The Lithic Assemblages of Qafzeh Cave.* Oxford: University Press.

LE TENSORER J.–M.

2004 Nouvelles fouilles à Hummal (El Kowm, Syrie centrale) premiers résultats (1997–2001). *BAR International Series* 1263: 223–239.

LE TENSORER J.-M., JAGHER R. and MUHESEN S.

2001 Paleolithic Settlement Dynamics in the El Kowm Area (Central Syria). *In*: CONARD N.J. (ed.), *Settlement Dynamics of the Middle Paleolithic and Middle Stone Age*: 101-122. Tübingen, Kerns Verlag, Tübingen Publications

LE TENSORER J.-M., MUHESEN S. et JAGHER R.

1993 Nadaouiyeh Aïn Askar: une grande séquence paléolithique du bassin d'El Kowm (Syrie), premiers résultats, fouilles 1989- 1992. *Cahiers de l'Euphrate* 7: 11-36.

LOURDEAU A.

2011 Stability in the intermittence: a spatio-temporal approach to Mousterian behaviour in the Near East based on the technological analysis of lithic industries of complex VI3 at Umm el Tlel (Central Syria). *In* : CONARD N.J. and RICHTER J. (eds.), *Neanderthal lifeways, subsistence and technology. One hundred fifty years of Neanderthal study*: 167-186. Dordrecht/New York: Springer. Vertebrate Paleobiology and Paleoanthropology, 19.

MARKS A.E.

1968 The mousterian industries of Nubia. *In*: WENDORF F. (ed.), *The Prehistory of Nubia vol.I*: 194-314. Dallas: Fort Burgwin Research Center and Southern Methodist University Press.

MASOJC M., KUSIAK J., STANDZIKOWSKI K., PANER H., KUC M., PARAFINIUK M. and SZMIT M.

2017 OSL/IRSL estimation for Nubian Complex Middle Stone Age settlement from Bayuda Desert in Sudan. *Journal of Archaeological Science* 16: 391–396.

MEIGNEN L.

1995 Levallois lithic production systems in the Middle Paleolithic of the Near East: The case of the unidirectional method. *In*: DIBBLE H.L. and BAR-YOSEF O. (eds.), *The definition and interpretation of Levallois Technology* : 361-380. Madison: Prehistory Press.

1998 Le Paléolithique moyen au Levant sud et central: que nous apprennent les données récentes ? *In* : OTTE M. (ed.), *Préhistoire d'Anatolie, Genèse de deux mondes*: 685-708. Liège: ERAUL, 85.

2019 The Mousterian lithic assemblages from Kebara Cave. *In*: MEIGNEN L. and BAR-YOSEF O. (eds.), *Kebara Cave, Mt Carmel, Israel. The Middle and Upper Paleolithic Archaeology. Part II*: 1-147. Cambridge Massachusetts: Peabody Museum Press (American School of Prehistoric Research Bulletin, 51).

MEIGNEN L. et BAR-YOSEF O.

2004 Réflexions sur la fin du Paléolithique moyen et les débuts du Paléolithique supérieur au Proche-Orient. *In*: VAN PEER PH., SEMAL P. and BONJEAN D. (eds.), *Le Paléolithique moyen - The Middle Paleolithic. Session 5: Sessions générales et posters. Actes du XIVe Congrès UISPP, Université de Liège, Belgique, 2-8 septembre 2001*: 235-246. Oxford: Hadrian Books (British Archaeological Reports International Series 1239).

MEIGNEN L. and BAR-YOSEF O. (ed.)

2019 *Kebara Cave, Mt Carmel, Israel. The Middle and Upper Paleolithic Archaeology. Part II*. Cambridge Massachusetts: Peabody Museum Press (American School of Prehistoric Research Bulletin, 51).

MEIGNEN L., BAR-YOSEF O., SPETH J.D. and STINER M.C.

2006 Middle Paleolithic settlement patterns in the Levant. *In*: HOVERS H. and KUHN S.L. (eds.), *Transitions before the transition: evolution and stability in the Middle Paleolithic and Middle Stone Age* : 149-169). New York: Springer.

MERCIER N. et VALLADAS H.

2003 Chronologie par la thermoluminescence de gisements du Paléolithique moyen du Proche-Orient. In : VANDERMEERSCH B. (ed.), *Échanges et diffusion dans la préhistoire méditerranéenne. Actes du 121e Congrès national des sociétés historiques et scientifiques, Section pré- et protohistoire, Nice, 199* : 147-156. Nice: Éditions du CTHS.

MERCIER N., VALLADAS H. and VALLADAS G.

1995 Flint Thermoluminescence dates from the CFR Laboratory at Gif: Contributions to the Study of the Chronology of the Middle Paleolithic. *Quaternary Science Reviews (Quaternary Geochronology)* 14: 351-364.

MERCIER N, VALLADAS H, FROGET L, JORON J-L, VERMEERSCH P.M., VAN PEER P. and MOEYERSONS K.

1999 Thermoluminescence dating of a Middle Palaeolithic occupation at Sodmein Cave, Red Sea Mountains (Egypt). *Journal of Archaeological Science* 26: 1339–1345.

MERCIER N., VALLADAS H., FROGET L., JORON J.-L., REYSS J.-L., WEINER S., GOLDBERG P., MEIGNEN L., BAR-YOSEF O., BELFER-COHEN A., CHECH M., KUHN S.L., STINER M.C., TILLIER A.-M., ARENSBURG B. and VANDERMEERSCH B.

2007 Hayonim Cave: a TL-based chronology for this Levantine Mousterian sequence. *Journal of Archaeological Science* 34, 7: 1064-1077.

NISHIAKI Y. and COPELAND L.

1992 Keoue Cave, Northern Lebanon, and its Place in the context of the Levantine Mousterian. In: AKAZAWA T., KENICHI A. and BAR-YOSEF O. (eds.), *The Evolution and Dispersal of Modern Human in Asia*: 107-127. Tokyo: Hokusen-sha.

NISHIAKI Y., KANJO Y., MUHESEN S. and AKAZAWA T.

2012 The temporal variability of Late Levantine Mousterian Lithic Assemblages from Dederiyeh Cave, Syria. *Eurasian Prehistory* 9,1/ : 3-27.

OLSZEWSKI D.I., DIBBLE H.L., MCPHERRON S.P., SCHURMANS U.A., CHIOTTI L. and SMITH J.R.

2010 Nubian Complex strategies in the Egyptian high desert. *Journal of Human Evolution* 59: 188-201.

PAGLI M.

2013 *Variabilité du Moustérien au Proche-Orient. Approche géographique des dynamiques de changement en milieu méditerranéen et en milieu steppique*. Thèse de 3<sup>e</sup> cycle non publiée. Université Paris X – Nanterre.

2015 Middle Paleolithic variability in the Near East as a reflection of different settlement dynamics: a comparative study of Umm el Tlel , Yabrud I (Syria) and Ksar Akil (Lebanon). In: CONARD N.J. and DELAGNES A. (eds.), *Settlement Dynamics of the Middle Paleolithic and Middle Stone Age*: 145-170. Tübingen: Kern Verlag.

PASTOORS A., WENIGER G.-C. and KEGLER J.F.

2008 The Middle-Upper Paleolithic Transition at Yabroud II (Syria). A re-evaluation of the lithic material from the Rust excavation. *Paléorient* 34,2: 47-65.

RASSE M. et BOËDA E.

2006 De la lecture verticale à la lecture spatiale des enregistrements archéologiques: réflexions géographiques tirées de l'exemple du site d'Umm el Tlel (Syrie centrale). *M@ppemonde* 83: 1-11.

- ROSE J.I., USIK V.I., MARKS A.E., HILBERT Y.H., GALLETTI C.S., PARTON A., GEILING J.-M., CERNÝ V., MORELY M.W. and ROBERTS R.G.
- 2011 The Nubian complex of Dhofar, Oman: an African Middle Stone Age industry in southern Arabia. *PLoS One* 6 (11): 28239.
- SCHIETTECATTE J, AL-GHAZZI A, CHARLOUX G, CRASSARD R, HILBERT YH, MONCHOT H, MOUTON M and SIMEON P.
- 2013 Al-Kharj oasis through time: first results of archaeological fieldwork in the province of Riyadh (Saudi Arabia). *Proceeding of the Seminar for the Arabian Studies* 43: 285–308.
- SHEA J.J.
- 2003 The Middle Paleolithic of East Mediterranean Levant. *Journal of World Prehistory* 17: 313-394.
- SMITH J.R., HAWKINS A.L., ASMEROM Y., POLYAK V. and GIEGENGACK R.
- 2007 New age constraints on the Middle Stone Age occupations of Kharga Oasis, Western Desert, Egypt. *Journal of Human Evolution* 52: 690–701.
- SOLECKI R.S.
- 1970 Summary report of the Columbia University prehistoric investigations in Lebanon, season 1969. *Bulletin du Musée de Beyrouth* 23: 95-127.
- USIK V.I., ROSE J.I., HILBERT Y.H., VAN PEER P. and MARKS A.E.
- 2013 Nubian Complex reduction strategies in Dhofar, southern Oman. *Quaternary International* 300: 244-266.
- VALLADAS, H., MERCIER N., HERSHKOVITZ I., ZAIDNER Y., TSATSKIN A., YESHURUN R., VIALETES L., JORON J.-L., REYSS J.-L. and WEINSTEIN-EVRON M.
2013. Dating the Lower to Middle Paleolithic transition in the Levant: a view from Misliya Cave, Mount Carmel, Israel. *Journal of Human Evolution* 65 : 585-593.
- VAN PEER P.
- 1992 *The Levallois reduction strategy*. Monographs in World Prehistory 13.
- VAN PEER P. and VERMEERSCH P.
- 2007 The place of northeast Africa in the early history of modern humans: new data and interpretations on the Middle Stone Age. In: MELLARS P., BOYLE K., BAR-YOSEF O. and STRINGER C. (eds.), *Rethinking the Human Revolution*: 187-198. Cambridge: McDonald Institute for Archaeological Research.
- WENDORF F., SCHILD R., CLOSE A.E., SCHWARCZ H.P., MILLER G.H. ET AL.
- 1994 A chronology for the middle and late Pleistocene wet episodes in the eastern Sahara. In: BAR-YOSEF O. and KRA R.S. (eds.), *Late Quaternary Chronology and Paleoclimates of the Eastern Mediterranean*: 147-168. Tucson: Radiocarbon, Department of Geosciences, University of Arizona.
- ZAIDNER Y., FRUMKIN A., PORAT N., TSATSKIN A., YESHURUN R. and WEISSBROD L.
- 2014 A series of Mousterian occupations in a new type of site: the Nesher Ramla karst depression, Israel. *Journal of Human Evolution* 66: 1-17.