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New Insights into European Sites With Large Flakes: Observatoire Cave (Monaco) vs the Open-Air Site of Chanos-Curson (Drôme, France)

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Abstract

The publication of H. Breuil in 1932 defining the Clactonian culture was based, in particular, on two reference sites: Observatoire Cave (Monaco) and the open-air site of Curson (Chanos-Curson, Drôme, France). This choice was due to the exceptional lithic series from these sites consisting of abundant large Clactonian flakes. After the resumption of research in Observatoire Cave, the study of the lithic assemblages at the base of the infilling renewed the characterization of the technical and cultural environment of the Monegasque assemblages. It thus seemed judicious to compare them once again with those from Curson, in order to refine and verify the technical links between the assemblages. The lithic industries from these two sites actually reveal different typological compositions due to the type and functions of occupations. These disparities were accentuated by heterogeneous acquisition methodologies and the early period of excavations. Nonetheless, the analysis and comparison of these assemblages highlight the singularity of the lithic series and, in particular, of the remarkable series of large Clactonian flakes. The economic, technical, technological and morpho-functional behaviours involved in making these products are very similar and incite us to place them in the same technical tradition. On the other hand, specific characters attest to independent adaptations and innovations. These Acheulean-Clactonian assemblages, which are not very common in southeast France and in northern Italy, seem to present similarities with Acheulean series from the Iberian Peninsula and southwest France.

Keywords Large flake · Acheulean · Clactonian · Lithic technology · Morpho-function analyses · Cleavers · Hammerstones

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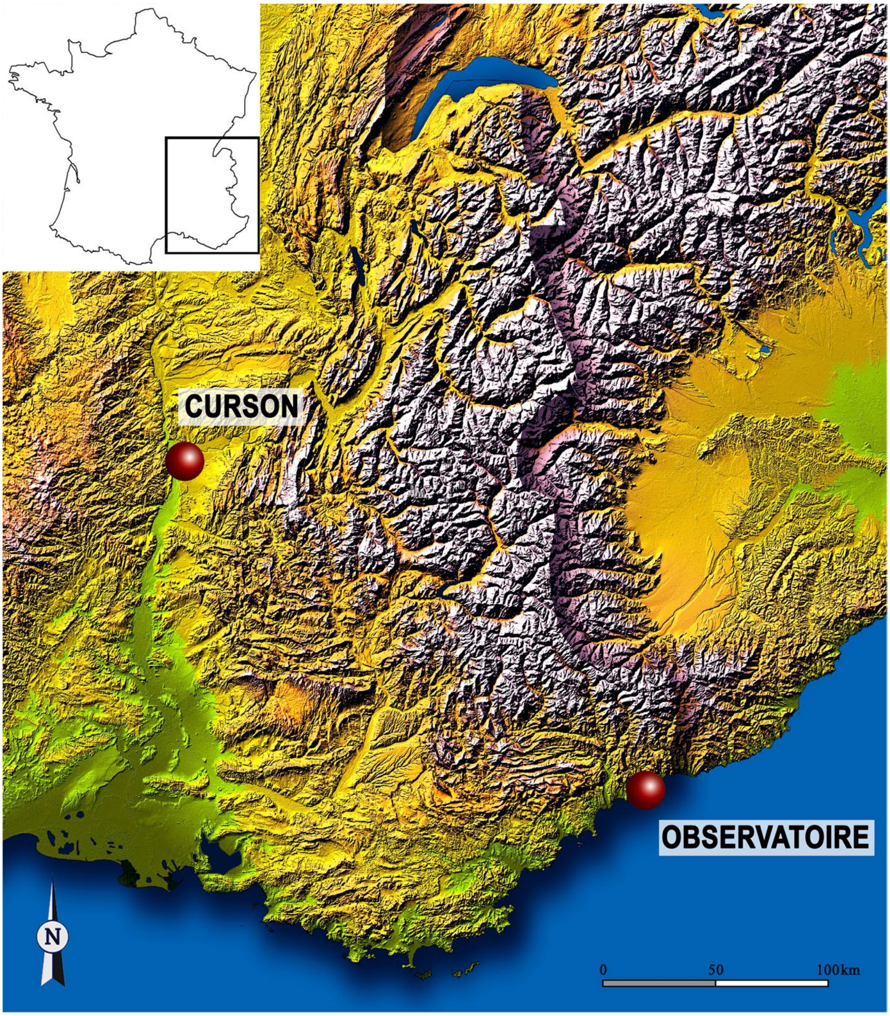


Fig. 1 Geographic position of the site of Curson and Observatoire Cave

Introduction

Observatoire Cave in Monaco (Fig. 1) aroused much interest when the site was first published in 1927 (Boule & Villeneuve, 1927). The singular lithic assemblages in the oldest archaeological units attracted the attention of the scientific community at the time and, in particular, of H. Breuil, who was in the process of drawing up a chronocultural framework for the Palaeolithic. He subsequently published the assemblage in his reference book *Les industries à éclats du Paléolithique ancien* (Breuil, 1932, pp. 16–190), to illustrate the Clactonian culture, concomitant with the Acheulean. In addition to the eponymous site Clacton-on-sea, he presented many other English and European sites, in particular the Observatoire Cave and Curson sites (Drôme, France). The association of the latter two sites as representatives of the Clactonian in the south of France was later taken up by Pottier (1938).

Over the past few years, the resumption of work in Observatoire Cave and the exhaustive study of the assemblage from the base of the infillings of layers i, k and l (Brugal et al., 2017; Notter et al., 2017; Porraz et al., 2014; Rossoni-Notter et al., 2016a) have enhanced our knowledge of the short and specialized occupations and the lithic productions. The latter are characterized by the importation of large flakes, associated with used pebbles and a biface. This overabundance of large flakes is also characteristic of the open-air site of Curson (Drôme, France), which was studied over 40 years ago (Brochier, 1976). A new study was thus undertaken in November 2015, at the Musée des Confluences in Lyon (France) and at the Institut de Paléontologie humaine in Paris (France) in order to analyse the whole lithic series.

Since then, the very notion of the Clactonian has become controversial, but it nonetheless seemed important to us to compare these two relatively geographically close assemblages (southeast of France) and their technical particularisms from a new perspective.

The comparison of their chronostratigraphic contextualization and their techno-morpho-functional analyses has shed new light on the operative and working modes of these very specific lithic series in the Lower Palaeolithic landscape of Western Europe.

Observatoire Cave

Geographic, Geological, Historic Context

Observatoire Cave opens below the steep cliffs of the present-day Exotic Gardens of the Principality of Monaco (latitude 43° 43′ 51.90″ N–longitude 7° 24′ 50.02″ E), at 100 m asl. The cave is located 150 m from the original shoreline of Fontvieille and rests against the southern sub-Alpine mountains, overlooking the western access of the vast natural amphitheatre of the present-day Principality of Monaco and the commune of Beausoleil (France). The latter is part of the Liguro-Provençal corridor that served as a refuge for Pleistocene fauna. Besides this strategic position, the dimensions of this vast cave were undoubtedly an additional factor in the choice of the site by populations of Lower Palaeolithic hunter-gatherers. However, difficult access to the site seems to have been a drawback to the long and permanent installation of groups, who only made brief halts there for specialized activities, alternating with carnivore occupations (Brugal et al., 2017; Notter et al., 2017).

The cave cliff is part of a thrust imbrication in Upper Jurassic dolomitic limestone (Kimmeridgian-Tithonian marine limestones) that runs into the sea. The cave developed as a result of dissolution and karstification along a northeast/southwest fault line (Boule & Villeneuve, 1927; Barral, 1950; Gilli, 1999a, b). The Observatoire Cave network runs along about a hundred metres and joins a water table near sea level (Gilli, 1999a). The archaeological infilling formed on a chaos of blocks from an altitude of about 81.5 to 103 m asl.

The first archaeological activities in this cave took place in 1916 after the first development works for the Exotic Gardens. For 4 years, excavations led by Léonce de Villeneuve, under the leadership of Prince Albert 1st of Monaco, extracted about 20 m of Quaternary sediments and revealed a significant stratigraphic sequence. The results of this first campaign were published in a remarkable monograph in 1927 by M. Boule and L. de Villeneuve. This first intervention left some sedimentary remains which were in turn partly truncated by the touristic development of the cave in 1950. During the 1980s (1982–1983 and 1986–1987), a second excavation campaign was carried out in conjunction with a series of dates on the flowstones of the sequence (Simone, 1993). The zone excavated by the teams of the Museum of Prehistoric Anthropology of Monaco (under the direction of L. Barral and S. Simone) is located at the base of the stratigraphy (level 'l') and had not been explored up until then. Since 2016, after the exhaustive analysis of the lithic material from the lower complexes, new excavations have been in progress (under the direction of some of us — O.N. and E.R.-N.) on archaeological remnants throughout the sequence, in order to clarify the archaeostratigraphic and chronological framework of the whole sequence (Notter et al. 2017; Rossoni-Notter et al., 2016a, b, c).

Stratigraphic and Chronostratigraphic Context

The long stratigraphic sequence of the cave extends from the Lower Palaeolithic to the Upper Palaeolithic. After the Palaeolithic, no Holocene occupations were observed, apart from the presence of an isolated polished axe discovered below the cave entrance and nineteenth century graffiti on the wall of the shelter adjacent to the cave entrance. Human occupations undoubtedly ceased as a result of rock falls which made access to the cave extremely difficult, as noted in a letter addressed by Léonce de Villeneuve to the Secretary of the Authorities, dated 26 March 1898 (Princely Palace Archives).

During the first archaeological operations, the archaeostratigraphic levels were named 'foyers' (ashy layers containing archaeological objects according to Villeneuve in Boule and Villeneuve, 1927). Overall, 18 of these layers were identified, in addition to a level at the base of the infilling described in the 1980s (level 'l'). These archaeological horizons are clustered into three archaeostratigraphic groups interstratified by four flowstones.

The upper group, located at the cave entrance and named 'the chamber', lies on a flowstone (flowstone I), which hermetically seals the infilling made up of reddish-brown silty sediments and blocks. The occupations in this group are contemporaneous with the Upper Palaeolithic, made up of Proto-Aurignacian ('layers' F and G), Aurignacian ('layer' E) and Gravettian ('layers' A, B and C) levels (Boule & Villeneuve, 1927; Onoratini and Raux, 1992, Onoratini et al., 1999, Onoratini and Simon, 2006; Porraz et al., 2010; Rossoni-Notter et al., 2016a; Doyon, 2017; Romandini, 2017; Notter et al., 2017).

The underlying middle group is situated below the 'Chamber', in a zone called the 'Crypt' by the first excavator and contains abundant fauna in a gravelly clay. The lithic assemblage is attributed to the Mousterian (Boule & Villeneuve, 1927), but due to the scarcity of artefacts ($n = 21$), this cannot be definitively confirmed (Notter et al., 2017; Rossoni-Notter et al., 2016a). Hearths a and b in this group lie on flowstone II, which also seals the surface of the site.

The lower group is part of the red clay sediments filling two vertical and adjacent crevices below the 'Crypt' and known as the 'Pit'. This group is about 10 m thick and comprises two flowstones (flowstone III which sealed the surface and flowstone IV which was partial). This group is divided into two cultural horizons. The first is attributed to the Final Acheulean or the Pre-Mousterian (layers d, e, f, h and 1) and contained two bifacial elements associated with debitage products, including Levallois products. The second contained the Acheulean-Clactonian assemblages which are the focus of the present paper (layers i and k and level l).

The sporadic stratigraphic indications for the fauna during the first explorations show that ibex is omnipresent in the whole infilling (Boule & Villeneuve, 1927; Chaix & Desse, 1982, 1983, 1991) but only rarely bears evidence of predation (Brugal et al., 2017; Notter et al., 2017; Romandini, 2017; Rossoni-Notter et al., 2016a). The carnivore guild is well represented and shows alternating carnivore and human occupations (Brugal et al., 2017). The associations reveal mixed environments with cold (reindeer, horse, arctic fox, marmot) to more temperate forms (deer, wild boar, red deer) in the two upper groups and seemingly more temperate groups in the Pit (Boule & Villeneuve, 1927; Brugal et al., 2017; Romandini, 2017).

At the same time as the excavation campaign by L. Barral and S. Simone at the base of the infilling of the Pit (archaeological level l), a dating campaign was conducted on all the flowstones of the sequence with the U/Th method. The samples attributed to flowstone I did not yield any conclusive results, and flowstone IV was not identified. On the other hand, samples attributed to flowstones II and III yielded dates older than 178 ka for flowstone II and older than 230 ka for flowstone III (Haussmann *in* Simone, 1993). In addition, the analysis of the microfauna from level 1 (Viriot et al., 1991) records the transition from an interglacial forest (*Glis glis*, *Eliomys quercinus*, *Muscardinus avellanarius*, *Apodemus sylvaticus*) to a glacial steppe (*Cricetus cricetus*, *Microtus agrestis*, *Microtus arvalis*) based on these associations and the presence of *Pliomys episcopalis*, which correlate this deposit with the Holsteinian, during MIS 11 and 10 (Simone, 1993). Thus, the Acheulean-Clactonian occupations situated in the Pit are earlier than or contemporaneous with the beginning of MIS 7 and would be contemporaneous with MIS 10 and 11. An extensive dating campaign is currently in progress (U-Th, ESR, Al-Be) in order to verify previous chronological data and to sample other locations to clarify the exact position of the different assemblages.

Material and Conservation

Most of the archaeological collections from Observatoire Cave are curated at the Museum of Prehistoric Anthropology of Monaco, but a small series of large flakes is also conserved at the Institute of Human Paleontology in Paris (I.P.H.), sent by Prince Louis II to H. Breuil: '…the small characteristic batch generously donated by Prince Louis of Monaco along with casts for the collections of the I.P.H., in memory of his late august Father, Prince Albert I (Breuil, 1932, p.187).

As the first excavations of this site took place at a very early date, several analytical precautions must be taken before studying the collections. The stratigraphic framework established by L. de Villeneuve is rather broad, although descriptions are precise, with a selection of well-contextualized pieces (this is the case in particular for the lithic assemblages from layers i and k concerned by this study) but also with major lacunae, such as the rarity of stratigraphic data for the faunal remains (Brugal et al., 2017; Notter et al., 2017; Romandini, 2017; Rossoni-Notter et al., 2016a).

The techniques of investigation also truncated the collection left by prehistoric groups (absence of sieving, excavation with earthwork tools, non-specialized excavators). It is difficult to evaluate this bias, but we can nonetheless have some idea of its extent by examining the lithics collected in the upper levels (presence of small elements such as Dufour bladelets), where no discrimination based on typological or technical criteria is evident (fragments/debitage or shaping debris are present in the collection). Thus, even though the collection must be partly truncated, the series nonetheless seem to accurately portray the activities that took place there during the second half of the Middle Pleistocene (Notter et al., 2017; Rossoni-Notter et al., 2016a).

On the other hand, level l was explored during the 1982–1987 campaigns by systematic excavations, with planimetric data for the archaeological objects and sediment sieving. However, considering that the surrounding sediments were backfill from the previous excavation campaign (Porraz et al., 2014), no accurate stratigraphic referencing was available. After the exhaustive study of the collection from level 1 (Rossoni-Notter et al., 2016a) and the resumption of excavations in 2016, we can confirm that these objects are in situ and only underwent slight lateral displacements, at the most.

The fauna identified in the sequence enables us to draw up a non-exhaustive list of the represented species:

The faunal lists from the Pit, established after the first excavations, comprise abundant *Capra ibex* and, to a lesser degree, cervids and bovids. Carnivores are varied with an abundance of *Canis lupus* and *Cuon alpinus* and the presence of *Lynx spelaea*, *Felis pardus* and *Ursus spelaeus*. *Vulpes vulgaris* and *Ursus arctos* may also complete the list, but at the present time, the latter attributions are not clear (Boule & Villeneuve, 1927; Chaix & Desse, 1982, 1983, 1991; Brugal et al. 2017).

The large mammals from layer l also include abundant *Capra ibex* remains, several elements of cervids sp., *Capreolus* sp. and perhaps *Rupicapra rupicapra*. Carnivore remains are less abundant, represented by *Felis pardus* and *Ursus spelaeus*. However, new excavation campaigns yielded an important concentration of coprolites and traces of carcass processing by medium-sized carnivores. The list of rodents indicates a transition from an interglacial forest to a glacial steppe and places the deposits in the Holsteinian, during MIS 11 and 10 (Simone, 1993; Viriot et al., 1991).

Overall, the lithic corpus from the Acheulean-Clactonian levels (layers i, k, i–k and level l) contains 429 artefacts, made up of 276 pieces in layers i, k, i–k and 153 in level l.

The lithic assemblages from layers i ($n = 11$), k ($n = 170$) and i–k ($n = 95$) are grouped together here as typological and technological similarities indicate identical activities (Notter et al., 2017; Rossoni-Notter et al., 2016a). They include dominant large cutting tools on large flakes (Mourre, 2003; Mourre & Collonge, 2009–2010; Sharon, 2006, 2009, 2010), associated with a significant number of pebbles with traces of varied use, when surfaces are sufficiently well preserved. A single biface with a cortical base accompanies these tools, along with several flakes and debris in limestone. In level l, the assemblage appears to be more varied, with a high proportion of pebbles used as hammerstones, less abundant large cutting tools and higher quantities of smaller debitage products and associated tools. Up to now, no bifaces have been found in level l (Fig. 2).

The lithic material is very well conserved, with slight patinas covering the surfaces of certain marly limestones; the ridges are sharp with scalar retouch produced during use. Parts of the cutting edges of the large flakes are masked by chipping, caused by the excavation, transport or conservation of the artefacts.

Site of Curson

Geographic, Geological, Historic Context

The open-air site of Curson is situated on the commune of Chanos-Curson (Drôme, France), in the hamlet of Veyrat (Chantre, 1900, 1901, 1922), in the

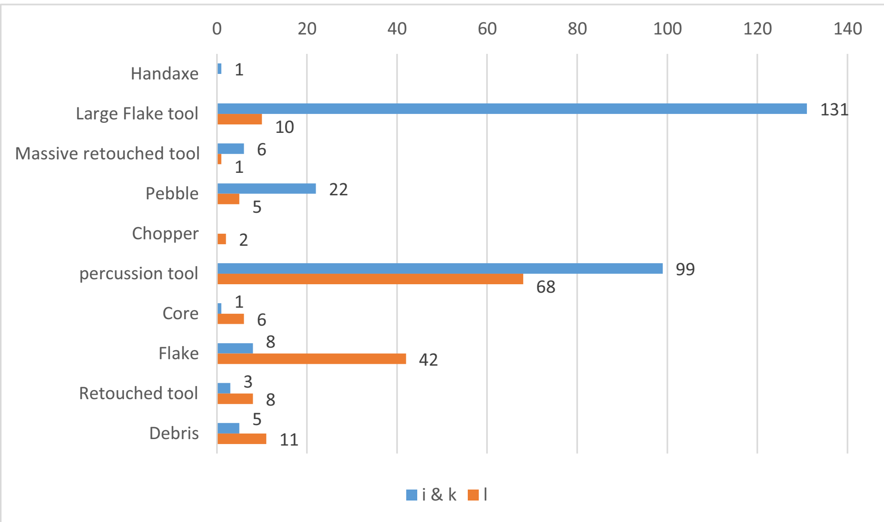


Fig. 2 Typological distribution of the Acheulean-Clactonian lithic material from Observatoire Cave (Principality of Monaco)

'Grand Pré' locality, about 1 km northeast of the village of Curson and 15 km north of Valence (latitude 45° 06′ 59″ N–longitude 4° 93′ 27″ E). It was discovered during work in a small sand quarry in the Veaune Valley (Combier, 1976, 2005), on the side of the road from Valence to Montfalcon (D67). The site is at an altitude of 169 m asl and is part of the Rhône watershed, 7 m above the bed of the Veaune, a small tributary of the Isère River (the site is 40 m above the bed of the latter).

In 1876, during the exploitation of a small sand quarry by Mr. Juge (owner of the adjacent farm), four *Mammuthus intermedius* upper molars were unearthed (Labe & Guérin, 2005; Brochier, 1976). A. Nughes (a dignitary of the commune) reported them to the director of the Natural History Museum of Lyon, L. Lortet. In 1883, E. Chantre (vice-director of the Museum of Lyon) visited the site and initially noted that 'the deposits do not contain any stones' but soon identified for the first time lithic industries associated with the mammoth remains, 'a block of quartzite used as an anvil and several stones in the same material used as hammerstones' (Chantre, 1900, 1901, 1922; Combier, 1976). In December 1884, after the discovery of new bones, E. Chantre extracted a mandible associated with hammerstones and 'quartzite' flakes (Chantre, 1885). He mentioned this new site for the first time the following year (Chantre, 1900, 1901, 1922) and organized an excursion there as part of the 11th session of the Congress of the Section of Anthropology of the French Association in Grenoble (Chantre, 1885). During the excursion, new artefacts were unearthed, and each visitor could take several artefacts away with them (those present included: Mr. Barthélemy, Daleau, de Mortillet, Dr Pommerol, Petit, Salmon and Sirodot). Several days later, the congress members met in the Natural History Museum of Lyon to analyse the artefacts (Chantre, 1885, 1900, 1901, 1922). In 1886 and 1887, new bone fragments (in particular fragments of a humerus and pelvis), associated with large flakes were discovered at a depth of 4 m (Chantre, 1886, 1887). We do not know exactly when the exploitation of the sand quarry stopped, but by 1902, it was definitely no longer in operation (Capitan, 1902, pp. 755–757).

On 21 April 1930, H. Breuil, C. Gaillard (director of the Natural History Museum of Lyon) and C. Côte (archaeologist, patron of Lyon) visited the site and convinced Mr. Juge (descendant of the first excavator) and the owner of the land to carry out new excavations, which yielded several lithic artefacts allowing for the identification of the archaeological level (Laurent, 1961). In 1934, C. Côte carried out the only accessible stratigraphic survey (Bourdier, 1961).

Apart from the faunal remains, several, often early studies of the artefacts were published, but the lithic series was not fully studied. E. Chantre published several characteristic pieces, completed by the publication of H. Breuil (Breuil, 1932), then a paper by J. Combier (Combier, 1976), and then finally by J.-E. Brochier in 1976. H. Breuil proposed a cultural attribution to the Clactonian and subsequently cited the series as a typical Clactonian assemblage in 1932 and confirmed this proposal in 1954 (Breuil & Kelley, 1954). This cultural attribution and that of Observatoire Cave were called into question due to their typological proximity and the presence of bifaces in the Monegasque site. This led H. de Lumley to create a third group in addition to the Acheulean and the Clactonian, which he called the 'Curson type' (Lumley, 1960). This new nomenclature seems to have been rapidly abandoned as the same author subsequently classified the series in the Acheulean (Lumley, 1969, 1976).

Stratigraphic and Chronostratigraphic Context

The Curson site is situated on a hill at 231 m asl, overlooking the Lower Isère Valley, and delimited to the west by the Veaune stream and to the east by the small Herbasse River, both of which are tributaries of the Isère (Fig. 3).

The geomorphology of the watershed is characterized by a series of Quaternary fluvio-glacial terraces deposited by the Isère and the Rhône. These terraces lie on Pliocene marine fossiliferous clays contemporaneous with the ria of the Rhône Valley, which sealed the underlying Miocene molasses. The earliest Pleistocene terrace in the sector is attributed, in the framework of the time, to the 'recent Günz', and indicates an early passage of the Rhône. Remnants of the 'Mindel' terrace are observable on the eastern slope of the hill (Bambier et al. 1979). The Rissian terrace containing the archaeological material lies in the opposite direction and is composed of molassic stratified sands reworked during the infilling of the Veaune Valley, when it was blocked by a fluvio-glacial sheet (Bourdier, 1961). P. Mandier suggested placing these sediments in an alluvial level called 'Curson1-Marquet', which he attributed to the 'early Riss' (Mandier, 1973, 1988). This was subsequently corroborated by J. Combier (2005), who added a chronological attribution to MIS 8 (around 250 ka). C. Guérin (2007) positioned the remains of *Mammuthus intermedius* in biozone MNQ 24, at the end of the Middle Pleistocene, between MIS 8 and 5 (305–105 ka). The whole of this alluvial sequence is partly covered by colluviums.

Excavations by H. Breuil, Cl. Côte and J. Laurent cut into a depth of about 3 m of Mr. Juge's former sand quarry. Taking into consideration the survey conducted

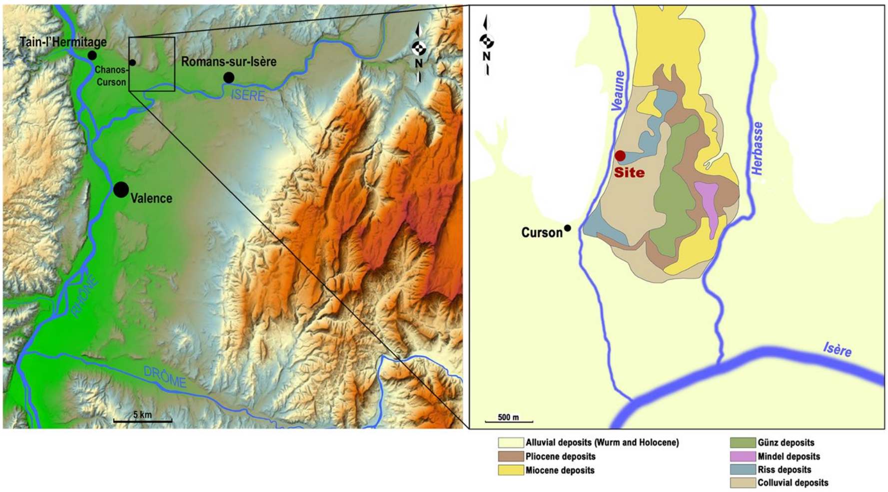


Fig. 3 Topographic and geological map of the site of Curson (Drôme, France)

by Cl. Côte, F. Bourdier proposed to situate the site in the section of the valley (Bourdier, 1967, p. 175) and published the survey plot in 1934 (Fig. 4). The archaeological material of Curson was in contact with Pliocene clays, at the base of the alluvial Rissian level. The latter is made up of a matrix of fine alluvial sands derived from the disaggregation of the molasses in which (from the top towards the base) layers of coarse sand, red sand, clay and black sand were interstratified (Bourdier, 1961; Brochier, 1975, 1976). As the site was no longer accessible, J. Combier and L. Moline drew the section of a small neighbouring sandpit showing 'the same finely stratified sandy sediment, affected at the top by cryoturbation with numerous undulations and plications, visible over a thickness of 1 to 2 m' (Combier, 1976).

These finely stratified sediments reveal a process of low-energy fluvio-lacustrine deposition characteristic of bodies of water, in the form of a lake retained by a glacier dam (Bourdier, 1961; Combier, 1976, 2005). As a result, the site of Curson would appear to correspond to a human occupation on the lakeshore. The artefacts seem to have been submerged below the level of this impoundment, as shown by the presence of ostracods in the carbonated sediments on a large, limestone flake (inventory no. 331 of the Musée des confluences).

Material and Conservation

Due to extraction conditions and the early discovery period of the site, the assemblage from the site is truncated. The site was not really excavated, in the strict sense of the term, but rather explored during the exploitation of the sand quarry by the owner himself. We can thus deduce that only part of the archaeological material was collected and conserved (exploration limited to the surface of the site, selection of collected material, no lithic material collected before at least 1883, absence of sieving, dispersion of part of the collection, …). This lithic and faunal series thus only appears to represent a selected sample of the archaeological potential of Curson. This impression is also backed up by the fact that most of the collected and conserved material dates from

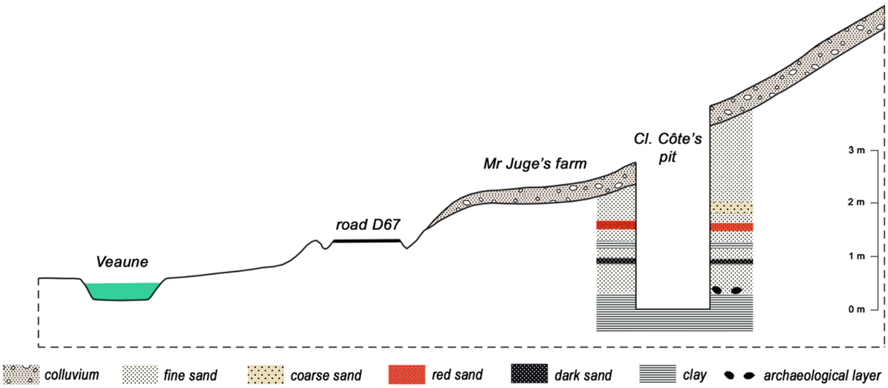


Fig. 4 Schematic section of the site of Curson according to the indications of Claudius Côte (after Bourdier, 1961)

1885, when E. Chantre extracted the mandible. Nonetheless, owing to the supervision of the exploitation by E. Chantre, a significant quantity of objects provides us with a glimpse of the human occupation installed on the lakeshore during MIS 8.

The fauna only includes a single individual attributed to *Mammuthus intermedius* (Chantre, 1886, 1900, 1901; Guérin, 2007; Labe & Guérin, 2005). The list of remains comprises a mandible, two cervical vertebrae (curated at the Musée des Confluences in Lyon), four isolated molars, humerus and pelvic fragments, and, at the time of discovery, 'a whole skull' is also mentioned (Chantre, 1886, 1900, 1901), but the latter may have been used as a lexical abbreviation for the mandible. None of the latter bones are conserved in the Musée des Confluences.

This very partial list only includes a small part of the skeleton, raising questions regarding the potential displacement of the objects in the archaeological level, the partial conservation or incomplete exploration of the site (absence of tusks, lower limbs, …).

The lithic assemblage from Curson is curated at the Musée des Confluences in Lyon, apart from one artefact kept at the Institute of Human Paleontology (I.P.H.) in Paris. Several plaster cast copies were made by H. Breuil in the 1930s and then sent to the I.P.H. and the Musée des Antiquités Nationales in Saint-Germain-en-Laye (France).

The surface state of conservation of the lithics is excellent. A slight greyish patina, sometimes with traces of orange oxides, covers the surfaces. The patinas are sometimes different on both faces of the same object, indicating exposure of part of the object to the open air or water during burial processes. Besides the presence of ostracods mentioned above (cf. above), certain flakes bear sandy concretions issued from the surrounding sediment. The aspect of the cutting edges is very fresh, not rolled or glossy, and only recent chipping, probably resulting from the discovery context, partly masks traces of prehistoric use.

Altogether, this assemblage consists of 66 lithic pieces. The majority of these are large flakes, associated with debitage products (cores, flakes and retouched tools) and a single pebble hammerstone (Fig. 5). The absence of pebbles or certain pieces described in the first publications, 'a block of quartzite used as an anvil and several stones in the same material used as hammerstones' (Chantre, 1900, 1901), implies that the selection of material during collection biased the assemblage.

Methodology

In order to discern hominid behaviour at each site, the different assemblages are first of all characterized by the raw material economy of the diverse techno-groups and the location of the potential provisioning sources. A petrographic analysis of the rocks used at the sites was carried out in order to identify the different lithotypes used. This analysis was based on macroscopic and stereomicroscopic observations and compared to the litho-reference collection at the Museum of Prehistoric Anthropology of Monaco for the raw materials from Observatoire Cave and to samples taken during prospections for the site of Curson. In this way, provisioning sources and the minimum territories exploited for raw material procurement were defined.

The technical components of each site underwent typological and technological analyses in order to ascertain production aims, operational sequences, technical convergences

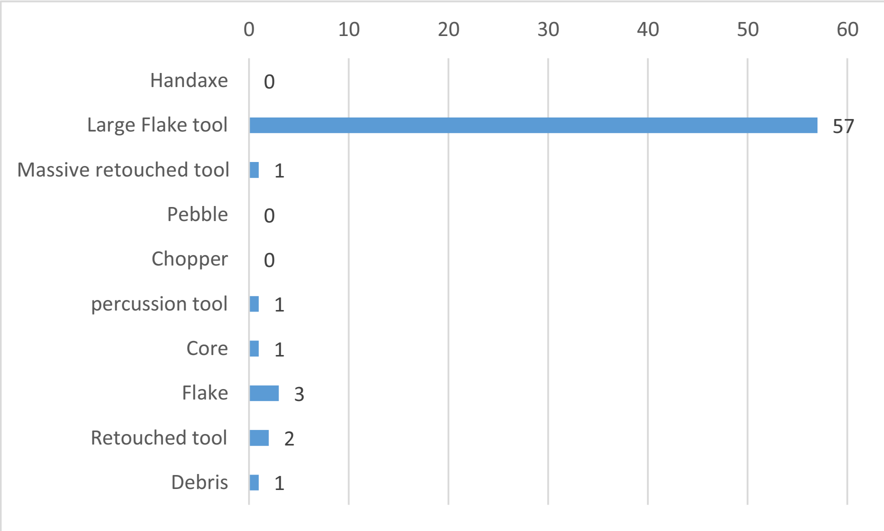


Fig. 5 Typological distribution of the lithic material from Curson (Drôme, France)

but also the specificities of each assemblage. As shown by previous studies (Notter et al. 2017; Rossoni-Notter et al. 2016a) of the large flakes (Kleindienst, 1962) from Observatoire Cave, a morpho-functional analysis (Lepot, 1993; Soriano, 2000; Boëda, 2001, 2013; Nicoud, 2011; Chevrier, 2012, Viallet 2016, De Weyer 2016) is an indispensable complement for the understanding of this range of tools. We thus characterized the surfaces and cutting edges of each piece depending on angles, planimetry and morphology, in order to define and individualize the morpho-functional units of the piece. These units can be active (marked 'UA' followed by an increasing number depending on the steps in the functional history of the object) or passive (marked 'UP' followed by an increasing number depending on the steps in the functional history of the object). These criteria do not enable us to define the use of the tool in the strict sense of the term, but they indicate the working of the tool object by including its ergonomics. The analysis of the morphology combined with the analysis of the selected raw material type, dimensions, weight, edge damage due to use and technology enables us to determine the functional aims of prehistoric groups, to better define the toolkit (active and passive parts), to differentiate edge preparation for maintenance purposes (removals, retouch, fractures …) and to prioritize any potential recycling of the same matrix. These analyses enable us to define the role of the large tools for each of the assemblages presented here.

Results: Technical Behaviour, Observatoire Cave vs Curson

Raw material economy

For both sites, the impact of the selected raw materials is decisive and seems to be adapted to the aims of knappers. The operational sequences linked to pebble exploitation, large flakes/biface and debitage are clearly identifiable and regulate the type of selected lithotypes and indicate the exploited territories.

At Observatoire Cave, most of the pebbles, percussion tools, were collected from beaches near and below the cave (beaches of Monaco and Cap-d'Ail), as shown by the range of selected raw materials: marly limestone, sandstone limestones, sandstone, andesite (derived from pyroclasts from the remains of Oligocene volcanic activity at Cap-d'Ail). Choices focused on subspherical or sub-ovoid morphologies or smaller fist-sized pebbles. Considering the accumulations still observable on present-day natural beaches, the shape and raw materials of these percussion tools indicate drastic selections, as the latter are currently very rare. Jurassic limestones were also used locally (45 pieces in level l and 40 in layers i and k). They are fine limestones, sometimes lithographic and dolomitic. Most of them were imported as pebbles from beach alluvions, but some of them were taken directly from the cave surroundings or even from the cave itself, as shown by the ridges, which are only slightly eroded by karstic dissolution. Native lithographic limestones were also used for debitage.

The large flakes and the biface were made on large pebbles in marly, clayey, siliceous limestone, from the semi-local alluvions of the Paillon and Var basins (Nice, France), 10 to 20 km away, as the crow flies. All these artefacts are found at the site as finished products, shaped outside the site and then brought inside for use in the cave.

Only one piece in flint was found in layer k: a side scraper on a large flake shaped by scalar retouch (*L*: 10 mm, *w*: 60 mm, *th.*: 21 mm). The origin of this flint is unknown; however, it appears to come from an allochthonous source. In level l, more varied siliceous rocks were used for debitage activities. Some of the flint probably comes from the conglomerates of 'I Ciotti', a semi-local source near the Balzi Rossi caves, but other raw materials come from further west, such as a flake in Permian rhyolite from Estérel (Crevola, 2010; Rossoni-Notter, 2011; Marzin, 2015; Rossoni-Notter et al., 2016b, c, 2017a, Rossoni-Notter and Simon 2016; Notter et al., 2017), or a range of flint from the northern Var (Fig. 6).

The procurement zones around Observatoire Cave are divided according to the type of predetermined tools. Raw materials were taken from just outside the cave or from the cave itself for the range of tools linked to percussion activities, and semi-local rocks were selected for the series of large flakes and the biface. Allochtonous raw materials were gathered for the debitage of smaller products (less than 70 mm long), up to 100 km to the west of the cave and only about 10 km to the east.

The raw materials of Curson can also be differentiated in accordance with the chaîne opératoires of the collection. Larges flakes are made in marly or sometimes zoned siliceous Jurassic limestone and, in lesser quantities, in medium-grained quartzite. Flint pebbles are used for a second chaîne opératoire, for the debitage of smaller flakes and retouched tools. An oval-shaped pebble (*L*: 88, *w*: 56, *th.*: 20 mm) and a hammerstone flake in marly limestone are the only elements linked to percussion activities in this series.

All these worked rocks were collected as pebbles from fluvial-glacial deposits. Some of them bear blunted and glossy ridges and surfaces with impact marks indicating moraine sources and some river transport. The selected lithotypes are found

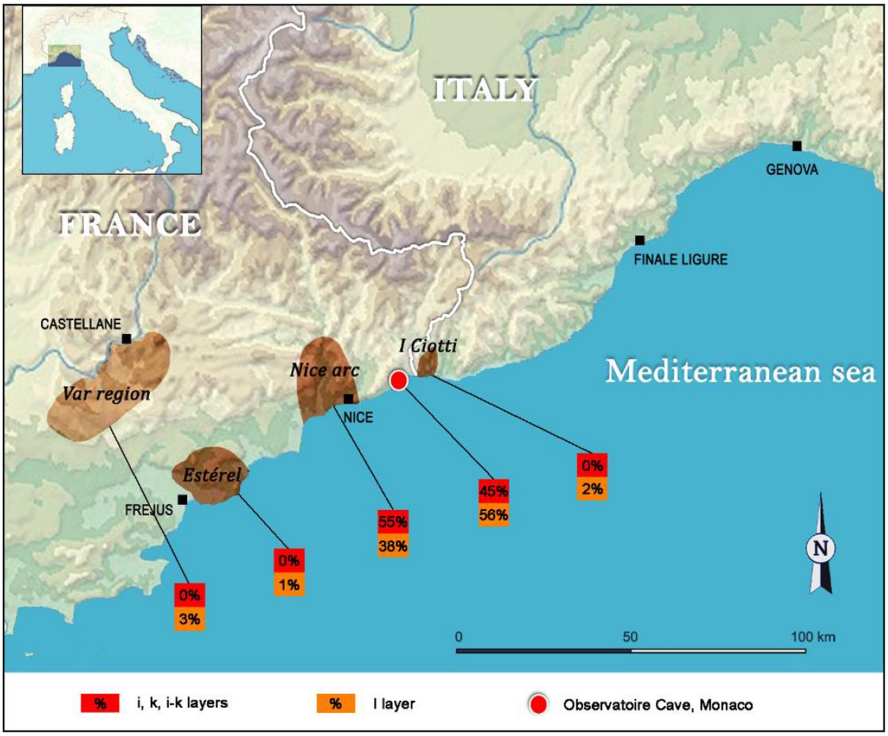


Fig. 6 Map of raw material provisioning sources for the different archaeological Acheulean-Clactonian levels of Observatoire Cave (Principality of Monaco)

in alluvions near the site, representing local procurement sources, along the watersheds of the Isère and the Rhône, several hundred metres around the site.

Technical Assemblages

The early explorations of these two sites considerably reduced their lithic assemblages (cf. above). However, the range of objects gathered enables us to compare their technical and behavioural components and to bring to light their distinctive and convergent characteristics.

In the Observatoire Cave, the infilling of the lower part of the Pit can be divided into two technical units; layers i ($n=11$), k ($n=170$) and i–k ($n=95$), with identical and consistent typo-technological components, and the more varied level l ($n=153$). The lithic corpus of the first layers consists of a singular technical range with a very high proportion of tools on large flakes (50%), associated with pebbles, generally with visible marks of use (44%), several flakes, cores and smaller debris from debitage and recycling (5%) and a biface (1%). In the lower level l, these proportions change; large flake tools decrease (8%), while the proportion of pebbles linked to percussion remains high (47%); two choppers are recorded in the collection (1%), and the rest of the lithic material is part of debitage operational sequences producing elements of smaller dimensions (43%).

In Curson, large cutting tools are predominant (88%) and are associated with two elements linked to percussion activities (1%) and a limited series of smaller debitage products (11%). No bifacial elements were observed in the collection or mentioned in the literature.

Pebbles and Percussion Tools

A total of 196 pebbles were unearthed from the sediments of the Pit of Observatoire Cave (Table 1; Fig. 8a–h), divided into 121 elements in layers i and k and 75 elements (including two tools typologically attributed to choppers) in level l. Most of the manuports come from the coastal beaches below the cave, but several pieces were collected in the site itself in the form of blocks rounded by karstic corrosion. When the cortex is well conserved, the pebbles show numerous traces linked to use (90% of the pebbles in level l and 82% in the upper layers). Sometimes, the use of these pebbles generated involuntary fractures or removals, in the form of retouch or removals along ridges (cf. pebble with a single removal and chopper). No specific characteristics differentiate these pebbles by archaeological level, apart perhaps from two elongated pebbles only found in level l. The selection of specific cobble shapes is recurrent, ovoid or subspherical pebbles and, to a lesser degree, angular morphologies (quadrangular or subtriangular). The dimensions, volumes and weight of these pebbles are relatively consistent (Fig. 7), including small hammerstones (up to 180 cm^3/200 g), a majority of medium-sized cobbles (from 180 to 450 cm^3/from 200 to 700 g), several large pebbles (from 450 to 600 cm^3/from 0.7 to 1 kg) and rare more massive elements (from 700 to 1200 cm^3/from 0.9 to 1.7 kg).

Various forms of traces are observed on the surfaces of these tools: fractures, flake-type scars, retouch-type scars, star-shaped shards, cupules, pecking, striations, deep incisions, crushing, polish, glossy facets …. These traces are generally isolated but can also be clustered in more or less extensive delimited zones and indicate repeated technical gestures. These tools generally bear a single type of mark

Table 1 Stratigraphic distribution of the pebbles and percussion tools from the collections of Observatoire Cave and Curson

	Archaeological layer	Pebble	Broken pebble	Hammer	Broken hammer	Hammer debris	Hammer flake	Anvil/ 'chopper'
Observatoire	i	1	1	1	-	2	1	-
	k	4	1	26	4	-	-	-
	i–k	13	2	52	7	4	2	-
	l	5	-	33	17	1	15	4
	Total	23	4	112	28	7	18	4
Curson	-	-	-	1	-	-	1	-
	Total	-	-	1	-	-	1	-

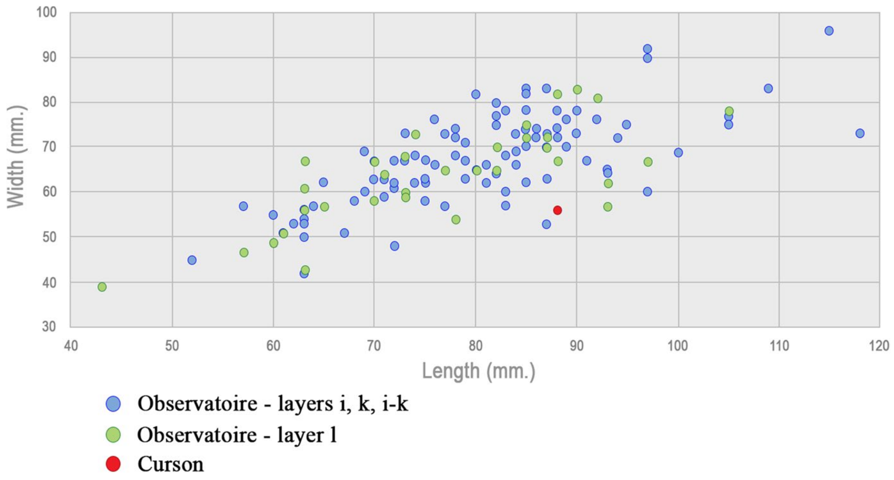


Fig. 7 Distribution of the whole percussion tools from Observatoire Cave and Curson according to their length and width

localized on the pebble. However, more than a third of them present composite marks on their surfaces, showing the variability of this mostly very specialized but at times multipurpose group of tools. These marks are not exclusively produced by percussion; other actions can also be envisaged, but an experimental programme is required to determine the types of actions. Here, it is important to recall that the links between debitage/shaping and hammerstones are limited as most of the pieces in layers i and k are imported, and only occasional recycling activities took place on site. Hammerstones are the best represented tools and are characterized by marks on the end of the rounded pebble surfaces. Several rather small pebbles in angular limestone used as anvils (level l) bear percussion marks on the flattest surface, sometimes in association with isolated or several removals, and can resemble choppers, from a typological perspective (de Beaune, 2000; Donnart, 2010; Hamon, 2010).

The Curson collection includes a single hammerstone (Fig. 8i) and a hammerstone flake in marly limestone (dimensions: 99 mm × 76 mm × 13 mm). However, in the literature, mentions are made of other objects from this group alongside the large flakes (cf. above). The hammerstone is a whole, rather small, oval-shaped, flat pebble in marly limestone (dimensions: 88 mm × 56 mm × 20 mm), presenting crushing striations at one end.

Certain elements are similar at both sites, such as marly limestone rock types and marks, but the hammerstone from Curson differs from those found at Monaco by its flat and oval-shaped morphology, whereas spherical and ovoid morphologies are omnipresent at Observatoire Cave.

Large Flake Tools and Biface

The second most characteristic group of tools in archaeological levels i, k and l of Observatoire Cave are large flakes without retouch or flakes used as blanks for making tools (Table 2). They represent more than 76% of the lithic series from 'layer' k and only 8% in level l ('layer' i only yielded a single large flake out of 11 artefacts).

This toolkit was imported to the site as finished products, and no other elements linked to these debitage operational sequences (cores, preparation flakes, debris) were identified in the assemblages. On the other hand, some rare bulb shards, resharpening flakes or debris are related to the use and sometimes to the recycling of these tools. Most of the large flakes present Clactonian features (Breuil, 1932; Pottier, 1938, 1941), with wide, open and generally smooth butts (average debitage angle: 116°; maximum: 130°; minimum: 95°; standard deviation: 7.9). However, some large flakes come from the primary debitage phase and present a reduced, punctiform butt. In general, the flakes are wide and voluminous, with relatively homogeneous dimensions oscillating between 65 and 175 mm, with an average of 105 mm (Table 2).

The techniques used for the production operational sequence consist of a combination of direct percussion on a static handheld core or a core placed on the ground and percussion on a passive anvil (Mourre & Colonge, 2009–2010).

The mostly cortical surfaces show that these flakes derive from short, sporadic debitage phases. This is corroborated by the debitage sequences, where a previous longitudinal or transverse removal contributes to the transformation of the blank into a bevelled tool (Boëda & Hou, 2011) and rarely to the transformation of the bevel itself, even when sequences are longer and previous removal scars intersect.

Most of the flakes are thin and present plano-convex sections or at least a long natural, very acute, rectilinear or convex bevel (cutting angles are between 20° and 40°). These cutting edges are surrounded by more open-angled cutting edges (cutting angles between 40° and 80°) than the used bevel, and in rare cases by backs (2% of the pieces), corresponding to natural backs, core edges or backs obtained by fractures. Nearly a quarter of the large flakes were subsequently modified by short unifacial, and sometimes bifacial removals, fractures or intentional retouch, which open cutting-edge angles and contribute to the regularization of the overall conformation of the tool. The intended shape of the blank corresponds to a trapezium or rectangle (Table 3), predetermined during the debitage of the blank/tool, or when that is not the case, flake edges can be regularized by slight modifications.

The mental refitting analytical method (Pelegrin, 1995) can be used to define the different operational sequences involved in the fabrication process (Fig. 14). Nearly a third of the large flakes are flakes derived from debitage initialization, at times the first flakes (8% of the cases), or follow on from the preparation of the striking platform by a secant removal, giving the flake its Clactonian appearance. Most of them are knapped according to the method of 'debitage of flakes with a cortical bevel' or 'EBC type debitage' (Notter et al., 2017; Porraz et al., 2014; Rossoni-Notter et al., 2016a), with not very recurrent transverse or orthogonal management (Fig. 11a, b).

Two other pieces (layer k) can be differentiated from this first technical group, and in particular a large flake (OBS-X94; Figs. 9a and 10b), on which recurrent debitage removed all of the cortical surfaces, the debitage surface shows centripetal management and the prepared butt presents a near right-angled debitage angle, suggesting a hierarchization of the core surfaces. This piece could be part of the

Fig. 8 Pebble hammerstones from Observatoire Cave (Monaco) and Curson (Drôme, France); **a** hammerstone with a removal, lithographic limestone, level l, Observatoire; **b** hammerstone presenting striations, cupules and incisions, marly limestone, level i–k, Observatoire; **c** chopper/hammerstone and anvil, marly limestone, level l, Observatoire; **d** hammerstone presenting cupules, lithographic limestone, level k, Observatoire; **e** hammerstone with removal and cupules, microcrystalline limestone, level i–k, Observatoire; **f** hammerstone anvil with a zone of cupules, sandstone limestone, level k, Observatoire; **g** fractured hammerstone, andesite, level l, Observatoire; **h** hammerstone with incisions, biodetrital limestone, level i–k, Observatoire; **i** hammerstone with striations, marly limestone, Curson ▸

variability of EBC-type debitage sequences. However, no other transition products between the more advanced phases (Fig. 14) were present in the assemblage, and therefore, no other elements can be linked to this product. Another large flake (OBS-X131; Figs. 9b and 10a) from the full debitage phase, with a reduced butt, presenting a core edge and centripetal management, is technically similar to the latter.

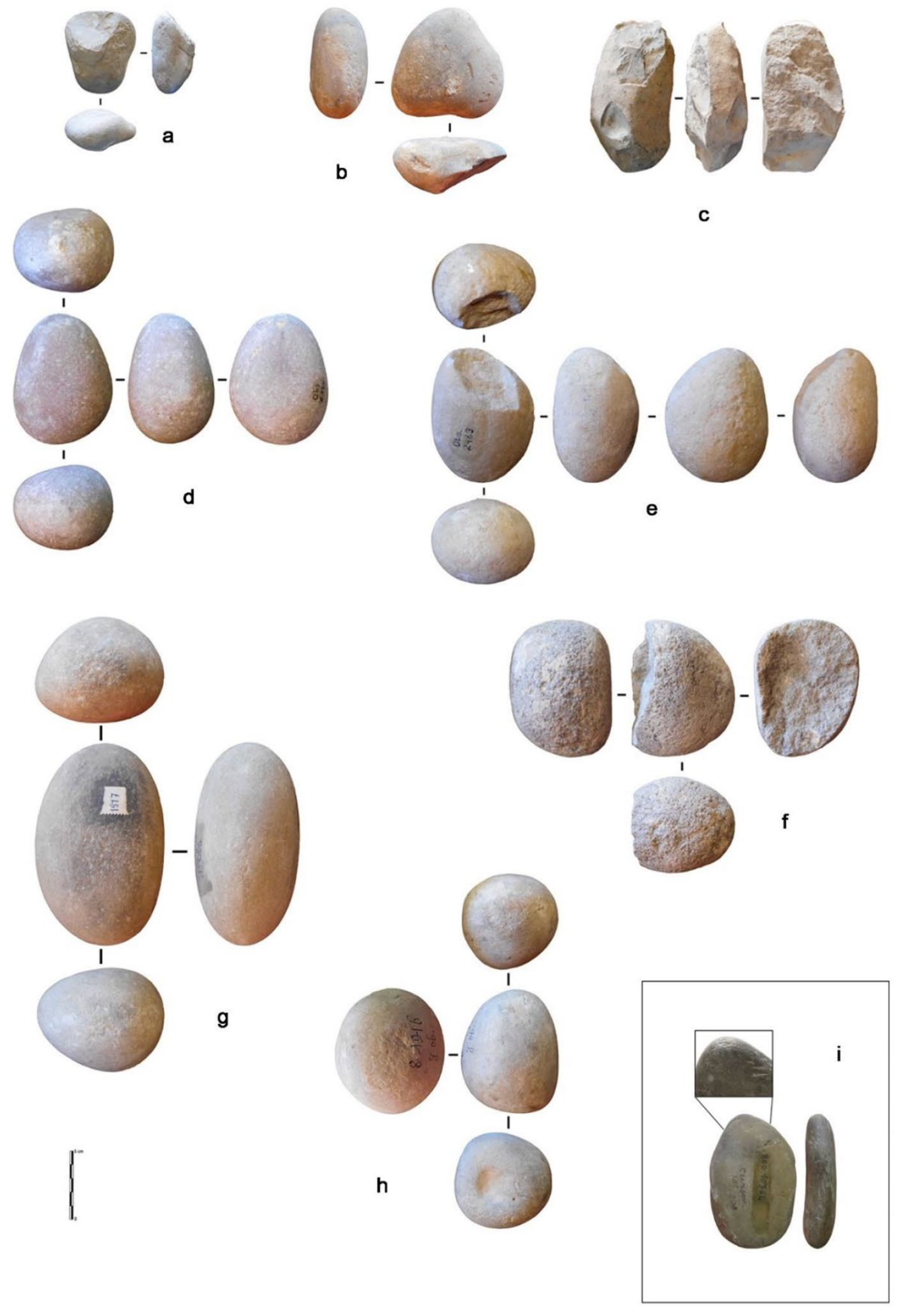
The absence of cores in the site and of all the products derived from the debitage chaîne opératoire is a problem for the precise identification of the methodology generating these two pieces, but the technical criteria show that they present similarities with Levallois concepts (Boëda, 1995; Sharon, 2006; Van Riet Lowe, 1945).

A last piece (layer k) deriving from the flaked surface of a voluminous flake points to the occasional use of the Kombewa method (Inizan et al. 1995; Owen, 1938; Sharon, 2006) (Fig. 10c). After being flaked, these large flakes did not undergo any subsequent bifacial shaping of both edges, apart from three artefacts (two from layer k and one from level l; Fig. 10g, h), classified as type 0 cleavers according to the typology of Tixier (1956).

Structural analyses shed light on the functional aims of the Acheulean occupants of Observatoire Cave. Most of the tools present active techno-functional units (TFU) in the form of natural ‘edges’ with biconvex and plano-convex sections with a cutting-edge angle between 20° and 40°, surrounded by more open-angled cutting edges or backs (passive/prehensile TFU). This a priori simple functional schema is actually more complex than it appears to be, and other types of active TFUs are also identifiable on these large blanks; namely ‘point’ ‘edge-point’, ‘edge-point-edge’ types (Fig. 11a, b, c).

Six retouched tools made on these large flakes or large flake fragments (Fig. 2) can be typologically classified into the following types: side scraper (Fig. 12a), notch (Fig. 12c), bec (Fig. 12b), point (Fig. 12d) and macro-burin (Fig. 11d). Only one piece is in allochthonous flint: a large side scraper on a flake (Fig. 12a), imported to the site as a finished product. The other large retouched tools are made in the same limestone as the flake cleavers and are generally smaller in size. They were produced by recycling and redeploying large flakes, as shown by the refit of the flake with the macro-burin (Fig. 11d).

The vast majority of the active bevels of the large flakes bear use-derived marks, in the form of large plane and invasive removals on one or both faces, small shards, chipping and crushing of the cutting edges (Fig. 13). The large size of these removals indicates violent, tangential percussion movements, aimed at cutting. Up until now, the matter worked by these tools has not been identified (Fig. 14).



The large flake tools from Curson constitute the main group of this undoubtedly very truncated collection (see above), and represent more than 86% of the assemblage (Fig. 5; Figs. 15 & 16). These large pieces are not associated with any other products

Table 2 Dimensions of the large flake tools from Observatoire Cave (Monaco) and Curson (Drôme, France)

		Length (mm)	Width (mm)	Thickness (mm)	Volume (cm^3)
Observatoire ($n=141$)	Maximum	175	172	61	1574
	Minimum	65	60	9	94
	Mean	105	103	27	326
	Standard deviation	18	22	8	214
Curson ($n=57$)	Maximum	146	147	48	775
	Minimum	62	82	17	123
	Mean	105	111	31	375
	Standard deviation	18	17	8	156

from the same operational sequence and seem to have been brought to the site in the form of finished products. Unlike in Observatoire Cave, no technical element linked to the recycling of these large flake tools was identified in the assemblage. The whole flakes of the series confirm the Clactonian attribution with smooth, wide and open butts (average debitage angle: 116°; maximum: 145°; minimum: 99°; standard deviation: 9.8). The largely cortical surfaces of the blanks indicate low debitage intensity. The initial flaking phases are well represented (13 pieces), as well as the products derived from debitage sequences on striking platforms prepared by a secant removal

Table 3 Comparisons of the main morpho-techno-functional characters of the LFT from Observatoire Cave (Monaco) and the site of Curson (Drôme, France)

		Observatoire Cave	Curson
LFT ($n=$)		141	57
Simple structure		87%	69%
Multi structure		13%	31%
Morphology of the support	Circular	13%	13%
	Half circle	3%	10%
	Triangular	6%	12%
	Quadrangular	73%	60%
	Irregular	5%	5%
Volume of the support	Maximum	1574 cm^3	775 cm^3
	Minimum	94 cm^3	123 cm^3
	Mean	326 cm^3	375 cm^3
	Standard deviation	214	156
Cutting edge angle (bevel)		20° to 45°	20° to 50°
Bevel morphology		Convex	Convex
Bevel cross-section		Biconvex–plano-convex	Biconvex–plano-convex
Bevel front delineation		Right–slightly curved	Right–slightly curved
Gripper unit shaping		25% Removal, fracture, retouch	5% Fracture, retouch

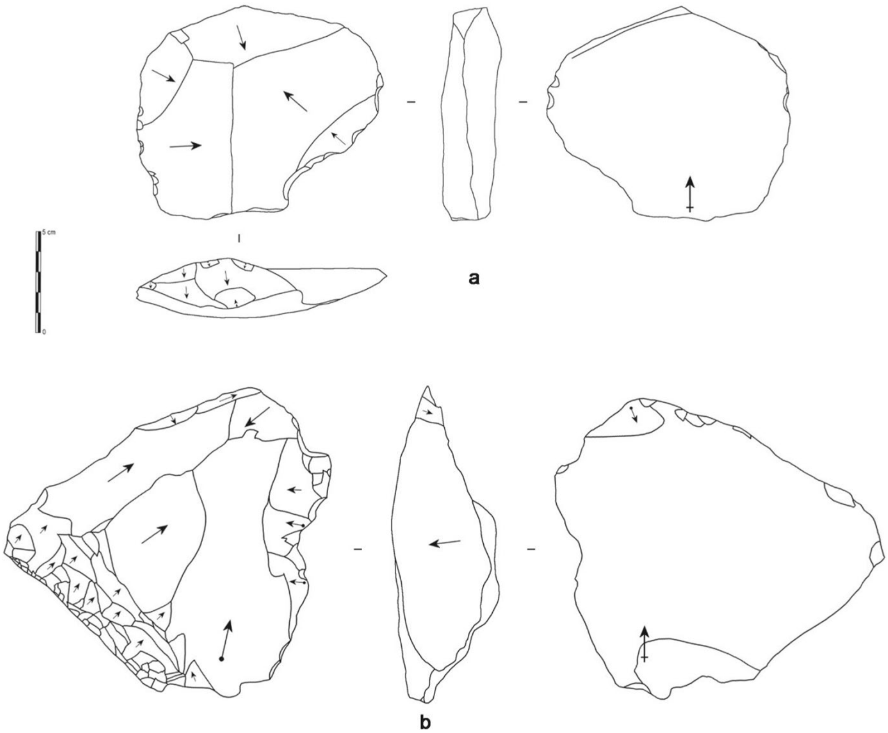


Fig. 9 Diacritic diagrams of the two large flakes different from the 'EBC type debitage' and similar to Levallois concepts

(14 pieces), creating smooth and open butts. Tool blanks are relatively homogenous, wide and voluminous, with very similar dimensions to those of Observatoire Cave (Table 2). The knapping techniques for this lithic material indicate direct percussion on a dormant anvil and on handheld cores or cores placed on the ground. These large flakes are issued from short and not very recurring debitage sequences, and were knapped by unipolar, bipolar or orthogonal management. The number of removals anterior to the flaking of the blank rarely exceeds three scars (a single piece shows four scars with orthogonal management of the debitage surface), and most of them do not present any removal scars. Tool bevels are natural but can also be shaped by a transverse removal extracted before the debitage of the blank, and no tranchet blows (Tixier et al. 1980) are observable in the series. Blank morphologies are mainly trapezium and rectangular, and to a lesser extent circular and triangular, with semi-circular shapes characterizing about 10% of the pieces at Curson. Post-debitage transformations of blanks are rare and require little technological investment. However, the edges can be modified by voluntary fractures to create a ledge (Fig. 15f) or by retouch to regularize the cutting edge and increase the cross-section angle to facilitate prehension. Notched retouch can also be used to delimit the prehensile units of the active zones (Fig. 15b). No typological cleavers were identified in the series.

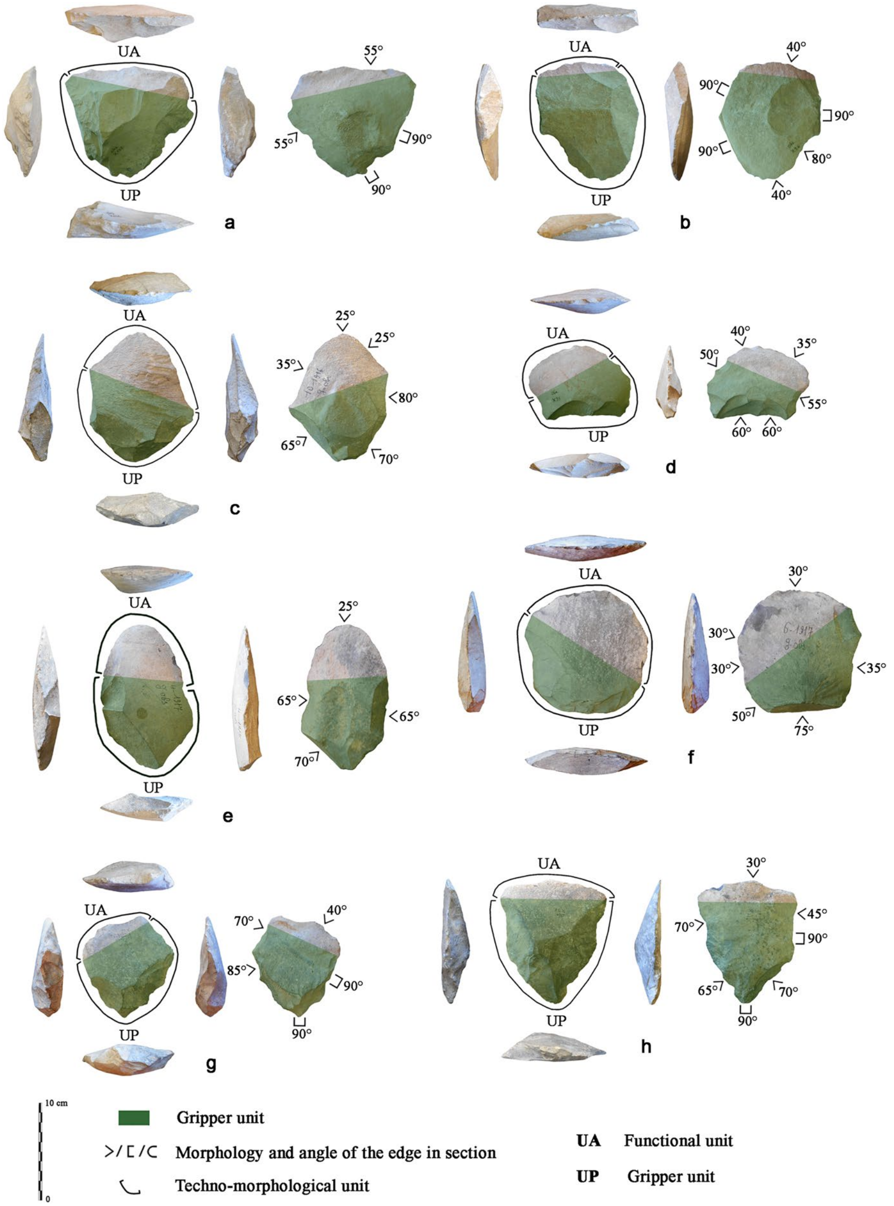


Fig. 10 Tools on large flakes with a simple functional structure from Observatoire Cave (Monaco); **a** simple convex edge on a débordant Levallois (?) flake, marly limestone; **b** simple convex edge on a Levallois (?) flake, marly limestone; **c** simple convex edge on a Kombewa flake, marly limestone; **d** simple convex edge on a blank transformed by unifacial removals, marly limestone; **e**, **f** simple convex edge on a blank transformed by unifacial removals, marly limestone; **g**, **h** simple convex edge on a blank transformed by bifacial removals, type 0 cleavers, marly limestone

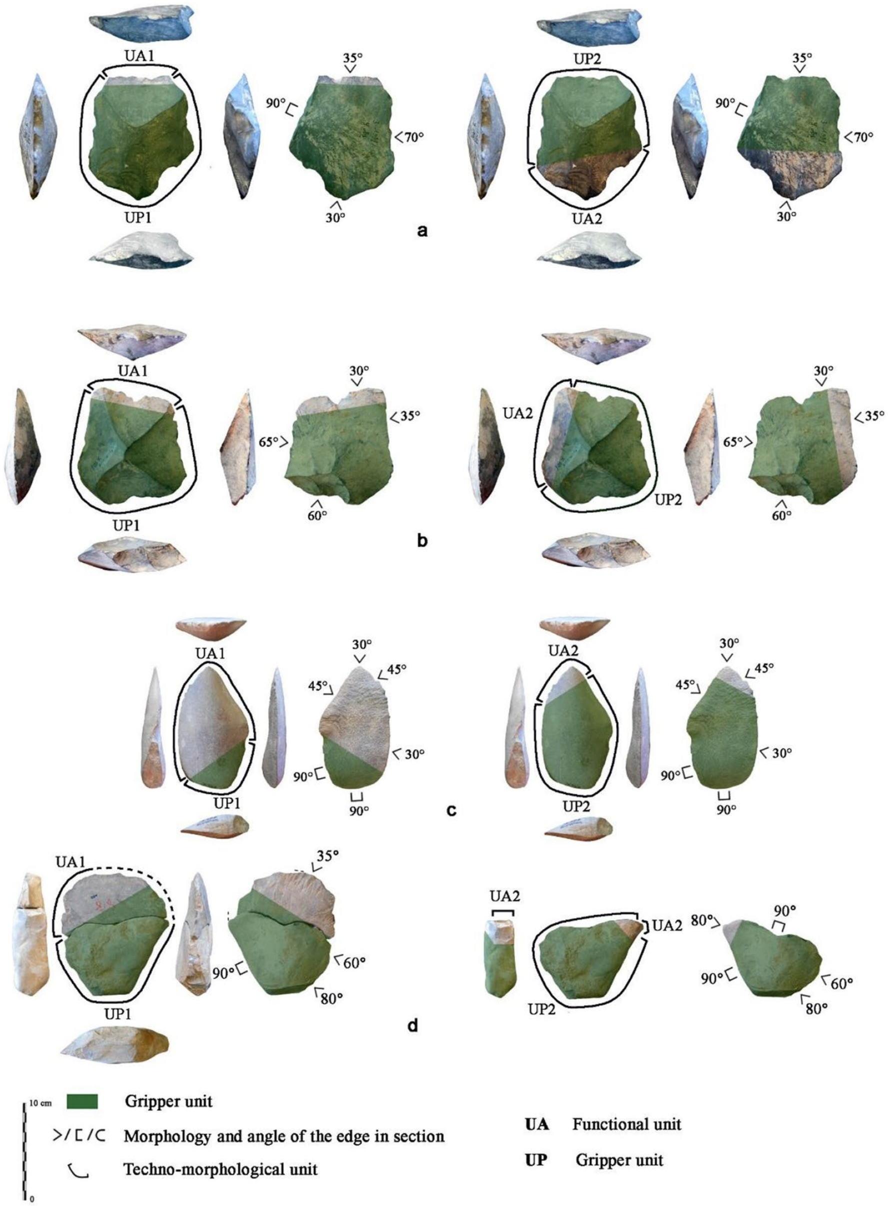


Fig. 11 Large flake tools with double functional structure from Observatoire Cave (Monaco); **a** opposed double edge on quadrangular blank, marly limestone; **b** double adjacent edge on quadrangular blank, marly limestone; **c** edge-point-edge superimposed on an edge-point on quadrangular blanks, marly limestone; **d** recycling of a convex edge into a massive burin, marly limestone

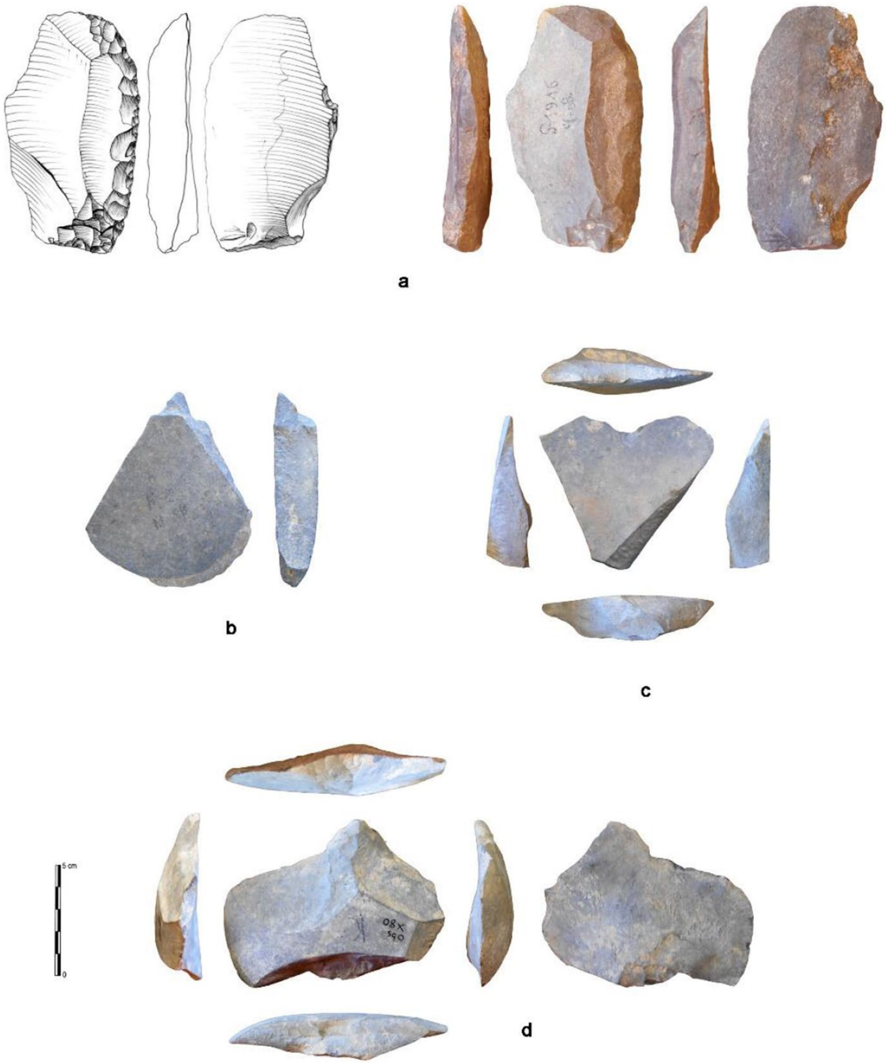


Fig. 12 Massive retouched tools, Observatoire Cave (Monaco); **a** massive side scraper on a large flake, allochthonous flint, layer k (drawing: D. Cauche); **b** beak on a large flake fragment, marly limestone, layer k; **c** notch on a large flake fragment, marly limestone, unit l; **d** point on a large flake fragment, marly limestone, layer k

These flakes were knapped on whole, or sometimes split, alluvial pebbles. Apart from the primary flaking phases, which cannot be easily linked to a specific method, production follows the EBC method (cf. above), which was also used in Observatoire Cave. Sequences are thus short, leaving large cortical zones on blank surfaces, with relatively standardized dimensions and morphologies. No other methods seem to have been used for the flaking of these large flakes (Fig. 14).

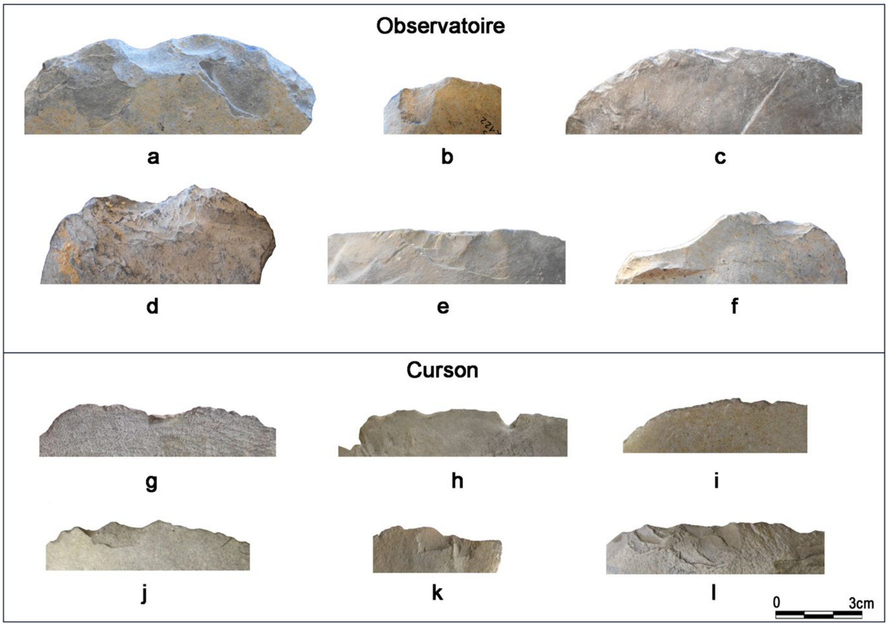


Fig. 13 Use marks observed on the cutting edges of the LFT in the series from Observatoire Cave and Curson

The structural analyses bring to light the aims of the users of these tools. The preferential active techno-functional unit is a long and convex bevel, with a straight or slightly curved edge and a biplanar or plano-convex cross-section, with cutting-edge angles between 20° and 40°. It is surrounded (adjacent and opposite the active bevel) by backs and more open and thus blunter angles (cutting-edge angles between 40° and 90°). The latter are considered to be passive zones of the tool (prehensile parts). Tool composition on the blank is mostly simple (69% of the Large Flake Tools, LFT; Fig. 15). However, a number of blanks bear a double combination of active TFU/passive TFU, intersecting or overlapping on the same blank (Fig. 16). Active TFU are mostly 'edge' types, and only three active cutting edges end in a point ('edge-point' type). These superimpositions demonstrate the recycling of blanks for identical functional purposes.

In addition to these large cutting tools, we also observe a large cortical-backed flake (dimensions: 95 mm × 70 mm × 28 mm) in marly limestone, issued from unipolar debitage, with a lateral side scraper made by small and semi-abrupt retouch (Fig. 17) and the edge opposite the tool thinned by removals on the flaked surface. It is also important to mention a marked abrasion of the overhang and a smooth and open butt. This debitage phase may be part of the preparation of the convexities of an EBC-type debitage but may also be part of other debitage methods.

No bifacial elements were found in the Curson assemblage, unlike in Observatoire Cave, where a biface was found in the series from layer k, at the base of the pit (86.72 m asl). It was shaped on a pebble limestone (dimensions:

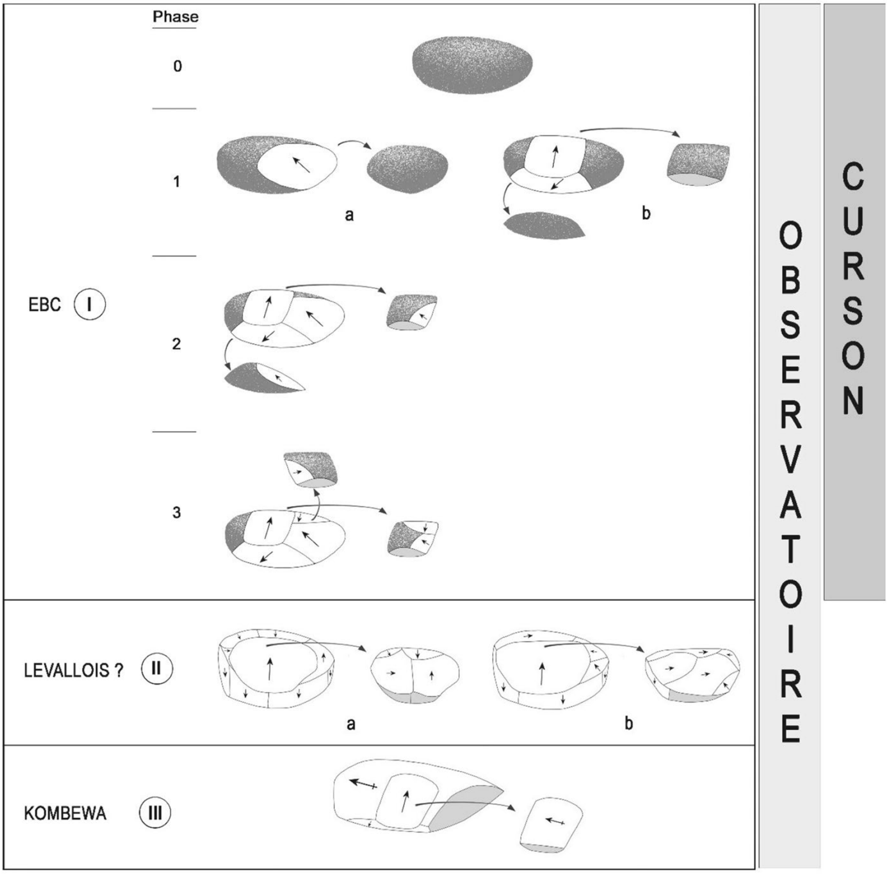


Fig. 14 Debitage operational sequences of large flakes from Observatoire Cave (Monaco) and Curson (Drôme, France)

213 mm × 102 mm × 46 mm) and presents a cortical base, with bifacial removals on the edges and the point of the tool. The biface is tapered, thick, with a fine and slightly bevelled point. The structural analyses classify this tool among the bifacial tool pieces (Nicoud, 2011), or an 'edge-point-edge' type TFU opposite a prehensile unit in cortex (Fig. 18).

The Other Debitage Sequences and Their Associated Toolkits

Debitage operational sequences producing blanks of smaller dimensions (maximum length of 5 cm) were also practised in Observatoire Cave. These debitage sequences are less common in the assemblages and vary according to the different archaeological levels (Fig. 2). In layers i, k and i–k, they only represent a small portion of the series (6% of the assemblage in these layers), whereas in the oldest level, level l, this proportion increases significantly and reaches nearly 44% of the lithic

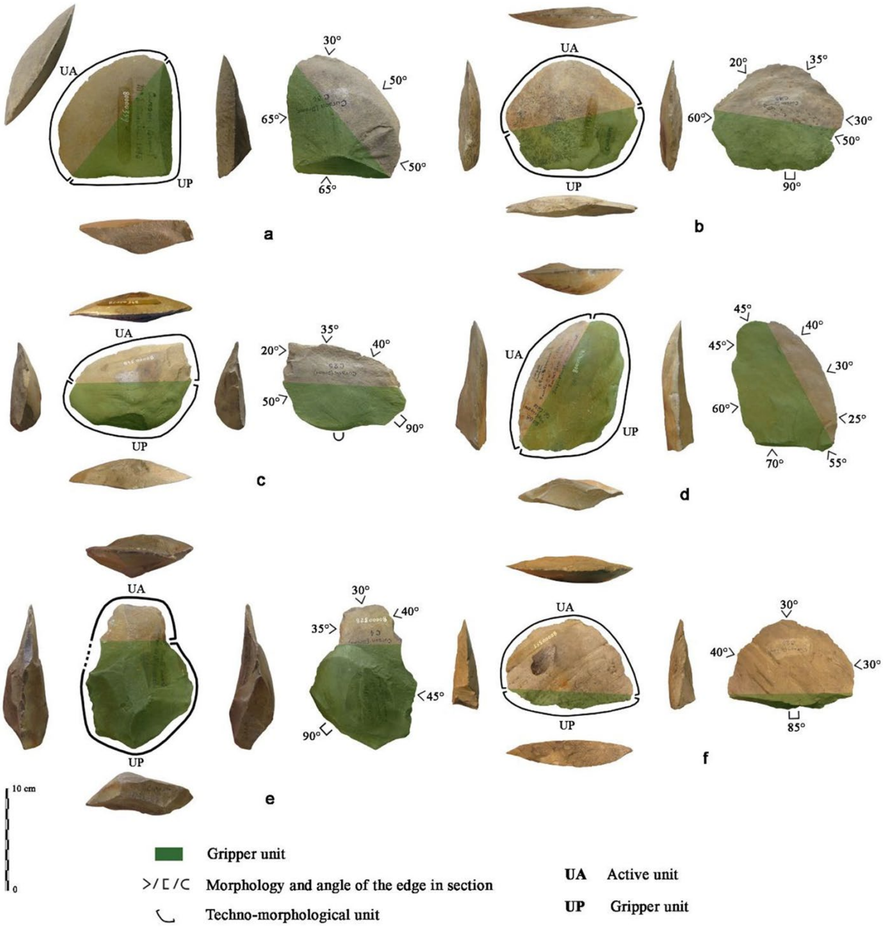


Fig. 15 Large flake tools with simple functional structure from the site of Curson (Drôme, France); **a** simple convex edge on triangular blank, marly limestone; **b** simple convex edge delimited by notches on an oval-shaped blank, siliceous limestone; **c** simple edge-point on trapezium blank, marly limestone; **d** simple convex edge on an oval-shaped blank, marly limestone; **e** simple angular edge on triangular blank, marly limestone; **f** simple convex edge on semi-circular blank, zoned limestone

assemblage. The technical status of these series is also very different; the upper layers only yielded limestone products and three retouched tools (side scraper, denticulate and retouched notch), similar to the raw materials used for the LFT. However, these pieces are different from the large retouched flakes mentioned above in that they come from distinct debitage operational sequences and production aims focus on smaller-sized products. A small limestone core, knapped by not very recurrent unipolar management, is part of this series. The flakes, also in limestone, are produced by overrun unipolar management and often include a cortical back. Technical investment in striking platform preparation is low, with smooth or cortical butts, sometimes with open flaking angles.

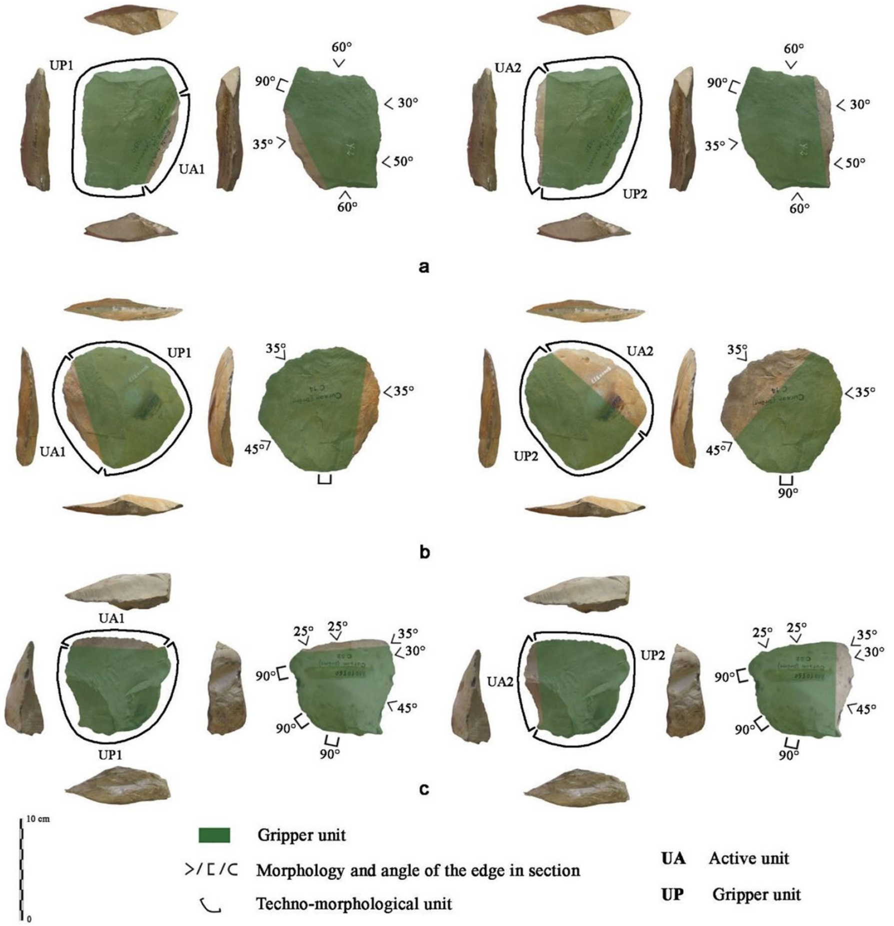


Fig. 16 Large flake tools with double functional structure from the site of Curson (Drôme, France); **a** opposed double edges on rectangular blank, marly limestone; **b** opposed double edges on circular blank, siliceous limestone; **c** double adjacent edge on quadrangular blank, zoned siliceous limestone

These debitage products are best illustrated in level 1. The flakes come mainly from limestone or sandstone pebbles. However, other rocks are also knapped, such as flint from I Ciotti (Grimaldi, Italy), the northern Var, or again, rhyolite from Estérel. Artefacts in rocks from the most distant sources seem to have been imported to the site as finished products, unlike the flint from I Ciotti, limestones and sandstone. Most of these artefacts are from debitage sequences, but some indicate resharpening or reworking activities, in particular the limestone flakes. The identified cores ($n=6$) demonstrate Quina (Bourguignon, 1997), SSDA (Forestier, 1993), orthogonal (Fig. 19d), unipolar or discoid debitage methods. The presence of Kombewa flakes and a core on a flake indicate the ramification of debitage (Fig. 19e). The generally unprepared butts are mostly open and affirm the Clactonian character of the series. The intended products are thick, rather short flakes, with backs opposite the cutting edges. The retouched toolkit (Fig. 2) comprises five side scrapers and three

Fig. 17 Large denticulated scraper, marly limestone from Curson (Drôme, France)

denticulates, all made on limestone products, apart from one side scraper (Fig. 19b) and one denticulate (Fig. 19c) in allochthonous flint. A fragment connects with a side scraper in lithographic limestone from the cave (Fig. 19a), confirming the presence of toolmaking activities in this level, as well as the exploitation of the mineral resources surrounding the cave.

At Curson, a small series of artefacts was knapped in flint, and a clear dichotomy of raw material economy is discernible. Large local pebbles in limestone or quartzite were used for the debitage of large blanks whereas the smaller blanks are in flint. Seven flint artefacts (Fig. 5) suggest that this series is undoubtedly under evaluated as a result of excavation exploration methods (cf. above). They include a core, four flakes and flake fragments, as well as two retouched tools. Quina core management (Fig. 20a) produced short flakes (Fig. 20b, c), with backs and non-prepared open butts (Bourguignon, 1997). These characters are in keeping with those observed on non-retouched and retouched products and confirm that this was the only method used for this type of artefacts. The association of products and the core tend to show that these debitage activities took place on site, near the mammoth carcass. Due to the absence of elements of small dimensions at Curson (excavation techniques did not take them into account), we cannot confirm that tool making activities also took place on site, but the presence of retouched elements implies that this was the case. The two identified retouched tools are a Clactonian notch on a backed flake (Fig. 20d) and a bec made by a notch adjacent to a fracture of the flake blank (Fig. 20e).

Synthesis and Discussions

The series compared here from two sites located in southeast France are separated by a distance of about 250 km as the crow flies and by the massifs of the French pre-Alps. The types of sites are very different. In the Principality of Monaco, human

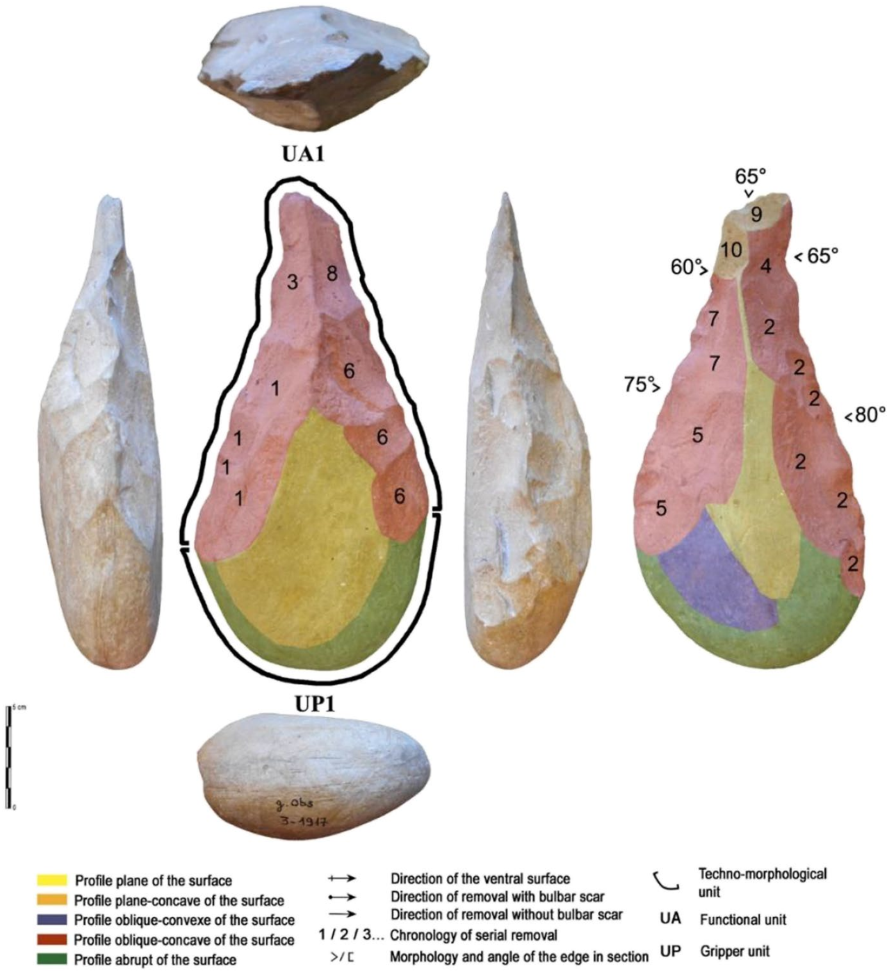


Fig. 18 Structural analyses of the handaxe in unit k, limestone — Observatoire Cave (Monaco)

occupations took place in a coastal cave, whereas the open-air site of Curson is located on a lakeshore. In both cases, prehistoric groups only seemed to use the sites occasionally and left limited traces of specialized activities (Notter et al., 2017; Rossoni-Notter et al., 2016a). The associated faunas are also very different. Carnivores, cervids and caprids are well represented in the cave site, whereas at Curson, only the remains of *Mammuthus intermedius* are linked to the lithic assemblage.

The different levels compared here are partially contemporaneous. Observatoire Cave contains levels contemporaneous with or anterior to the beginning of MIS 7 (layers i, k, i–k) and MIS 10 and 11 (level l), while the Drome occupation corresponds to MIS 8. However, this chronological framework is still rather coarse slack due to the early discovery contexts of both sites: the second half of the nineteenth century for Curson and the beginning of the twentieth century for Observatoire

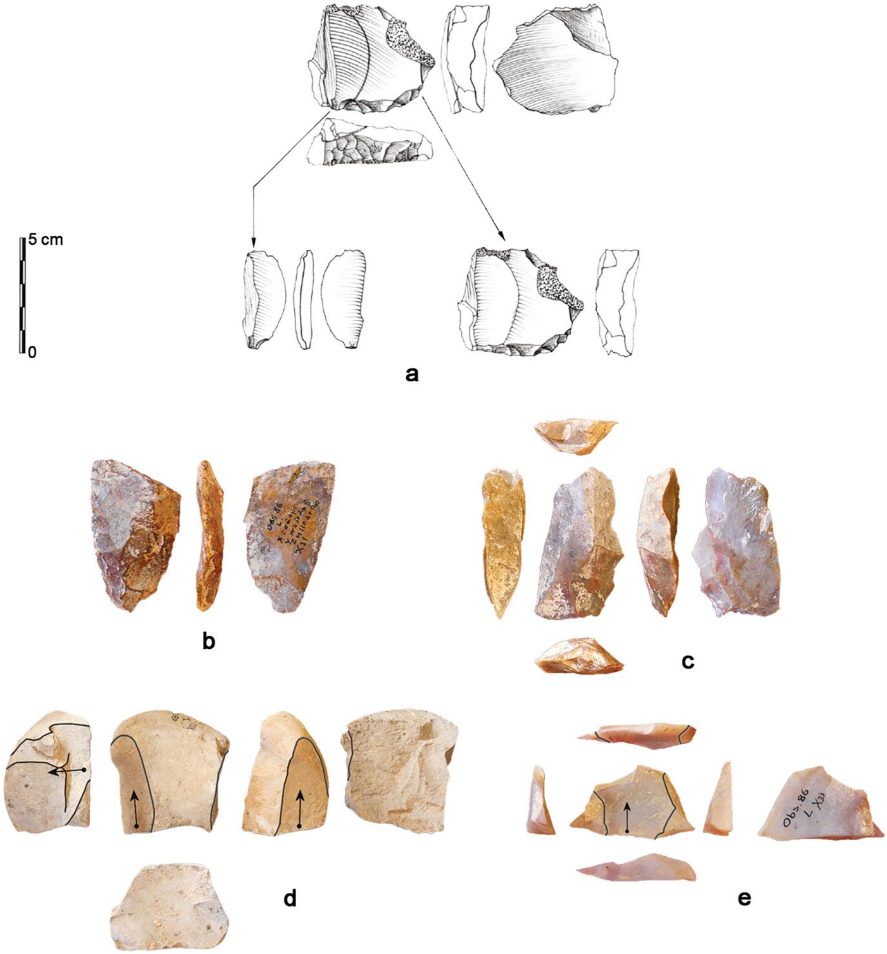


Fig. 19 Small tools and debitage from level l of Observatoire Cave (Monaco); **a** refit of a transverse side scraper and its shard extracted at the end of tool shaping, lithographic limestone; **b** side scraper on flake in flint from the northern Var; **c** denticulate on flake in flint from the northern Var; **d** orthogonally knapped core in marly limestone; **e** core on flake with unipolar management on flake fragment in Ciotti flint. (Drawings: D. Cauche, photographs: O. Notter)

Cave. A dating campaign of the Monegasque site is currently underway in order to fill these gaps. The assemblages from these early collections reveal more or less important biases, with highly selected objects at Curson, and to a lesser extent at Observatoire Cave. It is thus not possible to carry out an exhaustive assessment of the technical behaviour at these sites. However, we can still compare these exceptional assemblages and examine the shared presence of certain technical objects.

Both sites comprise an important collection of large flakes associated with numerous percussion tools and several smaller elements from debitage operational sequences. The presence of a biface in the Observatoire Cave (layer k) and

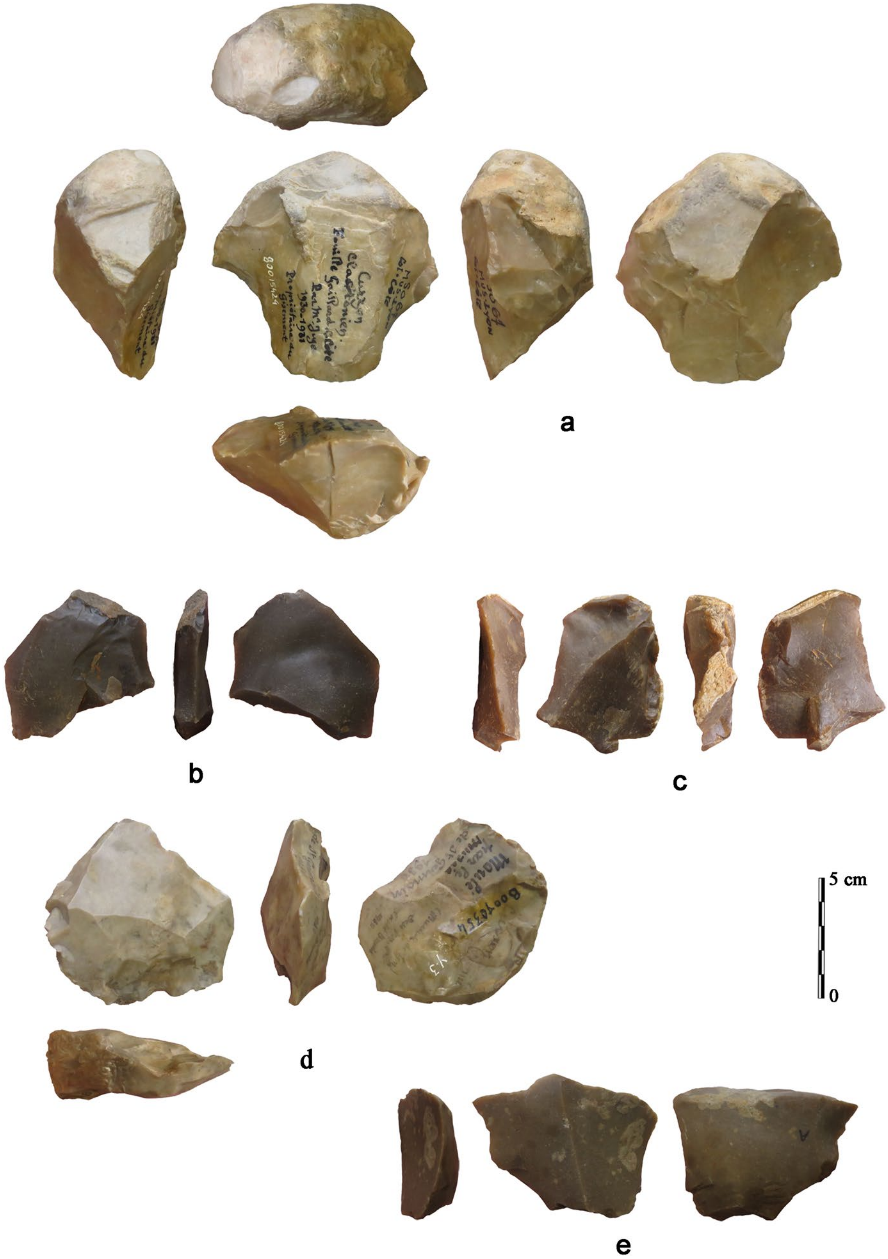


Fig. 20 Small tools and debitage in flint from the site of Curson (Drôme, France); **a** Quina type core; **b** débordant flake; **c** plunging flake with cortical back; **d** Clactonian notch on cortical backed flake; **e** bec transformed by a notch adjacent to a fracture

numerous percussion tools differentiate it from Curson. These lithic assemblages reveal Mode 2 (Carbonell et al., 1999, 2001; Clark, 1977) or Acheulean technical behaviours (Mortillet, 1872; Mayet, 1925; Bordes, 1988; Lumley, 1969; Tuffreau, 1996; Mourre, 2003; Mourre & Colonge, 2004; Turq, 2000; Sharon, 2006, 2009, 2010), associated with dominant Clactonian traits.

Lithic procurement strategies are similar for both sites. Alluvial resources near the site (less than 10 km as the crow flies) were exploited for large flakes, and finished products were brought to the sites. Recycling activities are perceptible in Observatoire Cave for some elements. On the other hand, local or even endogenous raw materials were used for debitage operational sequences producing smaller products, in conjunction with flint from more distant sources, in particular at Observatoire Cave.

Similar debitage techniques are observed at both sites. Direct percussion was applied to the 'small' debitage, as well as to several phases of large flake production. However, direct percussion on blocks placed on the ground and percussion on dormant anvils are dominant for large flake production. The link between the impressive collection of hammerstones found at Observatoire Cave and knapping activities is tenuous. Some of these hammerstones (in particular, the smaller ones) may be associated with the production and retouching of smaller elements, but the hammerstones do not appear to have been used for LFTs at either site nor for the Monegasque biface.

All of these large bevelled tools (including cleavers) at both sites constitute a set of very homogenous tools, identified by techno-morpho-functional analyses as flake cleavers. Debitage methods appear to be more diversified at the Monegasque site, where Kombewa and maybe Levallois debitage were recorded. However, most of the blanks come from pebble trimming phases, namely EBC debitage phases. As a result of this feature, both sites are intricately linked in a common technological framework.

Production by prehistoric groups at both sites was geared towards large flat cutting products, mainly with quadrangular shapes. However, particularities are perceptible, such as semi-circular morphologies at Curson. LFT volumes are relatively uniform (with higher variability at Observatoire Cave). The cutting edge of these elements is an active bevel-shaped functional unit, generally cortical, with plano-convex or biconvex profile cross-sections, sharp angles, ranging between 20° and 50° and thin cross-sections (Table 3). Bevel morphology is similar at both sites. However, use-related marks point to a different functional status at both sites with cutting percussion actions observed at Observatoire Cave and cutting actions by translation at Curson. Morpho-functional unit variability is slight, and the structural composition of products is generally simple, although some products present several bevels, confirming the clear and constant functional orientation of these toolkits.

Prehension zones are predetermined, generally during the debitage of the blank. The modification of the edges constitutes one of the main differences between the sites. At Observatoire Cave, a quarter of the pieces present regularization of this part of the tool, or shaping by bifacial removals, resulting in the classification of some of them among proto-cleavers or type 0 cleavers. On the other hand, at Curson, this regularization phase is poorly represented, and blanks are only retouched or intentionally fractured after debitage.

As a result, the large flakes from Observatoire Cave and the site of Curson are part of the same general techno-functional sphere, but the post-debitage transformation of blanks and the function of these artefacts show specific technical adaptations. These tenuous differences may result from diverse factors, such as site type and function but also raise the question of the contemporaneity of the different occupations. For now, we cannot provide more precise answers to these questions, although new ongoing research activities at Observatoire Cave should, in the medium term, clarify some of these issues. Nevertheless, it is possible that these sites represent adaptive episodes or the technical innovation of different groups incorporated in the same technical tradition.

Comparisons

In order to place these results in the technical context of southeast France, it is essential to link them to comparable chronological and technical sequences. However, the assemblages from Observatoire Cave and Curson must be compared to a wider geographic range of sites, on account of their specific attributes.

It is difficult to compare this exceptional lithic series to neighbouring contemporaneous technocomplexes, and few links can be established with technocomplexes from the south of France or from northern Italy due to the types of occupation and the origin of our collections (Notter et al. 2017; Rossoni-Notter et al 2016a). On the other hand, the significant series of large flakes can be compared to contemporaneous assemblages.

These large-sized debitage products are represented at numerous Acheulean sites in the south of France and in northern Italy, but in much smaller proportions. Some of these large flakes were used as blanks for bifacial elements, or cleavers or choppers, such as in Lazaret Cave (Nice, France), MIS 6 (Lumley de et al., 2004); Terra Amata (Nice, France), MIS 10 (Lumley et al., 2015); the Prince Cave (Vintimille, Italy), MIS 6 and 7 (Rossoni-Notter et al 2016b, c); the Baume Bonne (Quinson, France), MIS 9 and 10 (Gagnepain & Gaillard, 2005; Notter, 2007; Notter et al. 2015); Aldène Cave (Cesseras, France), MIS 10 to 7 (Rossoni-Notter et al. 2017b); Orgnac 3, MIS 8 and 9; Payre, MIS 6 (Michel et al., 2013; Moncel, 2003) ….

These blanks are large primary flakes or split pebbles, which are also found in the assemblages of Observatoire Cave and Curson but, which unlike the latter, do not seem to have been knapped by more elaborate debitage methods.

Several large flake cleavers are reported in certain sites. This is the case for la grotte du Prince (Italian Liguria), in Acheulean and pre-Mousterian breccia attributed to MIS 6 and 7 (Rossoni-Notter et al., 2016a), where unipolar and orthogonal debitage sequences produced very similar blanks to those from the two sites studied here. In Terra Amata (MIS 10), in addition to a typical cleaver shaped on a primary pebble, a large cortical flake with a long convex bevel bearing use-related chipping is also classified as a cleaver (Lumley et al. 2015, p.614). In both sites, these artefacts are in similar limestones to those used at Observatoire Cave.

A little further away, in Aldène Cave (MIS 9), a small flint cleaver is recorded, but it differs from the large above-mentioned flakes in that it is made by retouch and a tranchet blow (Rossoni-Notter et al. 2016b). Near Curson, the collection of surface material on the terraces of Fouillouse and the site of Champouiller (Châteauneuf d'Isère, Drôme) brought to light proto-cleavers (J. Tixier's type 0, 1956) on large primary flakes in quartzite (Brochier, 1975, 1976). The rarity of large flake cleavers in southeast France highlights the exceptional nature of the assemblages from Monaco and Curson. On the other hand, in the south, southwest of France and the Iberian Peninsula (Baena Preysler et al. 2018), this type of artefact is more widespread and presents similarities to the sites studied here. In these regions, large flakes appear at the beginning of the Middle Pleistocene (Bouguignon et al., 2016) and cleavers towards MIS 8 and 9 (Mourre, 2003; Sharon, 2007, Mourre & Colonges, 2009–2010) and are mainly made in hard rocks, such as quartzite or basalt. The series comprise many large, mostly cortical flakes, from 'primary flake debitage' sequences (Sharon, 2007, 2011), on which type 0 cleavers were made. These technical elements partly correspond to those identified at the two sites studied here. On the other hand, certain criteria differ, such as the small quantity of type 0 cleavers in Observatoire Cave and their absence at Curson or, again, the differential exploitation of raw materials. Indeed, tender rocks were preferred at Observatoire Cave and Curson in spite of the presence of several artefacts in quartzite in the latter site, whereas harder rocks were used on the Spanish terraces. It thus seems that the two series from southeast France share some technical traits with those from the Iberian Peninsula and its surroundings, but an analysis and verification of the EBC method could substantiate this first impression. If this is the case, the chronological position of the Observatoire Cave and Curson sites, respectively attributed to MIS 7 (layers i, k, i–k), 10 and 11 (level l) and MIS 8, places these series in a rather early phase and could provide arguments to fuel the debate on the diffusion of large bevelled tools in Western Europe.

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