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**Master Erasmus Mundus em  
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# **The lithic assemblage of the US 13 at the Middle Paleolithic site of Oscurusciuto (Ginosa, Taranto, Southern Italy): Technological studies.**

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## INTRODUCTION

This work deals with the research potential of lithic materials through the case study of a level of Oscurusciuto rockshelter.

Flaked lithic materials, because of their durability, represent one of the most abundant artefact classes ever found in archeological sites. The lithic artefacts preserve also traces of the actions that have been carried out on them. For these reasons stone artefacts are one of the most important data sources for understanding prehistoric human behavior.

This master thesis has the purpose of studying the technical devices owned by Neandertal population in the Southern region of the Italian peninsula.

We consider the period between 40.000 and 55.000 BP because it proves of particular interest especially for the dynamic of human occupation, and for the management of the area by the resident human population. The explanation lies in the fact that during this period both the last occupation of Neandertal and the first settlement of Modern humans in Europe have taken place.

The site we choose for this study is the Oscurusciuto rockshelter, localized in the region of Puglia (municipality of Ginosa, province of Taranto). The region, during the Musterian, had a particular context according to its location in the far South-East of Italy. Moreover, the Oscurusciuto site is located in the middle part of Puglia and therefore it stands at a crossroad of different areas of the south of Italy: the south (the Salento) and north of Apulia (the area of Murge the Gargano peninsula) and ,finally, the area of the Gulf of Taranto and Basilicata.

The choice of the level US 13 was targeted in particular at the possibility of presenting an integrated study in order to understand the technological behavior expressed by Human groups living in this site considered also in their spatial context.

We intend to reach this purpose by: the description of the economic behavior as far as regards the acquisition and the exploitation of raw material and the production of lithic tools; the identification of the *Chaine operatoire*, which means to check the different stages of the lithic production that are cortex removal, management, production, transformation by retouch, utilization and abandon; the definition of concepts, methods, dynamics and objectives of *débitage*.

Understanding the *chaine operatoire* means getting the ability of putting each single artefact into the sequence of the technical operations, actions and choices made by the knapper i.e., to practically go back to the real purpose that probably the original craftsman had pursued.

To obtain the previous purposes, we consider two levels of “magnification” on the site: a general data obtained from technological analysis and a more punctual one obtained by the analysis of the elements that made up a single unit (RMU). The RMU allows us to analyse the industry in its

smallest unit, the single pebble, that means *identify technical events* in order to get informations about the segmentation of the *chaîne opératoire*. A special focus has been given to the study of cores and the numerous refitting and conjoin.

Finally the technical aspect of the industry was considered in relation to the spatial context in which each single piece was found.

## 1. PHYSICAL SETTING OF THE REGION OF GINOSA, TARANTO

### 1.1 LOCALIZATION AND GEOMORPHOLOGY

Ginosa is a municipality situated in the Southern part of Italy in the region of Puglia, province of Taranto. Its surface covers almost 190,06 km<sup>2</sup> comprehending also the Ionic costal line of Marina di Ginosa. It is situated around 40°30'0" latitude North and 16°45'0" longitude East.



Fig. 1 Localization of Ginosa. (Photo modified Google Earth.)

The region Puglia for its different geomorphological features can be divided into 3 parts: the northern part, corresponding to the Gargano promontory, the central-northern part represented by the plain of the Tavoliere and the plateau of Murgia and, finally, the southern part referred to the Salento peninsula.

The Gargano promontory presents a mountainous morphology that reaches its maximum pitch with 1,065 m.s.l.m. of Monte Calvo. The Tavoliere is an extensive plain that is connected to the Salento peninsula through the plateau of Murgia that corresponds to a square-shaped karst plateau which has its greatest peak on the North-West area.

The municipality of Ginosa stands in the Southern part of Murgia, the so-called Murge Tarantine. Here there are a great example of ravines, which are crevice shaped valleys, even more than 100 m deep, dug in the limestone, with steep walls, distant from each other up to 200 m, which collects water only during rainy seasons. The ravine of Ginosa (*Gravina di Ginosa*) is part of a protected natural area.

The ravine has local names, they are known as : Valle dell'Arciprete l'Oscurusciuto, Canale San Giuseppe, Torrente Lagnone Tondo, Canale il Palombaro, Torrente Gravinella, Canale Cecera, Selva Venusio, La Difesella, Gravina Grande, Passo di Giacobbe, Gravinella di Cavese e Canale San Pellegrino, Fosso dell'Alloro e Gravinella del cacciatore.

One of them, Valle dell'Arciprete l'Oscurusciuto, is a particular interest because here it is attested the prehistoric site of Oscurusciuto that it's the object of this dissertation.

The Oscurusciuto rockshelter is located 20 km from the current ionic coast line at 225 m above the sea level.



Fig. 2 Localization of Oscurusciuto rockshelter.(photo Modified Google Earth, Boscato)

## 1.2 GEOLOGY

Briefly, the ravine opens into Mesozoic limestone, on its top have been found formations of Quaternary calcarenite. Starting from the last part of the early Pleistocene, progressive uplift caused the formation of paleorivers which progressively incise the Murgian edge, so creating a deep and narrow valley (ravine).

On a closer inspection, from the geological point of view, the stratigraphy and lithology of the area covers a period of time from upper Cretaceous to Olocene, while the stratification shows a great hiatus from the end of Cretaceous to the beginning of upper Pliocene<sup>1</sup>.

Here it is presented the sedimentary series beginning from the most ancient:

- *Calcare di Altamura*: calcareous deposits organized in layers and benches biostromali (usually finely calcarenitic); in beds of residual deposits and "crostoni" of reddish limestone or layers brecciformi cemented in ferruginous matrix. These limestones seem to be more dolomitic (or dolomite calcariferous), the roof and the bed of the formation are dark grey. Chronologically, the formation refers to the Upper Cretaceous (Senonian-Maastrichtian).

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<sup>1</sup> RONCHITELLI ET AL. 2011.

This formation is located in outcrop in the area of the Murgia of Matera, Laterza, Castellaneta-Mottola, and Altamura<sup>2</sup>.

- *Calcarenite di Gravina*: yellowish-white calcarenitic fossiliferous deposits formed of fine powder or available in a more compact form, sometimes with gravel and limestone breccia and irregular hints of layering. The formation is in transgression with angular unconformity on the Limestone of Altamura. Chronologically, it refers to the late Pliocene and early Pleistocene (Calabrian). This formation is located in extensive outcrops in the eastern part of the area (from Palagianello to Statte), on the edge of the Murgia's plateau, and in an isolated flap on it<sup>3</sup>.
- *Argille Subappennine*: grey blue clays and marly clays deposit. In certain levels they also appear silty or sandy (the clay rock types are more prevalent at the base of the formation, in the upper part is prevailing the marly fraction, towards the top it is possible to detect a stronger component clay-marly and sandy-calcareous). These deposits occur in shoals of considerable thickness (the stratification is normally absent, it is found where sandy intercalations appears). The formation is in eteropic relation with the Calcareniti of Gravina. Chronologically, it ranks among the late Pliocene and early Pleistocene (Calabrian). Extensive outcrops appear in the hilly interior area (from Montescaglioso to the hills situated on the Western part of Basento river and Matera), partially in the area of Taranto, and North of Mottola<sup>4</sup>.
- *Sabbie di Monte Marano*: quartz sands medium and fine-grained, the color range from yellowish gray to yellow-ocher, usually loose, with abundant marine fossils. Rest in accordance on Subappennine Clays. Chronologically, the deposit is referred to the Pleistocene (Calabrian), during the regressive stage of the sedimentary cycle of *Fossa bradanica* in connection with the phenomena of regional uplift. Outcrops of this formation are found in the upper portions of the highest slopes of the tabular hills that characterize the *Fossa bradanica*<sup>5</sup>.
- *Calcareniti di Monte Castiglione*: coarse yellow with pinkish appearance bench type calcareniti (sometimes floury calcareniti and coarse limestone containing breccia). They come in layers (sometimes in cross-vane arrangement, reflecting a costal sedimentary environment) or banks. The formation is eteropic on the sands of Monte Marano and is

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<sup>2</sup> AZZAROLI ET AL. 1968, MERLA & ERCOLI 1971, BOENZI ET AL. 1971, DE MARTINIS & ROBBA 1971, BOENZI ET AL. 1976.

<sup>3</sup> AZZAROLI ET AL. 1968, MERLA & ERCOLI 1971, BOENZI ET AL. 1971, DE MARTINIS & ROBBA 1971, BOENZI ET AL. 1976.

<sup>4</sup> AZZAROLI ET AL. 1968, BOENZI ET AL. 1971, DE MARTINIS & ROBBA 1971, BOENZI ET AL. 1976.

<sup>5</sup> AZZAROLI ET AL. 1968, BOENZI ET AL. 1971, BOENZI ET AL. 1976.

dated to the Early Pleistocene (Calabrian). It is located in outcrop in a band to the North-North East of the Murgia of Altamura, Santeramo and Gioia del Colle and South-SouthWest of the Murgia of Matera and Laterza and Castellaneta<sup>6</sup>.

- *Conglomerato d'Irsinia*: the conglomerate consists of pebbles of small and medium size (1-10 cm), rounded shape embedded in a matrix with rare calcareous sandy-clayey lenses. At the baseline, the matrix presents a whitish color, in surface it is reddish. The pebbles are of various kinds (flint limestone, *brecciole nummulitiche*, sandstone, jasper, granite and gneiss) and come from deposits interbedded conglomeratic sandstones in the Cenozoic of Lucan Apennines (undifferentiated complex of limestone marl of the "Flysch"). The formation rests directly on the sands of Monte Marano and Calcareni of Monte Castiglione and lies at an advanced stage of the Pleistocene (Calabrian top-Siciliano baseline). It is located in outcrop at the edge of the Murgia of Matera and Laterza (sometimes transgression on cretaceous limestone)<sup>7</sup>.
- *Depositi marini terrazzati*: a series of terraced areas arranged at various altitudes. It is possible to recognize a total of eight terraces, elongated parallel to the shore line, sloping towards the sea (the higher ones show pedogenic effects more or less marked). In the southwestern part the terraces are composed of fine-grained or coarse sands (colored yellow ocher, often at cross-bedding), with alternating beds of gravel or flattened lenses or polygenic conglomerates, origin Apennines. The highest deposits of the eastern part consist of calcareniti type bench, while the lower ones are conglomeratic calcareous matrix. The highest terraces are in transgression with an angular unconformity on Clays Subappennine, the lower ones are willing "to cloak". From a chronological point of view, the formation is placed in the middle-upper Pleistocene<sup>8</sup>.
- *Depositi Alluvionali Terrazzati*: continental deposits products, in conjunction with the Marine terraced deposits, because of changes in the base level of the rivers (linked to the Pleistocene marine regression and phases of standing of the sea). In the valley of Bradano the deposits are related to three separate flood cycles. It usually presents limited thickness and are constituted by gravels with sandy-silty lents or by deposits sandy-pebbly. The alluvial plains of the valley floor are recorded for long stretches and retain traces of ancient alvei<sup>9</sup>.

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<sup>6</sup> AZZAROLI ET AL. 1968, MERLA & ERCOLI 1971, BOENZI ET AL. 1971, DE MARTINIS & ROBBA 1971, BOENZI ET AL. 1976.

<sup>7</sup> BOENZI ET AL. 1971, BOENZI ET AL. 1976.

<sup>8</sup> BOENZI ET AL. 1971, BOENZI ET AL. 1976, BENTIVENGA ET AL. 2004.

<sup>9</sup> AZZAROLI ET AL. 1968, BOENZI ET AL. 1971.

- Recent and current deposits: alluvial deposits, Holocene lake and marsh, consisting of brown sands, gravels and black sandy clays<sup>10</sup>.
- Coastal dunes and nowadays beaches: recently cemented sands in loose, arranged in dune cordons of variable amplitude (aligned parallel to the shore), and dissolved in a narrow and continuous line that beards the cost<sup>11</sup>.



Fig. 3 Geological Map of Ginosa area and in red the Ocoruscuto rockshelter. (Modified CARTA GEOLOGICA D'ITALIA ALLA SCALA 1 100.000 FOGLIO 201 MATERA)

CHRONOLOGY	SEA DEPOSIT	CONTINENTAL DEPOSIT
OLOCENE		Recent and current deposits
		Coastal dunes and nowadays beaches
MIDDLE AND UPPER PLEISTOCENE	<i>Depositi marini terrazzati</i>	<i>Depositi alluvionali terrazzati</i>
UPPER PLEISTOCENE EARLY PLIOCENE	<i>Conglomerati d'Irsinia</i>	
	<i>Calcareniti di Monte Castiglione</i>	
	<i>Sabbie di Monte Marano</i>	

<sup>10</sup> AZZAROLI ET AL. 1968; MERLA & ERCOLI 1971; BOENZI ET AL. 1971; DE MARTINIS & ROBBA 1971; BOENZI ET AL.1976.

<sup>11</sup> MARTINIS & ROBBA 1971; BOENZI ET AL.1971.

	<i>Argille Subappennine</i>	
	<i>Calcareniti di Gravina</i>	
UPPER CRETACEUS	<i>Calcare di Altamura</i>	

**Table 1 Chronostratigraphic table of the area.**

### 1.3 HYDROLOGY, CLIMATE AND VEGETATION

Beside its geomorphological diversity, Puglia has a temperate-Mediterranean climate, which is characterized by the presence of hot, dry summers and mild winters with only few precipitations. The sea helps to mitigate the climate making the temperature range, daily and annual, modest. Also spring and autumn have mild temperatures closer to those of summer days.

The summer months are characterized by drought due to the warm and dry tropical air masses which dominates the Mediterranean basin. The winter and autumnal months have frequent cloud cover and relatively abundant rainfall, and bring typically scirocco winds, alternated with calm and rather cold periods caused by cold northerly winds of Northeast. In spring, it is also present current from Southwest, that brings hot and stuffy air from Africa.

Rainy days are scarce: their number is between 60 and 80 a year. Snow is fleeting except for the Gargano and the Sub Apenninoes Dauno. The region receives an average of a little more than 600mm of rain per year. Precipitations are focused in the winter months, while during the summer season rainfall is almost absent except for violent showers with peaks of 30-50mm in a few minutes. Finally, it is possible to register an elevated inter-annual variability of rainfall<sup>12</sup>.

The Puglia's landscape is dominated by limestone outcropping almost everywhere covered with rock formations or strata more or less subtle of farmland. Just this karst nature, typical of such a land makes the region essentially poor of surface water resources. At the same time, the territory has significant subterranean water resources that have enabled the development of agriculture, also integrated with infra-regional channels.

The ionic-arch corresponding to the province of Taranto is substantially free of surface water resources, that's due both to poor rainfall and to the nature of the soil, which is mainly karst, and quickly absorbs rainwater.

In correspondence with the limestone outcrops natural water is absent: on the Murgia there is a series of erosive furrows of variable width and length, usually with a flat bottom, called "lame". These pits are the remains of an ancient hydrographic surface today disappeared. Only in the case of

<sup>12</sup> AUTORITÀ DI BACINO DELLA PUGLIA, PIANO DI BACINO 2004.

very heavy rainfall they can convey - for short periods - a certain amount of water. Except for the ravines, disposal of water from rainfall occurs through underground karst formations.

The region Puglia falls within the defined region with Mediterranean biome where the climate is strongly influenced by the Mediterranean sea itself.

The main endemic vegetation species are located in the ravine, characterized by a availability of water, due to the presence of circulating water in the rock after the rain and by a greater amount of light and heat due to the particular position and inclination of the walls. This particular morphology of the ravine allows the formation of micro-climatic niches which give the possibility of development of different environments in short distances such as rocky platforms, moist cavity, wooded valley, grassy meadows, muddy quagmires and pools of clear water<sup>13</sup>.

Typical of the narrow valley and limestone gorge of the ravine is also the phenomenon of thermal inversion of the environment. It provokes a cooler and moister climate in the lower area that receives a lower insolation together with a warmer and drier climate at the top of the ravines where the insolation is higher. So, consequently linked to the thermic inversion is the inversion of altitude vegetation, that explains the presence of species typical of shaded areas of the upper part of Murgia on the bottom of the ravine, at much lower altitude.<sup>14</sup>

The ravine of Ginosa shows its true uniqueness about vegetation, in fact it is possible to recognize a great ecological diversity including also the survival of rare and endemic species.

Influenced by those factors, the vegetation of Ginosa's ravine is very varied and differentiated also in relation to other parts where the ravine itself is divided. The ancient oaks, elms and ash trees that once covered almost entirely this area, and the whole area of the current Murgia, are reduced nowadays to few relict traces which, due to the millenarian human activity, almost never can achieve the state of climax<sup>15</sup>.

The highest part of the ravine of Ginosa is occupied by a forest of holm oaks associated with some samples of pine trees and plants typical of the Mediterranean scrub. In other parts of the ravine are still present coppice of fragno (*Quercus troiana Webb*), a species typical of this part of Apulia. The lower part of the ravine is instead characterized by a more sparse vegetation, where it is interesting to notice the presence of different species of orchids and aromatic and medicinal plants<sup>16</sup>.

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<sup>13</sup> VIOLANTE ET AL 1993.

<sup>14</sup> AUTORITÀ DI BACINO DELLA PUGLIA, PIANO DI BACINO 2004.

<sup>15</sup> VIOLANTE ET AL 1993.

<sup>16</sup> VIOLANTE ET AL 1993.

## 1.4 HUMAN OCCUPATION

The first human settlement in Puglia dates back at least to the Early Pleistocene, as evidenced by the remains of Pirro Nord (Apricena-Foggia). This attestation so far represents one of the first example of human occupation in Europe attributable to a chronological interval between 1.3 and 1.7 MA<sup>17</sup>.

As regards the parte ancient part of the Lower Paleolithic, we have also attestations related to the pebble culture found along the side of lago di Varano (Gargano, Puglia). All the pieces of this set were collected on the surface of a terrace and can probably be attributed to the Middle Pleistocene. The collection consists in uni-facial and bi-facial choppers. Among the flakes, the denticulate ones are dominant, but the quantity of scraper is also remarkable, especially of those showing marginal retouch.

Afterwards, we have other attestations attributed by Palma di Cesnola, to the Acheulean, Tayazian, Clactonian<sup>18</sup> founded in different part of Puglia, from Gargano region to Salento. By the way the majority of this attestation are merely lithic artifacts from surface which don't have a sure stratigraphic origin.

Nevertheless, *in situ* material was found in Paglicci (Riparo esterno, layers 4-3)<sup>19</sup> and in the terrace of Torrente Romandato<sup>20</sup>.

The Riparo Esterno of Paglicci (which was a first room of the cave where the ceiling has collapsed and opens next to the homonym current cave), is the key site of the Gargano area and for all the southern part of Italy: it show a stratigraphic sequence made up by 4 level in which it is possible to follow the lithic evolution from the end of Acheulean (levels 4-3) to the beginning of the Middle Paleolithic (levels 2-1). The levels 3 and 4 represent the only Acheulean site found so far on the southern side of the Promontory. The few bifacial are short in size small and very small, their shape are oval and discoid, in appearance rather standardized, as regard the utilization. For the characterization of the edges, indeed, prevails dihedral shape utilized mostly on soft animal raw material such as skin and flesh. The gesture mainly of cutting is probably related to different stages of slaughter .Rather marginal is the use on plant material<sup>21</sup>.

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<sup>17</sup> ARZARELLO ET AL. 2007; ARZARELLO ET AL. 2012.

<sup>18</sup> PALMA DI CESNOLA 2001. This Source Is Utilized For All The Paragraph, Otherwise Is Specified.

<sup>19</sup> MEZZENA ET AL. 1971; GALIBERTI ET AL. 1980; OLLE 2003; BOSCATO & RONCHITELLI 2000.

<sup>20</sup> PALMA DI CESNOLA & ZORZI 1961.

<sup>21</sup> OLLE 2003.

As regards the component of flakes, it shows very marked characteristic of Tayazian and the industry is made on thick support of small size. The butts usually are flat and inclined, the ventral face sometimes dihedral (typical of Quinson). There isn't any attestation of Levallois technique.

In the Terrace of Torrente Romandato, and precisely in the excavation made by Zorzi in the years 1954, 1955 and 1957 it was found an Acheulean industry *in situ* and a production on flakes attributed to Clactonian.

On the current state of research the data regarding the Lower Paleolithic are still few, moreover there is a significant gap from the attestation of Pirro Nord and the beginning of the Middle Paleolithic, so as to make difficult an evolutionary synthesis of techno-complex that have taken place in this region.

In the matter of the archaic phase of the Middle Paleolithic (before OIS 5), in Italy there are a series of site that attests some different techno-complexes call by Palma di Cesnola as evolved Tayaziano, evolved Clactoniano, pre-mustertian<sup>22</sup>.

In the region of Puglia there are some site that can be integrate in this phase: on the Gargano promontory we remember the Riparo Esterno of Paglicci (level 2)<sup>23</sup>; in Salento the main site are Grotta dell'Alto<sup>24</sup>, Grotta Mario Bernardini<sup>25</sup> and Grotta di Capelvenere<sup>26</sup>, all situated near Nardò.

The two pressing problem regarding this phase are the lack of absolute chronological date and the scarcity of recent studies of the lithic industries with an appropriate technological approach.

Anyway regarding the Riparo Esterno of Paglicci (level 2) it is possible to say that the lithic industry is mainly made flint in form of nodule, the débitage on flakes prevail, there are especially supports that have as lateral margin a slope, made of one or more detachments, constituting an open scarp the so called type Quinson. The Levallois is completely absent. It is difficult to attribute the core to a particular concept because they result really exploited; as tools there is a great attestation of scraper and denticulate, foliate are also present.

About the débitage utilized in Grotta dell'Alto, we can say briefly that the concept Levallois is almost absent and that flake's butts are mostly flat and tilt, rarely faceted. Furthermore, the technique Quinson results well attested. Referring to Levallois typology, there must be recorded the prevalence of convex scraper followed by transversal scraper and double scraper, side\transversal scraper, then scraper with bi-facial retouch and, finally, some Mousterian point and bi-facial point.

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<sup>22</sup> PALMA DI CESNOLA 2001.

<sup>23</sup> GALIBERTI ET AL. 2008; PALMA DI CESNOLA & FERGUGLIA 2005.

<sup>24</sup> VON LÖWENSTERN BORZATTI 1966

<sup>25</sup> VON LÖWENSTERN BORZATTI 1970; VON LÖWENSTERN BORZATTI 1971; ROMAGNOLI 2012.

<sup>26</sup> GIUSTI 1979.

Grotta Mario Bernardini has a lithic collection interpreted as evolved Tayazian. The industry of the layers 13-6 is characterized by Quinson instruments, which include a point of narrow of elongated shape whose upper face is a little convex, while the ventral face presents a dihedral shape which is very pronounced. In the cave were also found thick and very thick scrapers.

In the site of Capelvenere was collected a production of tools made of siliceous limestone and flint, more rarely on shell *Callista chione*. In the lithic production there is the presence of elements of Tayazian, such as the point of Quinson, thick and very thick scrapers, point of Tayac and bilateral scrapers.

In a later phase of the Middle Paleolithic, corresponding to the OIS 5 and the first part of the OIS 3, in Puglia the occupation of humans is well attested, especially in cave sites and rock-shelters, that gave back many interesting lithic and fauna collections. They all were found in stratigraphy and are attributed to the Mousterian.

Is not only the abundance of sites that gives us a more comprehensive picture about this period but also the presence of plenty recent studies, especially for the recent part of the OIS 4 and OIS 3, with a technological and techno economical approach, that focus their goal in a more comprehensive understanding of the human behavior, related with the environment. The main focus of a series of studies and PhD thesis<sup>27</sup> elaborate in the last years are the understanding of the acquisition and exploitation of raw material, the production of lithic tools and the identification of the *Chaine operateire*.

The main Mousterian sites are: Grotta Paglicci Riparo Esterno (level 1)<sup>28</sup>, Grotta Spagnoli<sup>29</sup>, Caruso<sup>30</sup>, Sorgenti di Irchio<sup>31</sup>, Piani di S.Vito<sup>32</sup> in the Gargano promontory; Grotta del Cavallo<sup>33</sup>, Grotta di Uluzzo<sup>34</sup>, Grotta Mario Bernardini<sup>35</sup>, Grotta di Serra Cicora<sup>36</sup>, Grotta delle Cattie<sup>37</sup>, Grotta Romanelli<sup>38</sup>, Grotta Zinzulusa<sup>39</sup>, Grotta delle Striare<sup>40</sup>, Grotta delle Prazziche<sup>41</sup>, Grotta dei Giganti<sup>42</sup>, Grotta Titti<sup>43</sup>, Grotta del Bambino<sup>44</sup> in the Salento peninsula. And between these two area

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<sup>27</sup> ROMAGNOLI 2012; CARMIGNANI 2011; RANALDO In Press; SPINAPOLICE 2012; MILLIKEN 2007.

<sup>28</sup> PALMA DI CESNOLA 2001; BOSCATO & RONCHITELLI 2006 .

<sup>29</sup> GUERRI 1979; SALA 1979.

<sup>30</sup> PALMA DI CESNOLA 1989.

<sup>31</sup> PALMA DI CESNOLA 1960; MANCINI & PALMA DI CESNOLA 1958

<sup>32</sup> SARTI 1979; PALMA DI CESNOLA 1963a.

<sup>33</sup> PALMA DI CESNOLA 1963 ; PALMA DI CESNOLA 1965 ; PALMA DI CESNOLA 1967; SARTI ET AL.1998; CARMIGNANI 2011.

<sup>34</sup> VON LÖWENSTERN BORZATTI 1967; VON LÖWENSTERN BORZATTI & MAGALDI 1969.

<sup>35</sup> VON LÖWENSTERN BORZATTI 1970; VON LÖWENSTERN BORZATTI 1971; ROMAGNOLI 2012.

<sup>36</sup> CAMPETTI 1984; CAMPETTI 1987.

<sup>37</sup> CREMONESI ET AL. 1984.

<sup>38</sup> STASI & REGALIA 1904; BLANC 1921; BLANC 1929; PIPERNO 1975; FABBRI ET AL. 2003; ROMAGNOLI 2012.

<sup>39</sup> BLANC 1962 A.

<sup>40</sup> BLANC 1965; PIPERNO 1975.

<sup>41</sup> VON LÖWENSTERN BORZATTI 1966.

<sup>42</sup> BLANC 1962.

Grotta di S. Croce<sup>45</sup>, Grotta delle Mura<sup>46</sup>, Grotte di Cala Camicia<sup>47</sup> e Cala Corvino<sup>48</sup>, Grotta dei Ladroni<sup>49</sup> and Riparo L'Oscurusciuto<sup>50</sup>, which is precisely the one that we are going to present.

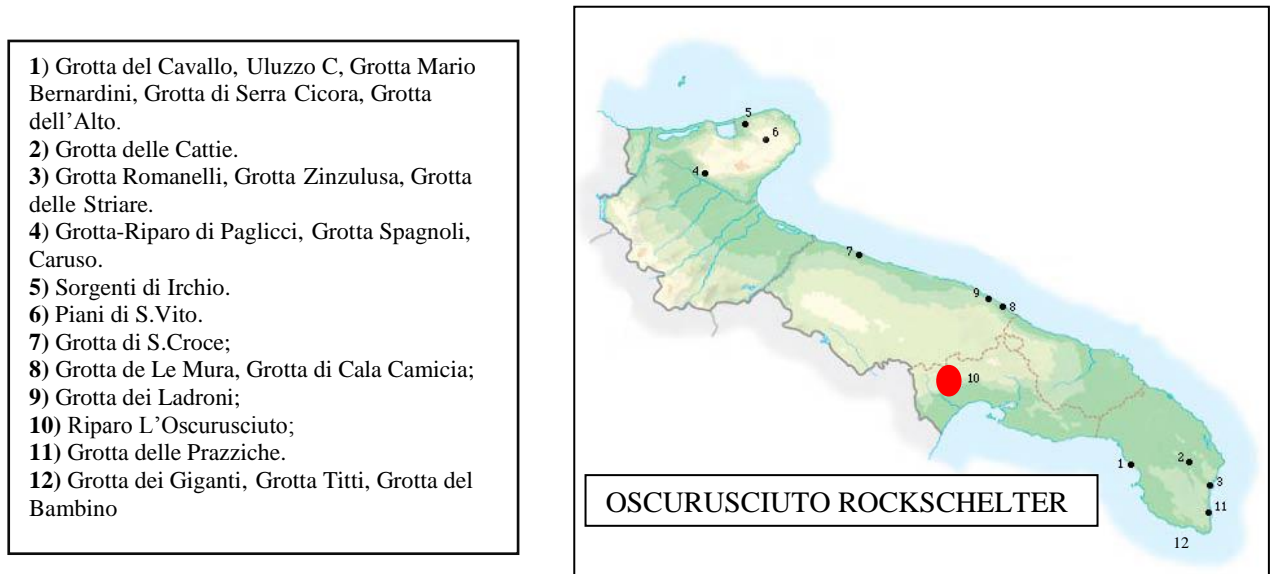


Fig. 4 Middle Paleolithic sites in Puglia.

We report a short description of the most relevant site related to the Musterian culture divided in geographic zone.

In the Gargano promontory:

- Grotta Spagnoli

The lithic industries of Grotta Spagnoli still maintain some characteristic rescue in Paglicci esterno layer 2, as frequently supports thick, the presence of some piece Quinson, the high presence of scrapers (especially charentian type) and the presence of Quina retouch. In comparison to Paglicci, the innovative aspects consist in the adoption of the débitage Levallois and in the interesting presence of faceted butts and bladed elements. This mixed composition is due to the border position of Gargano that receives both the influence of the central area of the Adriatic, where

<sup>43</sup> ID.

<sup>44</sup> ID.

<sup>45</sup> CARDINI 1955; MALLEGGNI ET AL. 1987; SEGRE & CASSOLI 1987; BOSCATO ET AL. 2006; ARRIGHI ET AL. 2009; BOSCATO ET AL. 2010.

<sup>46</sup> CORNAGGIA CASTIGLIONI & PALMA DI CESNOLA 1965; CORNAGGIA CASTIGLIONI & PALMA DI CESNOLA 1967.

<sup>47</sup> GUERRI 1987

<sup>48</sup> GUERRI 1987.

<sup>49</sup> BIDDITTU 1987; RITATTORE 1955.

<sup>50</sup> BOSCATO ET AL. 1999; BOSCATO ET AL. 2000-01; BOSCATO ET AL. 2002; BOSCATO ET AL. 2003; BOSCATO ET AL. 2011; BOSCATO & CREZZINI 2012; BOSCATO & RONCHITELLI 2005; BOSCATO & RONCHITELLI 2006; BOSCATO & RONCHITELLI 2007; BOSCATO & RONCHITELLI 2008; BOSCATO & RONCHITELLI 2009; BOSCATO & RONCHITELLI 2010; BOSCATO & RONCHITELLI 2011; RONCHITELLI ET AL. 2011.

the Levallois tradition was already utilized, and the tradition Quina of the Southern region of Puglia<sup>51</sup>.

- Caruso, Sorgenti di Irchio

This same kind of Mousterian records have been recovered in open sites such Caruso (a few kilometers from San Nicandro), and in the nearby San Nicandro Sorgenti di Irchio (Ischitella). In this surface site was recovered a Mousterian related probably to an advanced stage, especially if compared to Grotta Spagnoli. Here, in fact, the Charentian aspect subdue, as well as the Levallois technology is dominant.

In the Salento peninsula:

- Grotta del Cavallo

The most important site of this area is Grotta del Cavallo, in which it is studied the diachronic evolution of the Mousterian. Its development is well attested in the stratigraphic sequences from the layer N to F.

The Mousterian, which rest on a sea beach of eutirrenian age, begins with a Charentian Quina type made on limestone (for large instruments) and in flint and jasper (for smaller instruments). In the highest level the layer M (MI), has been reported the presence of tools on shells of *Callista chione*. It is attested a great predominance of scraper. However there is also a considerable quantity of Mousterian points. The technique Quinson is observable in some elements (scrapers, points). We remark that this aspect is linked to the local tayazian tradition.

In Mousterian layer L the Charentian character seems to improve: the number of scrapers increases and, on the contrary, the quantity of the Mousterian points decreases.

On the whole, the industry appears to be of smaller size, even microlithic, and it is obtained both on limestone and on flint, *Callista chione*. The débitage Levallois is represented, although very rarely.

The industry contained in the horizon I 1 is made on flint and on limestone-silica plate, the technique is non-Levallois. There aren't any longer lots of scrapers and Mousterian points but it is registered an increase of denticulate. This can be considered the last expression of the local Charentian tradition.

A few pieces were found in the higher levels H that is Mousterian, too. The layer G is a layer of tephra, sterile. The overlying layer F close the Mousterian sequence in this cave. (For details regarding the layer F, see paragraph 5).

- Grotta di Uluzzo, Grotta Mario Bernardini, Grotta di Serra Cicora

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<sup>51</sup> PALMA DI CESNOLA 2001.

They seem to repeat the sequence of Grotta del Cavallo with Quina elements and production on *Callista chione*.

- Grotta Romanelli

Grotta Romanelli is the most known site of the Adriatic coastal area. Here, the Levallois débitage is completely absent, the supports of the tools are always thick and present flat butts, usually very inclined and made in limestone. Sometimes they even conserve a large part of cortex. This site was considered Charentian Quina.

Central part of Puglia:

- Grotta di Santa Croce

In the cave Santa Croce (Bisceglie) the US 546 and US 535 are attributable probably to OIS 4, the main *chaîne opératoire* is the discoid production. Anyway a laminar and a SSDA production are also attested. The discoid production is almost exclusively aimed at obtaining sub-triangular flakes and pseudo-Levallois flakes, slightly small with dihedral or faceted large and thick butts. On the contrary the SSDA production seems to be aimed more to the realization of small flakes. The objective of the laminar production are laminar flakes with a central arise on the dorsal face and triangular section or with two arises and thus a trapezoidal section .

The techno-functional analysis of this lithic assemblage has evidenced the complementarity of the two main knapping processes: the laminar débitage, which is characterized by a higher level of standardization, proves to have a more specialized function, since they have been used mainly in the processing of hard materials / semi-hard. Whereas the discoid débitage seems to be used for different kind of activities.

The fauna is almost entirely made up of *Bos primigenius* and *Equus ferus*, an association that suggests open environment near the cave.

If the dating of those levels are confirmed, the laminar production in Santa Croce could represent so far one of the most ancient proof of laminar débitage in Italy. The lithic industry is characterized by the dominant presence of scrapers and denticulates, while the points are rare. The raw materials are flint and jasper pebbles, very rarely quartzite.

- Grotta delle Mura,

The industry of small size is mainly achieved on relatively thick block. There were also found elements of the Levallois technique (not quantified). The butts are usually faceted and the retouching is invasive and often deep, sometimes slightly steep. Sometimes there are retouches of Quina and “demi-Quina” type. The industry shows a clear predominance of Musterian points which constitute about half of the total of instruments, while the scraped ones are a little less numerous

and include simple types (rarely convex) and double. Denticulates are extremely rare. It appears to be an absolutely unique phase of the typical Mousterian.

- Grotte di Cala Camicia e di Cala Corvino

The lithic industry of Cala Camicia and Cala Corvino is predominantly microlithic, the débitage is non-Levallois. It was reported only a single element of technique Quinson. Scrapers, both lateral and transverse, clearly dominate all other typological groups. The scaled retouch is very represented.

The collection of the two caves would be attributable to Charenziano Quina.

- Grotta dei Ladroni

In Grotta dei Ladroni, as well as in Cala Camicia, the lithic materials are of little size and the débitage is non-Levallois.

The tools are made on caps or pebbles coves and for this reason this industry was previously compared to Pontiniano of Lazio. Scrapers are dominant (especially double and *déjetés*). Mousterian points are rare and Quina retouch is not very frequent.

Like the sites mention above those collections would be attributable to Charenziano Quina.

- Riparo L'Oscurusciuto

In the Oscurusciuto rockshelter it is attested the great dominance of the concept Levallois. The procurement of raw material is local, the blank choice to be knapped are mainly oblong pebbles of jasper and flint, less attested quartzite.

The lithic materials from the upper level US 1 and US 4<sup>52</sup> are mainly made by recurrent unipolar Levallois, less represented the bipolar modality. In the final knapping phases the production is converted into a centripetal method. The aim of this production are blades, and some of them are also selected for retouch. Among them scrapers result dominant follow by denticulates and points. A secondary *chaîne opératoire* utilize cortex removal cap as blank for flakes production. Scarcely but still present are flake removed with a volumetric orthogonal method.<sup>53</sup>

The lithic production of the US 8 can also be assimilate to the production of the upper level (US 1, US 4). The débitage recurrent Levallois is dominant; there is a blade bladelets volumetric production, and a more generic débitage from surfaces. Almost insignificant are the items from discoid débitage. The researched objectives of the production are long flakes and convergent flakes. As attested in the US 1 and US 4, in the final stage of production the recurrent unipolar Levallois is rearranged for a centripetal modality of a preferential one for the production of flakes.<sup>54</sup>

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<sup>52</sup> The Studies Of The Lithic Materials Of These Layer Is Part Of The Phd Project Of Filomena Ranaldo.

<sup>53</sup> BOSCATO ET AL. 2011.

<sup>54</sup> RONCHITELLI ET AL. 2011.

According with these data, finally it is possible to make a brief summary of the Paleolithic situation in Puglia.

First of all, it is documented in almost all the sequences, in a period that coincide with the OIS 5, the dominant presence of type Quina retouch, the presence of pieces of type Quinson, and the absence of the débitage Levallois. (the Riparo Esterno of Paglicci - level 2; Grotta del Cavallo levels M N; Grotta Spagnoli.)

Later on during the OIS 4 the Levallois production continues to be absent, there are present other concept of débitage as the discoid, especially attested in Grotta Santa Croce and in the level L of Grotta del Cavallo.

The real development of the Levallois happened during the OIS 3, in fact it become the main concept of débitage, it can be found in all the variables that this concept offers, both from a qualitative and quantitative point of view.

The absence of débitage levallois for the stage earlier to the isotopic stage 3 it is considered as a distinctive character of this region compared to rest of the peninsula where the system seems to be well developed since thr OIS 4-5<sup>55</sup>.

During the final phases of Musterian between 40.000 and 28.000 years BP, it is also attested a not Levallois production oriented in the production of blades and bladelets made by a Volumetric exploitation. A great production of this time is identified in the level F III of Grotta del Cavallo, but it is also attested in Oscurusciuto rockshelter and Grotta Santa Croce<sup>56</sup>.

## **2. OSCURUSCIUTO ROCKSHELTER**

### 2.1 DESCRIPTION OF THE SITE

The Oscurusciuto rockshelter opens on the northern side of a ravine of Ginosa (Taranto), it is located 20 km from the current ionic coast line at 225 m above the sea level.

Investigations have been carried out since 1998 until nowadays by the Dipartimento di Scienza Fisiche, della Terra e dell'Ambiente-UR Preistoria e Antropologia of the University of Siena, in co-operation with the "Soprintendenza per i Beni Archeologici of Apulia", the municipality of Ginosa and the local division of Legambiente<sup>57</sup>.

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<sup>55</sup> PALMA DI CESNOLA 2001.

<sup>56</sup> CARMIGNANI 2010.

<sup>57</sup> BOSCATO ET AL. 2000-01.



Fig. 4 View of the site (Photo P. Boscato)

The overhang of the shelter had collapsed, so today it presents a little coverage capacity. By the way the deposit spreads for approximately 60 m<sup>2</sup> and the entire stratigraphic sequence reaches, in its central part, a depth of 6 m as it was evidenced by the trial trench opened along one of the shelter rock wall<sup>58</sup>.

The stratigraphic sequence is made up by 27 sub-horizontal layers, whose extension downwards gradually increases cause in the shelter the hill erosion has damaged deposit especially on the upper layer<sup>59</sup>.

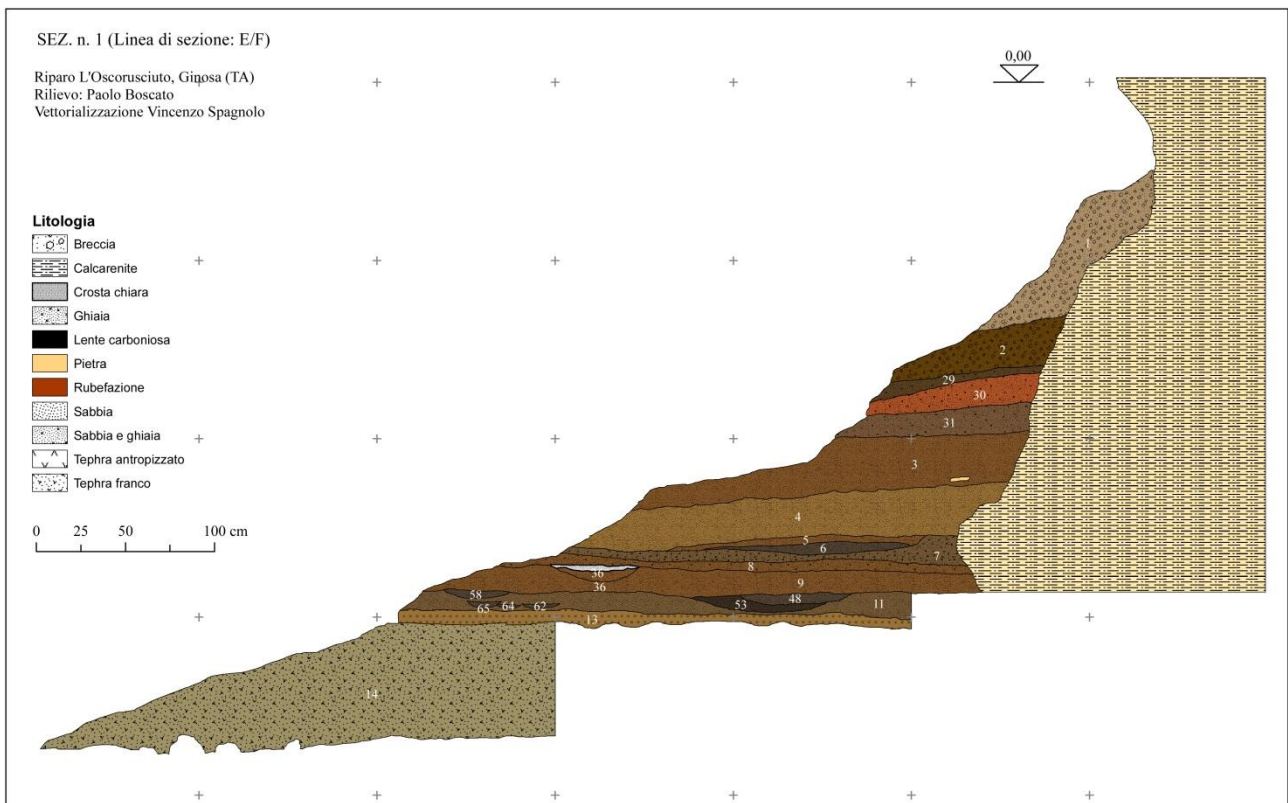


Fig. 5 Stratigraphic profile of the site (Profile P. Boscato)

<sup>58</sup> BOSCATO & CREZZINI 2012

<sup>59</sup> BOSCATO ET AL..2000-01.

## 2.2 HISTORY OF THE EXCAVATION

The excavations have taken place almost every September since 1998 until today. Interventions can be briefly summarized as follows:

- 1998: excavation of the trench for the identification of the stratigraphic sequence<sup>60</sup>.
- 1999: removing reworked sediments over the area and clarification of the stratigraphic sequence<sup>61</sup>.
- 2000: removing of US 1 ,2 ,29 that consist in residual plaque placed against the wall so as to open a surface of 2m<sup>2</sup>.<sup>62</sup>
- 2001: removing of US 1,2,30,31 to discover an area that measure almost of 7m<sup>2</sup> in sectors C-G\9-12 and excavation US 3 in the sectors E-F<sup>63</sup>.
- 2002: excavation US 2 ,29 ,30,31 in the sectors G10-11 expose US 3 to an area of almost 9 m<sup>2</sup>.<sup>64</sup>
- 2003: excavation US 3-4<sup>65</sup>.
- 2004: excavation US. 4 for an area of about 10 m<sup>2</sup> and expose US 5 and US 7 in an area of about 3 m<sup>2</sup>.<sup>66</sup>
- 2005: final removal of the US 4 and investigation of US 5 and 7<sup>67</sup>.
- 2006: continuation of the excavation of US 5 and 7, excavation US 6 and beginning of the excavation of US 8, which results particularly rich of fire-pits<sup>68</sup>.
- 2007: excavation of the US 9, removal of the series of fire-pits on the top of US 9 and identification of new fire-pits<sup>69</sup>.
- 2009: excavation of the US 9 (for an area of about 10 m<sup>2</sup>) and of the US 43. Beginning of excavation of US 11 and identification and excavation of another complex fire-pits<sup>70</sup>.
- 2010: continuation of the excavation of US 11 (for an area of about 10 m<sup>2</sup>) and related fire-pits<sup>71</sup>.

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<sup>60</sup> ID.

<sup>61</sup> ID.

<sup>62</sup> ID.

<sup>63</sup> BOSCATO ET AL.2002.

<sup>64</sup> BOSCATO ET AL.2003.

<sup>65</sup> BOSCATO & RONCHITELLI 2005.

<sup>66</sup> ID.

<sup>67</sup> BOSCATO & RONCHITELLI 2006.

<sup>68</sup> BOSCATO & RONCHITELLI 2007.

<sup>69</sup> BOSCATO & RONCHITELLI 2009.

<sup>70</sup> BOSCATO & RONCHITELLI 2010.

<sup>71</sup> BOSCATO & RONCHITELLI 2011.

- 2011: continuation of the excavation of US 11 and the beginning and continuation of the excavation of US 13 and associated fire-pits (in an area of about 12 m<sup>2</sup>), with savings of a band (0.25m to 0.5 m wide) along the wall of rock shelter<sup>72</sup>.
- 2012: excavation of the US 14-Tephra in the square D/G-13/16 (for an area of about 11 m<sup>2</sup>) and expose in the same sectors, of the US 15 that is a paleosol sealed on the top by the tephra<sup>73</sup>.

### 2.3 STRATIGRAPHY AND CHRONOLOGY

Excavations interest about half of the area and they reached the top of US 14 (in the deepest area in the trench) in the 2012 season. The topographic profile of the deposit (limited to the excavated portion), as evidenced by the four sections (spaced apart by one meter), appears articulated in a concave contour, which defines two sectors with two different angles of slope. The first sector (corresponding to the upper part of the deposit) stood at an angle of approximately 40 °, while the second stands at an angle of slightly more than 23 °. The stratigraphic deposit consists in a rich sequence of sub-horizontal layers, exposed along the surface of erosion of the slope<sup>74</sup>. The general sequence up to the US 13 consists of fifteen levels, we present the US of this level below.

- US 1: Breccia made of tenacious limestone cement with fragments of sandy matrix calcarenite, yellowish light gray (10 YR 6/4- Munsell), the

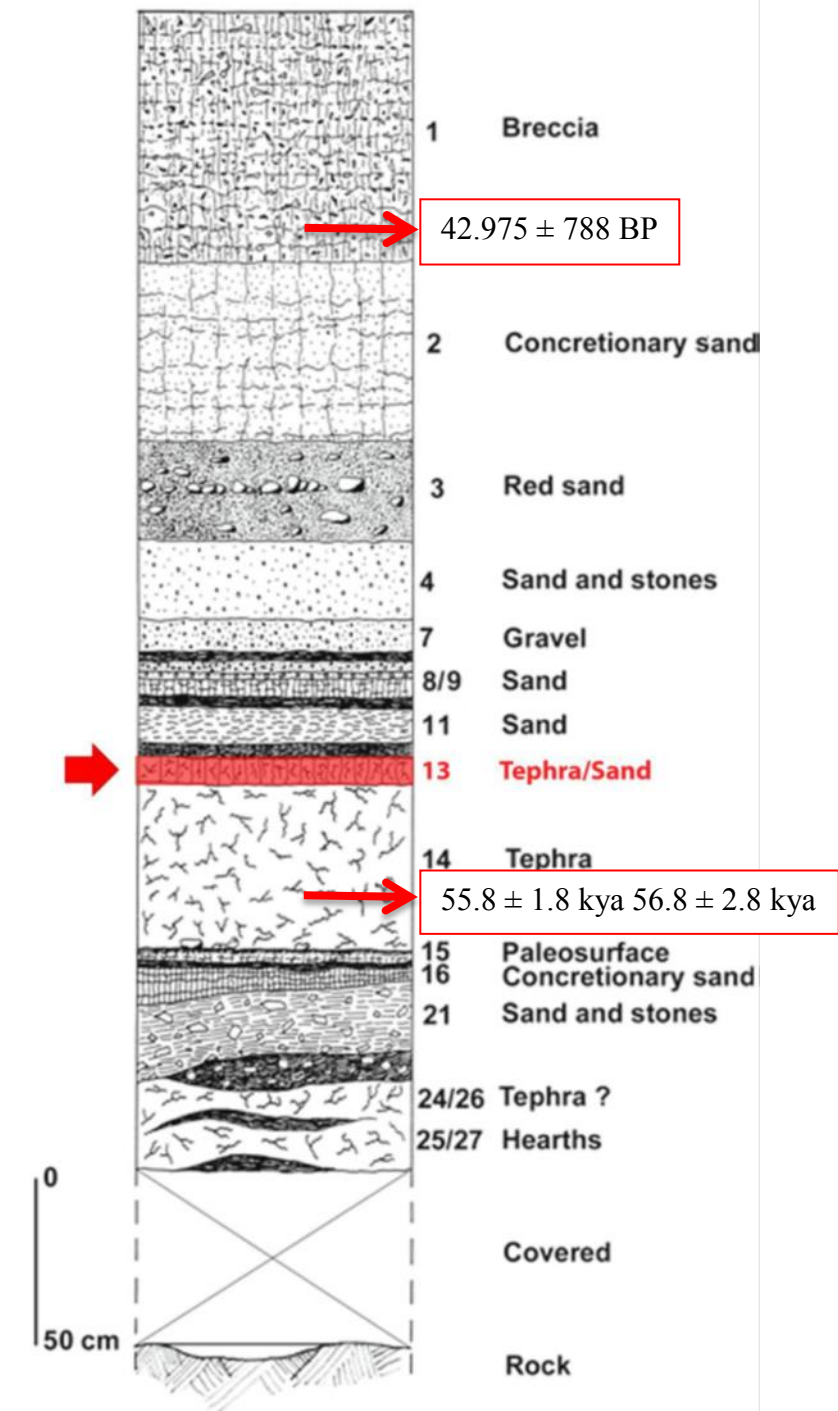


Fig. 6 Stratigraphic scheme of the main US of the site .

<sup>72</sup> BOSCATO & RONCHITELLI 2011, FASTIONLINE 2011.

<sup>73</sup> BOSCATO & RONCHITELLI 2008, FASTIONLINE 2012.

<sup>74</sup> SPAGNOLO 2011-12.

average thickness of about 70 cm) The layer is little inclined with immersion to N / NE (147 ° N 12 ° N / NE). For the base of this layer is available a calibrated C14 data of 42.975 ± 788 BP (AMS, beta 181165; not cal. 38.5 ± 0.9 ky BP)<sup>75</sup>. This dating has been done on a fragment of burned bone. This dating is near the end of the last anthropic occupation of the site, which coincides with the final presence of Neandertal in Europe and does not differ much from the arrival of the first Modern human in Europe (moreover noted in Salento)<sup>76</sup>.

- US 2: Breccia similar to the previous one but more sandy, dark yellowish brown (10 YR 3/6- Munsell), the thickness between 2 and 43 cm. The layer is slightly tilted with immersion in E / SE (170 ° N 27 ° E / SE).<sup>77</sup>
- US 29: friable sand with gravel component, dark yellowish brown (10 YR 3/4 - Munsell), with a thickness between 1 and 9 cm. The layer is sub-horizontal with a slight dip to E / NE (160 ° N 7 ° E / NE).<sup>78</sup>
- US 30: friable sand with gravel component, dark yellowish brown (10 YR 3/4 - Munsell), with a thickness between 1 and 16 cm. The layer is sub-horizontal with a slight dip E (178 ° N 7 ° E)<sup>79</sup>.
- US 31: friable sand with gravel component, brown (7.5 YR 4/4 - Munsell), with a thickness comprised between 2 and 20 cm. This layer present some dark patches of ash. The layer is sub-horizontal with a slight dip to E / NE (163 ° N 8 ° E / NE) <sup>80</sup>.
- US 3: compact sand, dark brown (7.5 YR 4/6 - Munsell) tending to yellowish red (5 YR 4/6 - Munsell), with big calcarenitic fragments (almost 10 cm), the layer shows a thickness between 2 and 33 cm. The layer is sub-horizontal with a slight dip to E / NE (168 ° N 8 ° E / NE)<sup>81</sup>.
- US 4: compact sand probably resulting from the disintegration of the calcarenite on which the rockshelter is open, dark yellowish brown (10 YR 4/4 - Munsell), mixed with small pebbles, of a thickness of between approximately 2 and 35 cm. The layer is sub-horizontal with a slight dip NE (124 ° N 4 ° E)<sup>82</sup>.

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<sup>75</sup> BOSCATO & CREZZINI 2012.

<sup>76</sup> BENAZZI ET AL. 2011, SPAGNOLO 2011-12.

<sup>77</sup> BOSCATO ET AL 2000-01, SPAGNOLO 2011-12.

<sup>78</sup> BOSCATO ET AL.2002, SPAGNOLO 2011-12.

<sup>79</sup> BOSCATO ET AL.2002; BOSCATO ET AL.2003; SPAGNOLO 2011-12.

<sup>80</sup> ID.

<sup>81</sup> BOSCATO ET AL.2003; SPAGNOLO 2011-12.

<sup>82</sup> BOSCATO & RONCHITELLI 2005; SPAGNOLO 2011-12.

- US 7: compact sand with gravel component, dark yellowish brown (10 YR 4/4 - Munsell) with a thickness of between 2 and 17 cm. The sediment is slightly concretions. The layer is sub-horizontal with a slight dip in N / NE (110 ° N 5 ° N / NE)<sup>83</sup>.
- US 8: compact sand with gravel component, dark brown (7.5 YR 4/6 - Munsell) with a thickness between 1 and 8 cm. The layer is sub-horizontal with a slight dip in N / NW (78 ° N 6 ° N / NW)<sup>84</sup>.
- US 9: compact sand, dark brown not homogeneous (7.5 YR 4/6 - Munsell), with a thickness between 2 and 16 cm. The layer is sub-horizontal with a slight dip in N / NW (71 ° N 7 ° N / NW)<sup>85</sup>.
- US 11: compact sand, dark yellowish brown (10 YR 3/4 - Munsell) with a thickness of between about 1 and 18 cm, dug in 3 artificial cuts. The layer is sub-horizontal with a slight dip in N / NW (74 ° N 8 ° N / NW)<sup>86</sup>.
- US 13: sandy compact deposit mixed with pyroclastic sediment, yellowish brown (10 YR 5/6 - Munsell), with thickness between 3 and 11 cm (average of 5 cm in the non-eroded area), dug in 2 artificial cuts. The layer is sub-horizontal with a slight dip in N / NW (68 ° N 6 ° N / NW). The cut 1 consists in a transition between tephra below and some elements of the US above (US 11). The passage between the US11 and US13 is really clear: the tephra is composed of light yellow fine sand in clear contrast with the brownish coarser sand of the US 11. Above the ? of US 13 is exposed a series of structured fire-pits. Fragments of limestone concretions are present in D11/I-II and D12 / I. An area of rather tenacious concretion is present on the strip along the wall and some bands of advancement of the flow of carbonate water. US 13 fills the strong irregularity of US 14 (usually small holes apparently related to erosion or roots action). Within these depressions US 13 is clear brown and almost sterile. Also the switch between US 13 and proper tephra (US 14) is clear and easily distinguishable.
- US 14: Pyroclastic deposit, light yellowish brown (2.5Y 6/4 - Munsell), with thickness of about 60 cm. The layer is sub-horizontal with a slight dip in N (90 ° N 5 ° N). The prof. Roberto Sulplizio (University of Bari, Department of Earth Sciences and geo-environmental) attributed the level of tephra to Tufo Verde di Monte Epomeo (Ischia)<sup>87</sup>,

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<sup>83</sup> BOSCATO & RONCHITELLI 2005; BOSCATO&RONCHITELLI 2006; SPAGNOLO 2011-12

<sup>84</sup> BOSCATO & RONCHITELLI 2007; SPAGNOLO 2011-12.

<sup>85</sup> BOSCATO & RONCHITELLI 2009; BOSCATO & RONCHITELLI 2010; SPAGNOLO 2011-12.

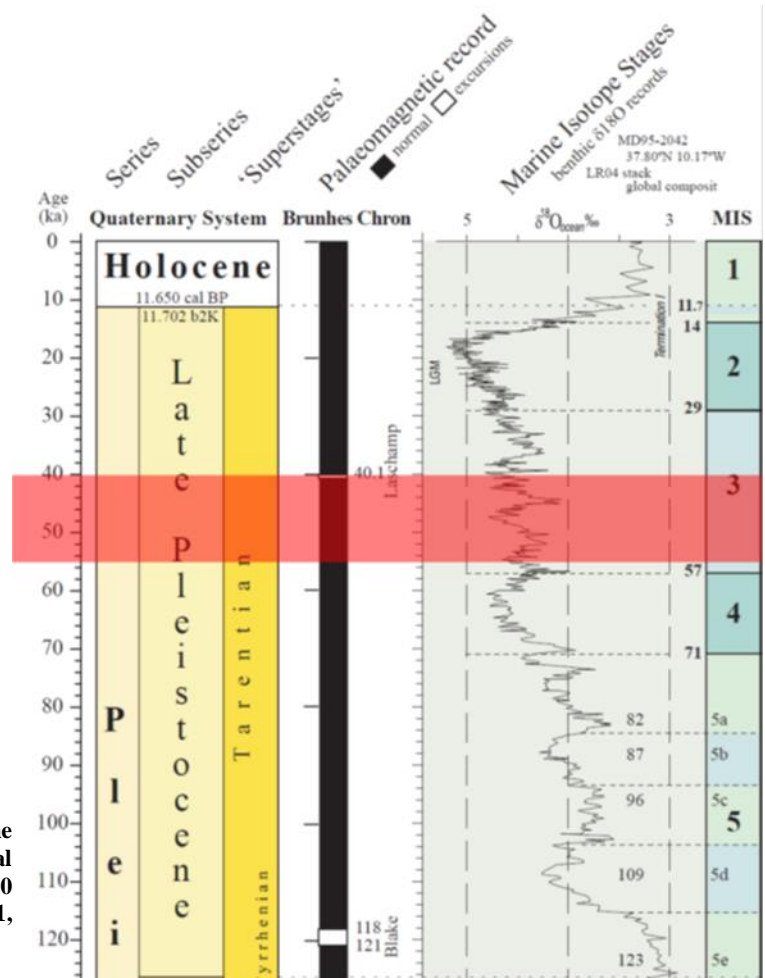
<sup>86</sup> BOSCATO & RONCHITELLI 2010; BOSCATO & RONCHITELLI 2011; SPAGNOLO 2011-12.

<sup>87</sup> Personal communication of Prof. Sulplizio to Prof. Ronchitelli.

identify in the stratigraphic series of Monticchio<sup>88</sup>, dated with the technique of K / Ar between  $55.8 \pm 1.8$  kya (Gillot 1982) and  $56.8 \pm 2.8$  kya (Vezzoli 1988)<sup>89</sup>.

The absolute dates available for the top and the base of the stratigraphic sequence described here (half of the all sequence in the rockselter) give a duration of 10.000-15.000 years to this part of the stratigraphic sequence that comprehended approximately between 40-55 ka correspondent to the first half of OIS 3. This is an important information because it allows a direct correlation between the deposit of the Oscurusciuto and the paleo-environmental events of the region Puglia during the last period of occupation of Neandertal population in the Peninsula.

**Fig. 7 Chronostratigrafic chart, in evidence the period of the analyzed sedimental record (Modified regional chronostratigraphical correlation table for the last 270.000 years Europe north of the Mediterranean 2011, Subcommision on Quaternary Stratigrap .**



## 2.4 WATER ACTION ON THE ROCKSHELTER

The action of water can erode the deposit but it can it can also carry material solved in it. The US 13 does not present a uniform consistency throughout its surface. Some areas, in fact, are affected by a strong concreting carbonate, which makes them difficult to dig. The distribution of the concretions is not random: water action is, in fact, directly linked to the level of resistance that the various types of rocks oppose the action of water.

In the deposit the concretion is particularly strong against the wall, while the rest of the layer appears in the form of "sagging" localized. This aspect is related to the chemical nature of the rock in which the rockshelter opens . The entire stratigraphic sequence, in fact, rests on a carbonate rock (Calcareni di Gravina), that is soluble in water. The meteoric waters, dissolving these rocks

<sup>88</sup> ALLEN ET AL. 2000.

<sup>89</sup> FASTIONLINE2012; TAMBURRINO 2008; SPAGNOLO 2011-12.

upstream, would transporting solutes carbonates, due to gravity, right into the layers of the shelter, where these carbonates deposited and cemented with the matrix <sup>90</sup>.

## 2.5 METHOD OF EXCAVATION AND DOCUMENTATION

The excavation area was divided into squares of 1m of size, which were further divided into four quadrants of 50 cm of size. The layer was removed with great accuracy working with chisels and trowels, and the sediment obtained has been dry- sieved and water- sieved with the aid of fine mesh sieves (1mm).

The material, divided by quadrants of origin, was then dried in the sun, then it was assessed and divided into general categories of artifact, that is to say lithic material, macrofauna, microfauna, malacofauna and coals.

The Cartesian coordinates of all the finds were collected and so it was possible to positionate all the findings of a size larger than 200mm<sup>2</sup>. Once divided, they were packaged and cataloged. The documentation of the excavation was carried out by filling out fixed US cards, accompanied, if necessary, by the collection of sediment samples. As regards the graphic documentation in particular we recurred to photos, plans and sketches.

The treatment of the archaeological material from US 13 has already been the subject of a study led by Vincenzo Spagnolo at the section di Preistoria e Antropologia at the University of Siena. In his research he has conducted a spatial analysis of materials with the help of a GIS platform. Due to these operations all the material has been washed thoroughly and signed.

Having thus concluded the preparations of the materials, it was possible to proceed to the analysis itself.

## 2.7 US 13 AND PALEOENVIRONMENT

The US 13 consists in the sedimentary interface between the US 11, sandy layer above, and the US 14, the proper tephra deposit. This layer is interpreted as a new occupation of the shelter, which occurred during the final phase of the deposition of the volcanic ashes.

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<sup>90</sup> SPAGNOLO 2011-12.

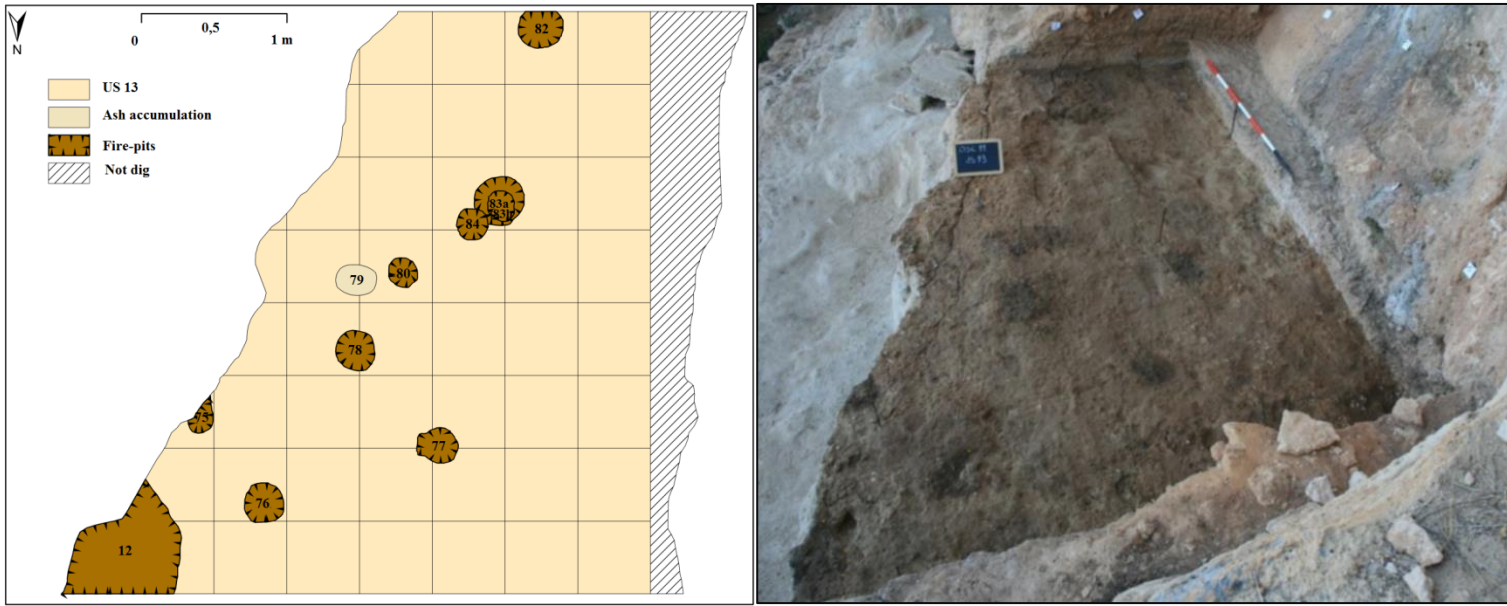
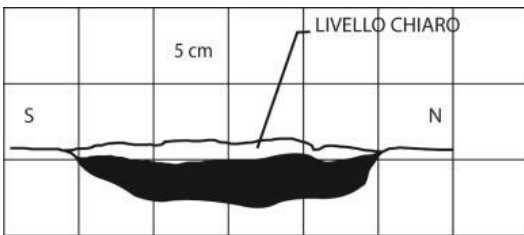
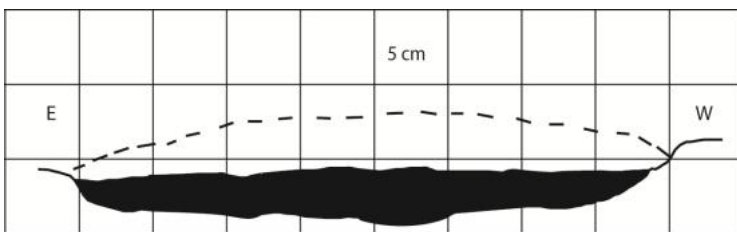


Fig. 8 Plan and photo of US 13 (Plan modified from SPAGNOLO 2013, photo BOSCATO)

Above the of US 13 is exposed a darker accumulation of ash named US 79 and a series of structured fire-pits made in prepared dimple (US 12,74, 75, 76, 77, 78, 80, 83A, 83B, 84, 82). Those fire-pits are divided on the basis of their dimension in two main categories: little ones, with a diameter of almost 20 cm; and middle ones with a diameter of 50 cm. All the deposit shows a great grade of conservation<sup>91</sup>.



US 80: Fire-pit structured in dimple of sub-circular shape (20x19). The dark fill is homogeneous with sporadic materials. On the edges of the dimple are almost vertical.



US 82: Fire-pit divided into sub-circular dimple (24x32). Above, in the same area of the fire, there were several dark spots not attributable to individual structures

Fig. 9 Example of fire-pits (draw Boscato, SPAGNOLO 2013)

The distribution of the fire-pits in the US 13 seems to form a cord that delimits an area on the corner of the shelter, this same distribution of the hearths was found in the upper US 9 and

<sup>91</sup> BOSCATO & RONCHITELLI 2008; SPAGNOLO 2011-12.

US11. In the US 7 on the other hand is no longer present the cord of small round fire and, on the contrary, we note the presence of a large hearth placed in a depression of about 2m radius in the northern corner of the shelter.

This double arrangement of the combustion area seems to indicate two different phases of management of the space inhabited.

While in the level US 7 the large hearth at an angle against the wall only allows the use of outer space in the shelter.

In level US 9, US 11 and US. 13 (the subject of this dissertation) the number of fires, located approximately 2 m from the walls of the shelter, at least partially lit at the same time could constitute a small protected area between the rock and fire.

These morphologies of fireplaces as well as a different management of the space may be linked to different modes of use: studies of micromorphology to solve this issue are still in progress at the University of Boston.

The archeological material found in this layer are lithic items and fauna remains. Their majority is concentrated in the outer band, next to the edge of erosion, apparently in small clumps, especially in the lower part of the US<sup>92</sup> (For specific information, refer to chapter 4).

The attestations of the presence of fauna in this layer are poor, moreover the bones we dispose of are extremely fragmented, but, in spite of this situation, some of the bones were attributable to *Bos primigenius*<sup>93</sup>. This data is in good accordance with the presences of fauna in the upper level where we also have the predominance of *Bos primigenius*<sup>94</sup>

The faunal association dominated by this taxa and the absence of forest species indicate that the environment was a grassland contains trees with limited coverage areas in wooded<sup>95</sup>.

The dating also raise the level of US 13 between 40-55 ka correspondent to the first half of OIS 3 that is a moment climate characterized by fluctuations rather cold and dry.

It is also possible to get information about the reconstruction of the environment thanks to the sedimentary record of Lago Grande di Monticchio

This is a lake situated in the volcanic crater on the western flank of Monte Vulture in Basilicata, southern Italy.

The site provide a sedimentary record with no major hiatuses since the formation of the lake that can be correlated to a calendar year chronology. An age of 101,530 calendar years BP is given for the lowermost sediments sampled, furthermore the sedimentary sequence includes numerous tephra

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<sup>92</sup> SPAGNOLO 2011-12

<sup>93</sup> Personal communication of Prof. Boscato.

<sup>94</sup> BOSCATO & CREZZINI 2009

<sup>95</sup> Personal communication of Prof. Boscato.

layers, the chemical composition of one of them, the Marker Tephra 9 (MT-9), indicates an origin in one of the Ischia volcanoes, and for its stratigraphic position was suggests its correlation with the eruption of Tufo Verde di Monte Epomeo<sup>96</sup>. This is exactly the same sediment on which lay the layer 13 of the Oscurusciuto.

The palinological record of Lago di Monticchio for the period between 40.000 and 55.000 BP indicate the following biome and climate:

- 40.000 BP: *Betula-Quercus* woodland with *Ulmus* and *Fagus* within predominantly steppe vegetation; that indicate a climate warmer and less dry.
- 42.300 BP *Artemisia*-Gramineae steppe with rare *Betula*, *Fagus* and *Abies*. Increase in *Juniperus* at end of zone; that indicate a cool dryish climate, becoming cold.
- 50.000 BP *Betula-Quercus* woodland at first, replaced by *Quercus-Abies* woodland. *Betula* and *Pinus* continuously present; that indicate a climate less warm and moist becoming cooler
- 53.800 BP *Artemisia*-Gramineae steppe with Chenopodiaceae and Caryophyllaceae; all trees very rare; regional *Pinus*; that indicate a cold and dry climate.
- 56.200 BP Steppe with occasional *Quercus* and *Fagus* woods, plus *Pinus* and *Juniperus*; that indicate a climate less cold and less dry<sup>97</sup>.

PAZ*	Age*	MOI*	GIS*		Palaeoclimate characteristics			
			(a)	(b)	Winter temperature	Growing season warmth	Temperature seasonality	Moisture availability
9	40,000-37,600	3	8	12	Very cold-cold	Cool-warm	Moderate-strong	Arid
10	42,300-40,000		9	10	Cold	Cool	Weak	Very arid
11	50,000-42,300	13	11	13	Very cold-cool	Cold-warm	Moderate	Arid-moist
			12	14				
12	53,800-50,000		14	15	Cold	Cool	Weak	Very arid
13a	56,200-53,800		15	16	Very cold	Cool	Moderate	Very arid-arid

\*PAZ — Lago Grande di Monticchio pollen assemblage zones; Age — lamination-based calendar years before present; MOI — marine oxygen isotope stages and sub-stages, dates for stage and substage boundaries follow Martinson et al. (1987); GIS — Greenland ice-core interstadials (a) matched by chronology of GISP2 core and (b) matched by 'wiggle-matching'.

**Fig. 10: Summary of correlations and palaeoenvironmental reconstructions (Modified Allen et al.2000)**

<sup>96</sup> NARCISI 1996.

<sup>97</sup> ALLEN ET AL. 2000.

### 3. LITHIC INDUSTRIES OF THE US 13

#### 3.1 THE LITHIC MATERIAL

7505 lithic artifacts were found in the layer (US13 and fire-pits). Their physical condition is very good and their edges are fresh. Due to the presence of fire-pits some artifacts present signs of fire. The surfaces of some artifacts show different patina because of chemical alteration.

The dominant raw material, as in the upper layer, are jasper and flint found in form of rolled and oblong pebbles. Probably it was collected locally from the gravel fluvial and sea terraces that still today are visible near the site.<sup>98</sup>

The quantitative composition of the lithic industry is show in the table.

<b>Classes</b>		
	Quantity	(%)
<b>Flakes</b>	1503	<b>20,0</b>
<b>Cores</b>	33	<b>0,4</b>
<b>Pebbles</b>	8	<b>0,1</b>
<b>Debris</b>	2203	<b>29,4</b>
<b>Indeterminates</b>	3758	<b>50,1</b>
Total	<b>7505</b>	100,0

**Table 2 Composition of the lithic industries**

Almost 80% of the collection is made by indeterminate items and debris, the 20% is made by flakes finally pebbles and core are few.

Since the composition of the industry is such, we thought of what could be the best approach to properly study it: since one of the essential methodology to understand a lithic industry is the technological approach, we came to the decision to complement it by an innovative approach: the minimum analytical analysis nodules (MAN)<sup>99</sup> or Raw material units (RMU)<sup>100</sup>, also knowed as Unità di Materia Prima Litica (UNPL)<sup>101</sup>. This approach allows us to study the individual blocks of raw material introduced to the site (n.b. by “block” we means here the single pebble). Through the analysis of the blocks it is therefore possible to get to the identification of individual technical episodes developed within the site.

<sup>98</sup> VILLA ET AL. 2008; BOSCATO ET AL. 2011; SPAGNOLO 2011-12.

<sup>99</sup> DOUGLASS 2010; HALL 2004; LARSON 2012; ODDEL 2004.

<sup>100</sup> ROEBROOKS 1988; UTHMEIER 2006; ROEBROOKS 1997; VAQUERO 2008; CARBONELL 2012; ROMAGNOLI 2012.

<sup>101</sup> ARZARELLO ET AL. 2011.

To develop the potential that this approach can offer we chose the level US 13 of the Oscurusciuto rock shelter because the amount of artifacts is not elevated there. Another reason for this choice was the accuracy of the documentation, especially the one related to the spatial distribution, and the particular features of the materials because, in fact, if observed from a macroscopic point of view, the artifact appears very different in granularity, color, aspect and nature of the raw materials.

Furthermore, the study is based on the collaboration with the student Vincenzo Spagnolo who, in his master's thesis, has developed a GIS platform to apply to the site, in order to have a better understanding of the management of the space, not only on the macro level but also at a more particular level. To state it precisely, this peculiar platform allows a deep understanding of the spatial distribution of the pieces that are considered part of each block (For specific information, refer to chapter 4).

For the analysis of the lithic, the use of the classical technological analysis complement applied to every single block turned out to be a good chance to integrate the results of both studies in order to get a wider range of information.

### 3.2 OBJECTIVES OF THE STUDY

The goals we want to reach are different but complementary; our three main aims are:

#### I. TECHNOLOGICAL\TECHNO-ECONOMICAL GOAL

We mean to detect the technological Behavior expressed by Human groups living in this site. We intend to reach this purpose by: the description of the economic behavior as far as regards the exploitation of raw material and the production of lithic tools (procurement of raw material); the identification of the *Chaine operatoire*, which means to check the different stages of the lithic production that are cortex removal, management, production, transformation by retouch, utilization and abandon; the definition of concepts, methods, dynamics and objectives of *débitage*.

#### II. METODOLOGICAL GOAL

To obtain the previous objectives we need an integrated methodology of Technology & RMU to understand the technical aspect of the industry by relating it to the spatial context in which each single pieces was found. The RMU allows us to analyze the industry in its smallest unit, the single pebble, that means having information on the segmentation of the *chaine operatoire*.

By doing so, we have two levels of “magnification” on the site: a general data obtained from technological analysis and a more punctual one obtained by the analysis of the elements that made up a single unit (RMU).

### III. CHRONOCULTURAL GOAL

Once we have the technic tools suitable for studying the technological behavior of humans in that site, we intend to compare these data with those coming from the other contemporaneous site in the region of Puglia. We consider that the period between 40.000 and 55.000 BP is particularly interesting especially because of the dynamic of occupation, and management of the area by the human population. The reason lies in the fact that during this period the last occupation of Neandertal and the first settlement of Modern humans in Europe have taken place.

#### 3.2 THEORY AND METHODOLOGY

In this work, the methodological aspect plays an important role because we will proceed by testing the opportunity to cross technological analysis and analysis of the blocks.

The aim of the study is to integrate results about the general technologic composition of the lithic industry and a more specific analysis of each block, in order to design new hypothesis on the use and management of the site.

##### *Technological analysis*

Basic references in this research have been the French school works dated 70<sup>th</sup> and 80<sup>th</sup> and the text-book of Tixier, Inizan , Roche, Boeda, Geneste, Revillion, Tuffreau, Forestier<sup>102</sup>.

The understanding of cultural technology, inside the ethnologic study investigate the technical system<sup>103</sup> “Technology” means the conceptual approach to the culture of material. The rational study of technics and of manufactures of a human group together with all the cultural behavior is considered the first fundamental step for each scientific investigation<sup>104</sup>.

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<sup>102</sup> INIZAN ET AL. 1999; BOËDA 1990; 1993; 1994; FORESTIER 1993; GENESTE 1991; REVILLION & TUFFREAU 1994.

<sup>103</sup> Cit. In GENESTE 1991.

<sup>104</sup> INIZAN ET AL. 1999.

The basic concept in every technologic study is therefore the operative chain introduced by Leroi-Gourhan<sup>105</sup>. The expression “operative chain” actually indicate the operational sequence of actions to handmade the object.

So, the aim of lithic technology is to put the single artefact into the *chaîne opératoire*, which is the sequence of the technical operations, actions and choices made by the knapper, to practically go back to the real purpose that probably the original craftsman had pursued. All that is carefully made in order to comprehend what was the human techno-economical behaviour in the past and how it was influenced by the physical singularities of the raw material which, as already stated, was often conditioning the technical choices of men.

This process works on thanks to the reconstruction of what was the life of each single handmade object starting from simple raw material then going on to the final object and eventually reaching the phase of its discard. The process could be divided in phases: the first is the acquisition of the raw material, the second is the initialization and the cortex removal; the third is the shaping out of the core and management of the convexities; the forth the production; the fifth, the eventual transformation by retouch; then the use and at the end the abandon.

Another level of analysis interests the reconstruction of the technical schemes and the conceptual systems; this happens through the recognition of knapping methods and techniques.

The technological study puts in evidence the dynamic point of view of the hand-made object, showing each relationship between techniques, physical, environmental, socio-economic aspects and the choice to create the hand-made itself.

#### *Refitting and Minimum analytical nodules*

By *Minimum analytical nodules* we are able to study the single block of raw material exploited in the site (as *block* we consider each pebble). The analysis of the blocks makes possible the identification of technical evolution's phases and understand special management and dynamics inter and intra site.

In literature this approach is called by different acronyms:

- UMPL (Unità di Materia Prima Litica), use in Italy (ARZARELLO ET AL. 2011, *Manuale di tecnologia litica preistorica.*) *Concetti, metodi e tecniche.*

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<sup>105</sup> LEROI GOURHAN 1943.

- RMU (Raw Material Unit), used in European area (ROEBROEKS 1988, *from find scatters to early hominid behaviour: A study of Middle Paleolithic riverside settlements at Maastricht-Belvédère – The Netherlands*; CARBONELL I ROURA 2012, *High Resolution Archaeology and Neanderthal Behaviour. Time and Space in Level J of Abric Romani – Capellades, Spain*; ROMAGNOLI 2012, *Risorse litiche e comportamento tecnico dei Neandertaliani: variabilità culturale e adattamento all'ambiente nel Salento. Grotta del Cavallo, Strati L-N e Grotta Mario Bernardini, Strato D*; UTHMEIER 2006, *Stone Tools, Horses and Cognition: Transformation of Lithic Raw Materials at the Middle Paleolithic Open Air Kill and Butchering Site of Kabazi II, Level III/I*; VAQUERO 2008, *The history of stones: behavioural inferences and temporal resolution of an archaeological assemblage from the Middle Paleolithic*, SPAGNOLO 2011-2012, *Analisi spaziale di un contesto musteriano. Riparo L'Oscurusciuto (Ginosa – TA)*.
- MANA o MAN (Minimum Analytical Nodule Analysis), utilized in Anglophonic Countries especially in Australia and New Zealand (HALL 2004, *Evaluating prehistoric hunter-gatherer mobility, land use, and technological organization strategies using minimum analytical nodule analysis*; LARSON 2012, *Chipped stone aggregate analysis in archaeology*; ODELL 2004, *Lithic analysis*; DOUGLAS 2011, *The archaeological potential of informal lithic technologies: a case study of assemblage variability in Western New South Wales*; WHITE 2012, *Minimum analytical nodules and lithic activities at site W2, Hunter Valley, New South Wales* .

This approach has a most effective use with refitting and conjoin. So as regard this we use as references the text of LARSON M. L. & INGBAR E. E. 1992, *Perspectives on refitting: critique and supplementary approach* and SHURMANS U., 2007, *Refitting in the Old and New World*.

This scientific approach gives us the possibility to have a more precise vision of the lithic complex, including studies on lithic technology, refitting study and spatial distribution. It is exactly this, the possibility to correlate techno-economical needs, to search materials and to manage the space in and outside the sites, and then, to understand the relations between hand-made objects and human behaviour.

The research of RMU correlated to the spatial analysis was led out by the Spanish school of Tarragona after the experience on the site Abric Romani Level L. *The lithic assemblage will be analysed to identify technical events that is an activity episode related to the manipulation of lithic resources that is develop continuously without location changes or temporal interruptions*<sup>106</sup> .

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<sup>106</sup> VAQUERO 2008.

Blocks became then actions, single events that has their spatial position in the site and the archaeological site became a *higher temporal resolution, defined through the identification of single activity event in order to avoid the reduction of behavioural variability given to the fact that an archaeological site is a palimpsest created in hundreds of year.*<sup>107</sup>

Far from the European Paleolithic assemblage but not less interesting are the utilization of the Minimum analytical approach in Anglophonic countries as USA, Australia and New Zealand.

Here we present a short *ex cursus* of the use of MAN approach in those countries, also if the context are really different from the European Paleolithic it is still interesting have other references especially regarding the methodological and theoretical aspect.

Refitting and minimum analytical nodules (MAN) done in a site in Hunter Valley Australia allowed to identify different lithic activity. Those analyses demonstrate individual sequences of action and diversity in the life histories of individual nodule of stone<sup>108</sup>.

The relationship between refitting and analytical nodule is develop by Larson and Ingbar, in a critical article about refitting they argue that it is missing a real conceptual base for the use and interpretation of refitting<sup>109</sup>. Whereas a complementary approach to refitting can be the analytical nodule, this group can provide information analogous to the “Minimum Number of Individuals” in fauna assemblage. That means that the minimum number of nodules is roughly equivalent to the number of cores brought or utilized at a site, refitting are utilized at this point to assess the integrity and validity of nodule designations that give a better control to the interpretation of reduction sequences in each nodules. Moreover they consider the spatial distribution of pieces. The sites where this approach is tested is the assemblage from Laddie Creek in Wyoming USA.

Similar and complementary to the RMU is the application of the cortex methodology that indicates the number of nodule introduced in the site: taking into account the quantity of cortex on the surfaces of flakes and core. Douglas in his PhD thesis develop this technique utilizing also spatial patterning in assemblage cortex proportions, the data for this study are then used to investigate the scale of Aboriginal mobility. Interpretation of this patterning provides insights into the organization of land use at a landscape scale and thus demonstrates a greater appreciation of the potential for informal lithic technologies to inform on the organization of the past<sup>110</sup>.

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<sup>107</sup> ID.

<sup>108</sup> WHITE 2012.

<sup>109</sup> LARSON & INGBAR 1992.

<sup>110</sup> DOUGLAS 2011.

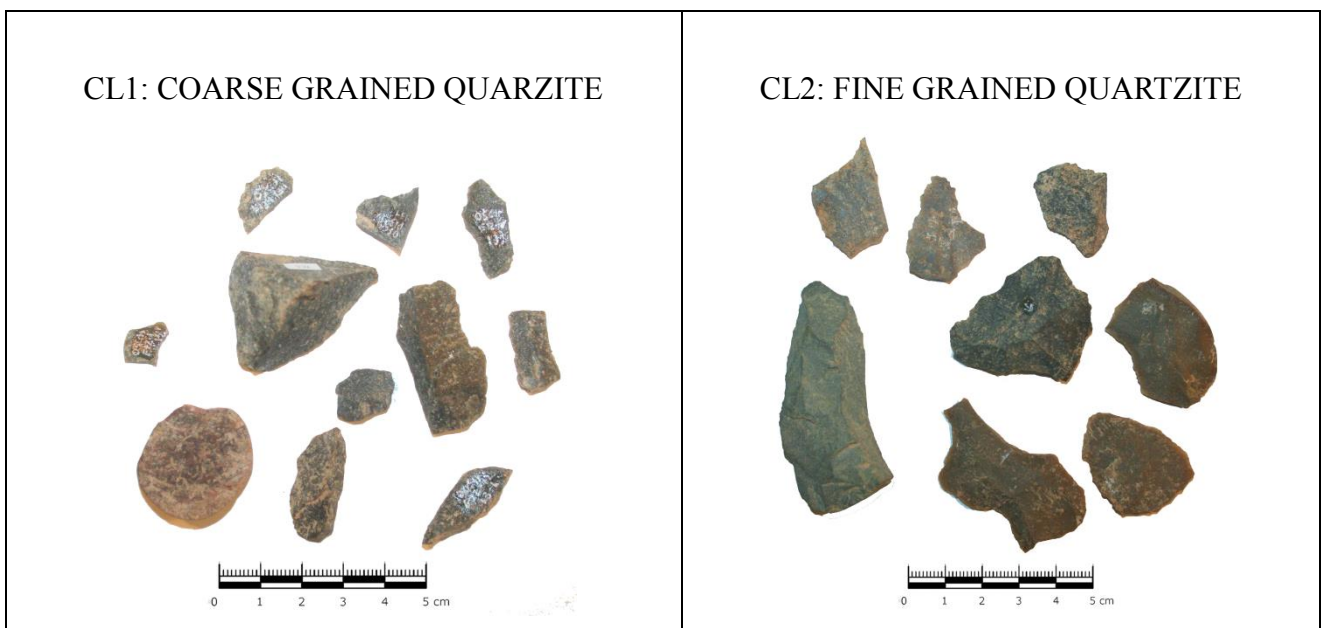
### 3.3 DATA COLLECTION AND STUDY ATTRIBUTES

#### 3.3.1 THE MINIMUM ANALYTICAL NODULES ANALYSIS: PROCEDURE AND STUDY ATTRIBUTES

For the Minimum analytical nodule analysis we do as follows.

All the signed material was spread out on a table and categorized on the basis of raw material. The deeply-altered material and the small pieces have been excluded from analysis, due to the difficulty in finding diagnostic characters in them. An exception is represented by a few elements which were either altered or small but showed the characteristics we were looking for.

We have considered 8 classes of raw material: CL1 coarse grained quartzite; CL2 fine grained quartzite; CL3 coarse grained jasper; CL4 fine grained jasper; CL5 coarse grained flint; CL6 fine grained flint; CL7 limestone and CL8 indeterminate, when was not possible the identification of the raw material for the small size of the items, for the alteration or any other reason.



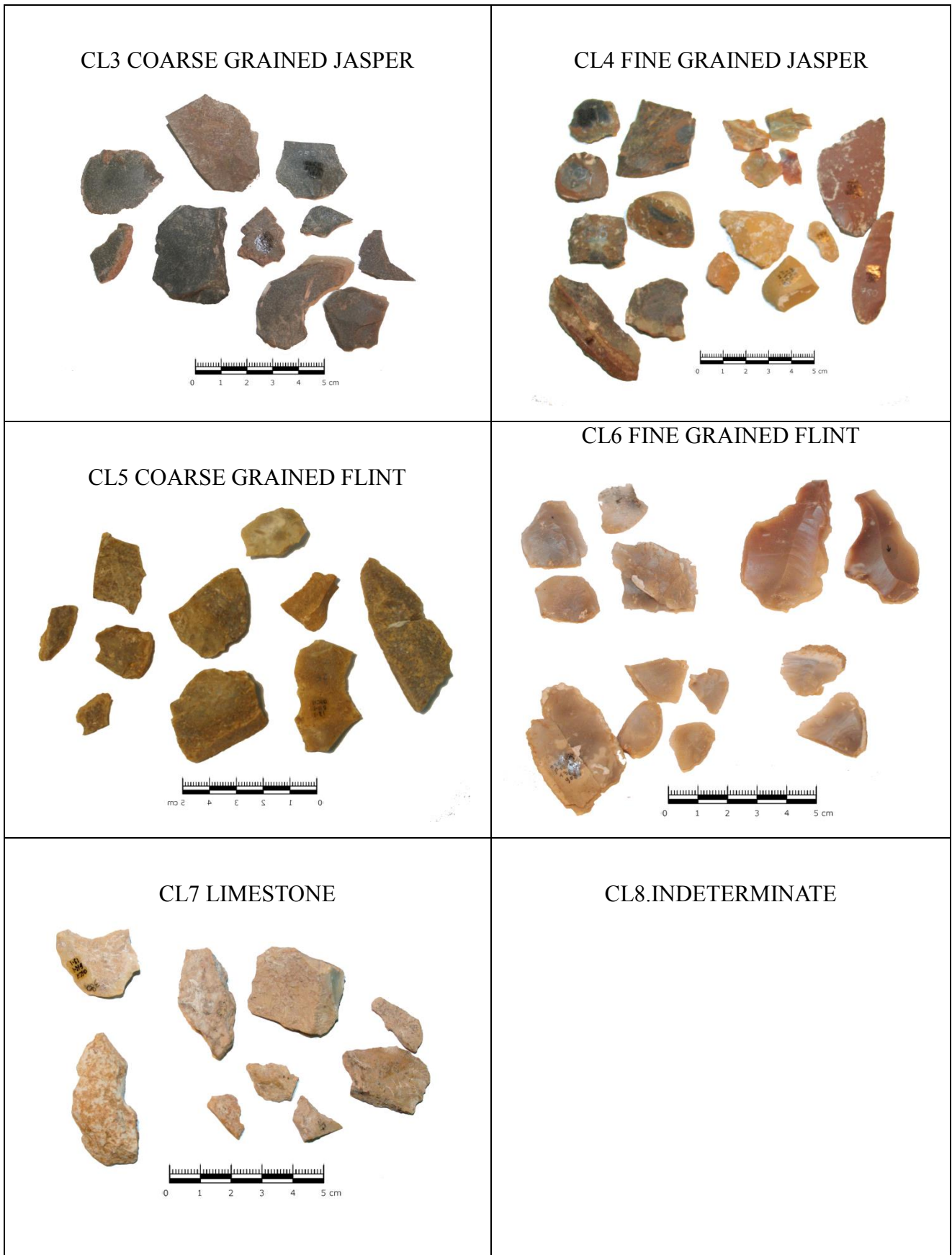


Fig. 11 Classes of raw material.

Afterwards we have distinguished some groups of artefacts belonging to a single pebble that represent a block or RMU, raw material units. The criteria for sorting are based on macroscopic

characteristics on lithic artefacts that comprehend the texture, the thickness and the colour of cortex and finally the colour of surface<sup>111</sup> (for a better description of each parameters see the table pag.41).

Among these, the parameter of colour is the relatively less reliable one, since the presence of thermic alterations can determine significant colour transformations and each nodule can present variability in colour in its inner part. The presence of patina on the surface of some items make this passage more difficult so for a better understanding of the affinities we have made this differentiation in a tray full of water; by doing so we were able to detect characteristics that were invisible on the dry artefacts. We have also used a magnifying glass.

The accomplishment of these procedures has taken a plurality of operators and a long time of more than a month, but this effort gave very good result as we were able to find a conspicuous number of conjoins (single broken items that fit together<sup>112</sup>) and refittings (part of the same sequence of flake removals<sup>113</sup>) that can be considered as a further verification of the reliability of the RMU.

Since the methodology of interpreting every single nodule is linked to subjective estimates, in order to avoid a too subjective analysis we must consider some parameters to objectively evaluating the degree of reliability of each RMU. The estimation of the degree of reliability of the nodule (excellent, good, and bad) aims to account for these issues. The parameters used to define the level of reliability were already developed by the research of Vincenzo Spagnolo<sup>114</sup>. These parameters are:

- Refitting ratio (*Rim-Rac Ratio*): it expresses the ratio between the amount of elements that are connected in a conjoin or in a refitting and the total quantity of elements in the block.
- Variability of Raw Material: it expresses the level of the internal variability in each single block of raw material. A pebble whose matrix presents a homogeneous structure is considered as homogeneous, while one in which the look is considerably different from the inside toward the outside is considered not homogeneous.
- Uniqueness of Raw Material: it expresses the level of uniqueness of the blocks of raw material exploited in the site (and therefore there is a probability that elements related to different pebbles can be referred to the same block or vice versa). The blocks whose formal

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<sup>111</sup> DOUGLASS 2010; HALL 2004; LARSON 2012; ODDEL 2004. ROEBROOKS 1988; UTHMEIER 2006 ROEBROOKS 1997; ROMAGNOLI 2012; SPAGNOLO 2011-12.

<sup>112</sup> LARSON & INGBAR 1992

<sup>113</sup> ID.

<sup>114</sup> SPAGNOLO 2011-12

features appear significantly different from those of other blocks are considered unique. Those with formal features shared with other blocks are not unique.

The level of reliability is calculated on the basis of the arithmetical sum of the parameters listed above. This is possible due to the fact that each parameter has its own numeric value.

For recorded the data we prepare a File Maker database that made possible to connect the schedule of each single nodule with all the pieces comprised in it.

Each RMU schedule is characterized by a photo showing the technological composition of the block, a plan showing its distribution in the space and all the information collected. An example of this schedule it is shown below and the complete records of the schedules of each nodule are in the annex of this dissertation. In the red circle is evidenced the button that allowed to go in the page related to each pieces that made up the RMU



<b>ID RMU 1</b>		<b>Associated ID</b>		<b>Number of elements 24</b>	
<b>Class of raw material</b> 6	<b>Raw material</b> Silex	<b>Granularity</b> Fine grained			
<b>Blank</b> Pebble	<b>Color of surface</b> Grigio Chiaro				
<b>Thickness of cortex</b> Thin	<b>Texture cortex</b> Rough	<b>Color of cortex</b> Grigio			

**RELIABILITY**

<b>Number of refitting or conjoin</b> 7		<b>Refitting ratio</b> ?	
<b>Variability inside the nodule itself</b> Homogeneous	<b>Codex variability</b> 1,00		
<b>Uniqueness</b> Unique	<b>Codex of uniqueness</b> 1,00		
<b>Relation</b>	<b>Number of relations</b> 0	<b>Codex of relations</b> 1,00	
<b>Reliability</b> Very good	<b>Codex reliability</b> 3,29		

**TECHNOLOGY**

<b>Cortex removal</b> yes	<b>Shaping out management</b> yes	<b>Objective researched</b> yes
<b>Core</b> yes	<b>Indst.</b> yes	<b>Concept</b> V/L

1	Cortical	<b>M</b>	<b>Photo</b>   <b>Plan</b> 
2	Cortical	M	
3	Cortical	M	
4	Not researched	M	
5	Cortical	M	
6	Cortical	M	
7	Researched	M	
8	Researched	M	
9	Not researched	M	
10	Researched	M	
11	Not researched	M	
12	Researched	M	
14	Not researched	M	
15	Not researched	M	
16	Indeterminate	M	

Remarks

Fig. 12 Example of schedule for registration of RMU.

The table describes the parameters utilized for the analysis of the block.

## General identification

ID RMU:	Number of identification of each nodule
Number of elements:	Number of elements that made up each nodule
Class of raw material:	<p>CL1. Coarse grained quartzite</p> <p>CL2. Fine grained quartzite</p> <p>CL3. Coarse grained jasper</p> <p>CL4. Fine grained jasper</p> <p>CL5. Coarse grained flint</p> <p>CL6. Fine grained flint</p> <p>CL7. Limestone</p> <p>CL8. Indeterminate</p>
Raw material:	<ul style="list-style-type: none"> <li>• Quartzite</li> <li>• Jasper</li> <li>• Flint</li> <li>• Limestone</li> </ul>
Granularity:	<ul style="list-style-type: none"> <li>• Coarse grained</li> <li>• Fine grained</li> </ul>
Blank:	Cobble
Colour of surface:	We describe the colour without a scale because for our description what matters is the differences between colours of different nodule and the differences inside the same nodule (inner variability), which is one of the descriptor that allows us to differentiate the nodules. Especially with jaspers!

Thickness of cortex:	<ul style="list-style-type: none"> <li>• Thin</li> <li>• Thick</li> </ul>
Texture cortex:	<ul style="list-style-type: none"> <li>• Smooth</li> <li>• Rough</li> </ul>
Colour of cortex:	We describe the colour without relying on scale
<b>Reliability of RMU</b>	
Number of refitting or conjoin:	Number of pieces that refit or conjoin
Refitting ratio:	It expresses the ratio between the amount of elements that are connected and the total quantity of elements in the block. The value falls in a range of variability between 0 and 1. The more the value is close to 1, the greater will be the reliability of the block.
Variability inside the nodule itself	<ul style="list-style-type: none"> <li>• Homogeneous</li> <li>• Not homogenous</li> </ul>
Codex variability:	<ul style="list-style-type: none"> <li>• Yes</li> <li>• No</li> </ul>
Uniqueness:	<ul style="list-style-type: none"> <li>• Unique</li> <li>• Not unique</li> </ul>
Codex Uniqueness:	<ul style="list-style-type: none"> <li>• 1</li> <li>• 0</li> </ul>
Relation:	If the block is not unique it is indicated the ID number of the nodule that is similar and with which it can be confused

Number of relations:	Indication of how many relations each nodule has
Codex of relations:	<ul style="list-style-type: none"> <li>• 0,25</li> <li>• 0,50</li> <li>• 0.75</li> <li>• 1</li> </ul>
Reliability:	<ul style="list-style-type: none"> <li>• +2,5 = Very good</li> <li>• Between 2,4 and 1,6 = Good</li> <li>• - 1,5 = Bad</li> </ul>
Codex reliability:	This is obtained by combining the codex of variability, uniqueness, relation and refitting ratio.
<b>Technology</b>	
Cortex removal:	<ul style="list-style-type: none"> <li>• Yes</li> <li>• No</li> </ul>
Management:	<ul style="list-style-type: none"> <li>• Yes</li> <li>• No</li> </ul>
Objective researched:	<ul style="list-style-type: none"> <li>• Yes</li> <li>• No</li> </ul>
Core:	<ul style="list-style-type: none"> <li>• Yes</li> <li>• No</li> </ul>
Indeterminate:	<ul style="list-style-type: none"> <li>• Yes</li> <li>• Non</li> </ul>
Concept:	It represents the volumetric reduction of a core regulated by organized flaking operations <sup>115</sup> .

<sup>115</sup> BOEDA 1997.

	<ul style="list-style-type: none"> <li>• Levallois</li> <li>• Levallois-volume</li> <li>• Volume</li> <li>• Indeterminate</li> </ul>
Remarks:	It contains any other interesting information that doesn't fill in the form.

### 3.3.2 TECHNOLOGICAL ANALYSIS: PROCEDURE AND STUDY ATTRIBUTES

The studies objective of this dissertation and the spatial analysis of Vincenzo Spagnolo in a first stage were conducted at the same time, so our approach to the material was aimed at a twofold analysis for different purposes but with complementary conclusions. If the spatial analysis answers the question where, technological analysis answers the question how, and only with the answers to these questions can be possible have an idea of space management by Neandertal.

The first phase, common for both approaches, the drafting of the material, after selecting the materials that are part of the blocks, was carried out the technological analysis of all the material found in the layer. During this preliminary phase of the vision of materials we have noted the technical character of the materials and we proceeded in search of refitting and conjoin.

The material was divided in raw material group; hereafter we subdivided those groups in subgroups on the base of their affinity and further divided into small units of raw material (RMU). The systematic research of refitting has been favourably advantage by these procedures. These phases were common for the analysis of the lithic industries and the development of GIS, and then the research takes different paths.

A second phase of the work has focused on the choice of parameters used in the analysis of the lithic material and the development of a FileMaker database for recording the data.

As far as the technological analysis is concerned we have proceeded by studying the material and by registering the information about each tool in a FileMaker database.

A more specific analysis has been made on the cores to get a detailed understanding of the methods and management of *débitage*. All the information regarding cores are filed in the general database dedicate to artefacts, to be able to develop statistics analysis focus on the recurring technical characters.

Moreover we prepare a schedule for a deeper analysis of core which have been drown, the removals on their surfaces have been studying following the diacritic method and fluently described

in order to explain the management of each single piece. The information that we recorded for the diacritical analysis of core are:

- the way of preparation of the striking platform,
- the number and role of each detachment on the débitage surface, and presence of eventual accident
- the diacritical analysis to explain the way of management of the core
- the concept and method of débitage
- And the objective of the débitage, this date is intend to be compared with the results of the analysis of flakes.

Whereas an example of the above mentioned database schedule (the one for all the artefacts) is presented below, in the red circle is evidenced the bottom that allowed going from each pieces to the page related to the RMU.

ID artifact	ID RMU	Tray	Associated ID	
US cut	Quadrant	Codex of excavation		X
Dimensional class	Height	Lenght	Thickness	Y
Fire alteration	Macro traces	Entirety	framm-fratt	Z
Refitting/Conjoin	Position of cortex			
Class	Concept	Chronology of refitting		
		Method		
Technological cathegory 1		Technological cathegory 2	Retouched	
Morphology	Symmetry	Section	Accident	Ratte
N. of negatives	Orientation of negatives		Scar of previous accidents	
Abrasion	Butt		Observation	
Position of impact point		Bulb		
Blank		N. of negatives	Direction of management negatives	
N. of reserched negatives	Direction of reserched negatives			
Type of Striking platform	Localization of Striking platform			
Flaking accidents	Reason of abandon			
Remarks				

Fig. 13 Example of schedule for registration of the artefacts

What follows here is the table containing the explanations of the descriptors used in the figure above.

### General Identification

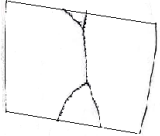
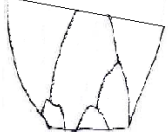

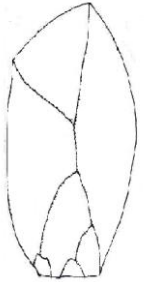
ID artefact	Number of identification of each single piece
ID RMU	Number of identification of the nodule to which it belongs
Tray	It is ordered with alphabetic letters
US cut	13\1, 13\2, 12,72,76,77,78,79,80,81,82,83
Quadrant	C14IV, D11I, D11II, D11III, D11IV, D12I, D12II, D12III, D12IV, D12IV\E12I, D13I, D13II, D13III, D13IV, D14I, D14IV, E10III, E11I, E11II, E11III, E12I, E12II, E12III, E12IV, E13I, E13II, E13III, E13IV, E14I, F11I, F11II, F11III, F11IV, F12I, F12II, F12III, F12IV, F13I, F13II, F13III, F13IV, G11I, G11II, G11III, G11IV, G12I, G12II, G12III, G12IV, G12IV\G12II, G13I, G13II, G13III, G13IV, H11I, RIP.TETTO
Codex of excavation	This codex is referred to coordinates: X Y Z
Dimensional Class	<ol style="list-style-type: none"> <li>1. 0 – 50 mm<sup>2</sup></li> <li>2. 50 – 100 mm<sup>2</sup></li> <li>3. 100 – 150 mm<sup>2</sup></li> <li>4. 150 – 200 mm<sup>2</sup></li> <li>5. &gt; 200 mm<sup>2</sup></li> </ol>
Height	Measurements (based on the technological orientation of the artefacts, when it is not possible the longest measurement is conventionally considered as the height)
Length	Measurements (based on the technological orientation of the

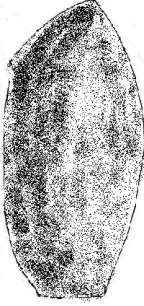
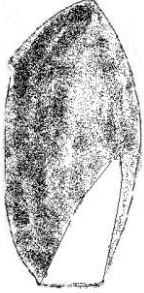

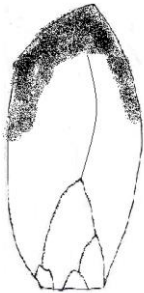
	artefacts, when it is not possible the longest measurement is conventionally considered as the height)
Thickness	Taken from the maximum thickness of the piece
Fire alteration	<ul style="list-style-type: none"> <li>• Yes</li> <li>• No</li> </ul>
Macro traces	<ul style="list-style-type: none"> <li>• Yes</li> <li>• Yes?</li> <li>• No</li> </ul>
Entirety	<ul style="list-style-type: none"> <li>• Yes</li> <li>• No</li> </ul>
Refitting\ Conjoin:	ID number of the elements that refit\conjoin
Chronology of refitting	They are indicated by an ordinal number.
Class	<ul style="list-style-type: none"> <li>• Cobble</li> <li>• Indeterminate</li> <li>• Core</li> <li>• Flake</li> </ul>
Concept	<p>Represents the volumetric reduction of a core regulated by certain organized flaking operations</p> <ul style="list-style-type: none"> <li>• Levallois</li> <li>• Volume</li> <li>• Indeterminable</li> </ul>
Method	Is the set of operations that lead to an end that is a technical process interposed between a target and the achievement of this objective.

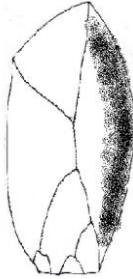

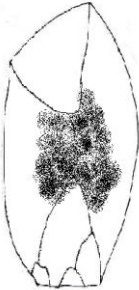
- Levallois unipolar
- Levallois convergent
- Volume:

Framm- Fract	It is indicate the position of accidental breaks or intentional breaks that we can consider as fracture
top break	If the tool is entire and it is missing only a little fragment on the top
base break	If the tool is entire and it is missing only a little fragment on the base
side break	If the tool is entire and it is missing only a little fragment on the lateral part
Fracture	If it is intentional
Fragment-Fracture	If it is not possible to determinate the intentionality of the fracture
Distal fragment	If it is not possible to determinate the intentionality of the fracture
Mesial fragment	If it is not possible to determinate the intentionality of the fracture



	
Proximal fragment	If it is not possible to determinate the intentionality of the fracture
	
Lateral fragment	If it is not possible to determinate the intentionality of the fracture
	
Composite fragment	If it is not possible to determinate the intentionality of the fracture, and there are more than one fractures that are not mentioned above.
Presence and position of cortex	The position of cortex is indicated only when it covers less than half of the surface of the artefacts.
Absent	
Total	If the entire surface of the tool is covered by cortex.

	
Semi cortical	If more than an half of the surface of the artefact is covered by cortex
	
Proximal	If less than an half of the surface of the artefact is covered by cortex. In this case the position of the cortex is explained.
	
Distal	If less than an half of the surface of the artefact is covered by cortex. In this case the position of the cortex is explained.
	
Lateral	If less than an half of the surface of the artefact is covered by cortex. In this case the position of the cortex is explained.

	
Lateral back	<p data-bbox="580 501 1374 591">If less than an half of the surface of the artefact is covered by cortex. In this case the position of the cortex is explained.</p> 
Central	<p data-bbox="580 972 1374 1061">If less than an half of the surface of the artefact is covered by cortex. In this case the position of the cortex is explained.</p> 
Mixed	<p data-bbox="580 1431 1390 1576">If less than an half of the surface of the artefact is covered by cortex. In this case the position of the cortex is explained. And the cortex result in a mixture of previous possibilities.</p>

**FLAKES**

Technological Category 1	
Indeterminate	Are part of this category all the elements that cannot be oriented Due to their highly fragmentation or alteration of the surfaces.
Non researched	Comprehend all the flake necessary for the management of the convexities of t Which are not the objective researched.
Researched	Researched objective of the production.
Cortical	Flake with total or semi total cover of cortex on the dorsal Surfaces.
Entame	Opening flake of a core

Technological category 2	This is a further specification of the technological category
	<ul style="list-style-type: none"> <li>• bladelet</li> <li>• long flake</li> <li>• long flake with back</li> <li>• convergent</li> <li>• Short flake</li> <li>• Blade production management</li> <li>• S/D Debordant</li> <li>• convexity management</li> <li>• Pseudo levallois point</li> <li>• Erase accidents</li> <li>• S/D</li> <li>• P/P</li> <li>• P/P cortex removal</li> <li>• S/D cortex removal</li> </ul>

Retouched	<ul style="list-style-type: none"> <li>• Denticulate point</li> <li>• Denticulate scraper</li> <li>• Lateral scraper</li> <li>• Inch</li> <li>• Grattatoio (end scraper? )</li> <li>• Retouched fragment</li> </ul>
Morphology	<ul style="list-style-type: none"> <li>• Oval</li> <li>• Circular</li> <li>• Half moon</li> <li>• Half circular</li> <li>• Triangular</li> <li>• Rectangular</li> <li>• Quadrangular</li> <li>• Trapezoidal</li> <li>• Irregular</li> <li>• Fan shaped</li> </ul>
Symmetry	<ul style="list-style-type: none"> <li>• Yes</li> <li>• No</li> </ul>
Section	<ul style="list-style-type: none"> <li>• Irregular</li> <li>• Isosceles trapeze</li> <li>• Rectangular trapeze</li> <li>• Trapeze</li> <li>• Triangular</li> <li>• Rectangular</li> <li>• Half circles</li> <li>• Linear</li> </ul>

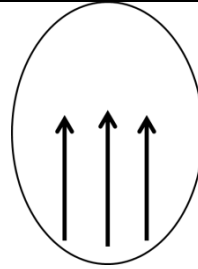
Flaking Accidents

- Siret
- Plunging
- Hinged
- Natural surfaces
- Exploded

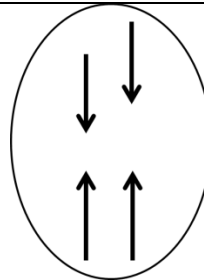
Number of previous scars/negative of removals

Orientation of negatives

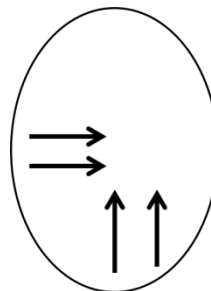
Unipolar

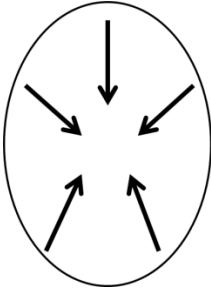
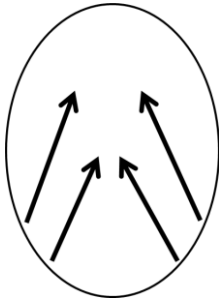
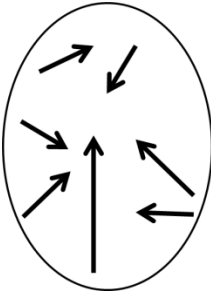


Bipolar



Orthogonal



Centripetal	
Convergent	
Multidirectional	
Indeterminable	
Ventral face- Kombewa	
Scars of previous accident	Hinged
Abrasion	<ul style="list-style-type: none"> <li>• Yes</li> <li>• No</li> </ul>

Butt	<ul style="list-style-type: none"> <li>• Cortical</li> <li>• Flat</li> <li>• Facetted</li> <li>• Facetted ,Chapeau de gendarme</li> <li>• Dihedral</li> <li>• Absent</li> <li>• Point form</li> <li>• Indeterminable</li> <li>• Linear</li> </ul>
Position impact point	<ul style="list-style-type: none"> <li>• Lateral</li> <li>• Central</li> <li>• Indeterminate</li> <li>• Absent</li> </ul>
Bulb	<ul style="list-style-type: none"> <li>• Prominent</li> <li>• Not Prominent</li> <li>• Absent</li> </ul>
Observation	This consists in an open camp to explain any information that doesn't fits in the prepared schedule

### CORES

Concept	<ul style="list-style-type: none"> <li>• Levallois</li> <li>• Volume</li> <li>• Indeterminable</li> </ul>
Method	<ul style="list-style-type: none"> <li>• Volume: Bladelet</li> <li>• Levallois unipolar</li> <li>• Levallois convergent</li> <li>• Indeterminable</li> </ul>
Blank	<ul style="list-style-type: none"> <li>• Cobble</li> </ul>

	<ul style="list-style-type: none"> <li>• Flakes</li> <li>• Fragment</li> </ul>
Number of negatives	
Number of researched negatives	
Direction of management negatives	<ul style="list-style-type: none"> <li>• Indeterminable</li> <li>• Centripetal</li> <li>• Convergent</li> <li>• Orthogonal</li> <li>• Pseudo bipolar</li> <li>• Pseudo unipolar</li> <li>• Unipolar</li> </ul>
Direction of researched negatives	<ul style="list-style-type: none"> <li>• Convergent</li> <li>• Unipolar</li> <li>• Orthogonal</li> </ul>
Type of striking platform	<ul style="list-style-type: none"> <li>• Absent</li> <li>• Cortical</li> <li>• Fracture</li> <li>• Prepared</li> <li>• Absent \ prepared</li> <li>• Cortical \ prepared</li> <li>• Fracture \ prepared</li> </ul>
Localization of striking platform	<ul style="list-style-type: none"> <li>• Partial</li> <li>• Large partial</li> </ul>
Flaking accidents	Inner natural surface Hinge
Reason of abandon	This is an open camp to explain if there are hypothetical reason for the abandonee of the core

Remarks

For any information of different kind those described above

### 3.4 TECHNOLOGICAL ANALYSIS

#### 3.4.1 INTRODUCTION

In this section we present the tables of technological analysis, for the development of these tables we used a Microsoft Excel spread sheets.

The first section deal with the raw material and the physical state of the supports considering the alterations due to physical and chemical agents such as the action of the fire and the onset of patinas.

Then we will present the technological data by dividing the collection into classes as cores, flakes, debris, pebbles and indeterminate items. The study of cores is accompanied by specific analysis of individual tabs.

The part referring to flakes begins with some general information considering the technical characteristics of the flakes such as: orientation of the negatives, location and amount of cortex on the dorsal surface of the flakes, the type of butt, the position of point of impact and the type of bulb. Then we will discuss the concepts separately: unipolar Levallois, Levallois convergent Levallois indeterminate and volume. To finish we will focus on researched flakes and we conclude with a brief analysis of the retouched tools.

We only counted pebbles and indeterminate; for the analysis of debris we only consider the subdivision in technology categories.

The next section will focus on the results of the RMU and the comparisons between the results of the traditional and the technological blocks. The chapter ends with the schemes of operational chains used in the site and a brief summary of the industry's technological composition

The number of replacements found at the site is high, but rather than develop a paragraph for the description of them we decided to show examples of significant refitting inside the text.

The whole lithic material coming from the US 13 is composed of 7505 parts. We divided the collection in 5 classes that exemplify more clearly the composition of the industry.

Those classes are:

- Cores: it is a block of raw material from which flakes, blades or bladelets have been struck, in order to produce blanks for tools. The flakes core are oriented according to the débitage axis of the last flake removed. Blade cores are oriented with the striking platform upwards, in case of several platforms, the last-used is use as a reference<sup>116</sup>.
- Flakes: we consider in this class a fragment of hard stone that is removed either from a core or from a tool during manufacture. We consider here only flakes that are possible to orientate. They are oriented according to their débitage axis, proximal end downwards, and upper face towards the viewer<sup>117</sup>.
- Pebbles: natural pebbles of raw material potentially imported in the site for future utilization.
- Debris: our class of Debris comprehend only entire flakes smaller than 12mm of length. This dimension is chosen because there is not the production of researched flakes smaller that 12mm in this layer (we measure it on cores and on dorsal surface of detached flakes).
- Indeterminate: Shapeless fragments, or much altered items whose mode of fracture cannot be identified and cannot be assigned to any technological category.

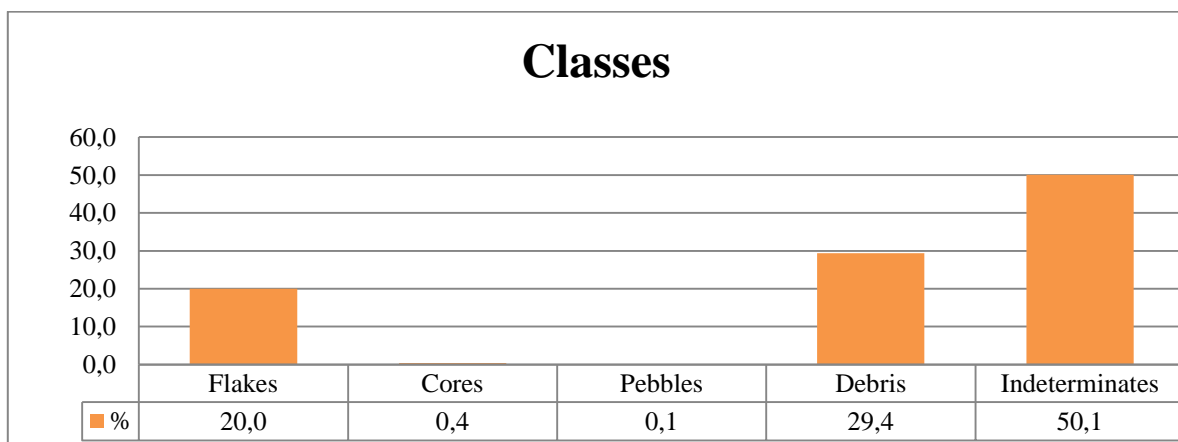


Fig. 14 General composition of the industry

The predominant classes are indeterminate (50.1%) composed of 3758 items, and Debris (29, 4%) composed of 2203 items. Follows the class of flakes with a total of 1503 pieces and 33 cores. The pebbles which represent 0.1% of the industry are only 8.

<sup>116</sup> IZNAN ET AL. 1999.

<sup>117</sup> ID.

### 3.4.2 RAW MATERIAL AND PHYSICAL STATE OF THE INDUSTRY

For the classes of debris and indeterminate items we have no data on the raw material because the pieces are too small or altered to allow a certain attribution. Therefore, we consider only the raw material of flakes and cores. (For pictures classes of raw material refer to paragraph 3.3).

RAW MATERIAL: FLAKES		
Raw material classes	N.	(%)
CL1.Coarse grained quartzite	7	0,5
CL2. Fine grained quartzite	111	7,4
CL3. Coarse grained jasper	224	14,9
CL4. Fine grained jasper	776	51,6
CL5. Coarse grained flint	83	5,5
CL6. Fine grained flint	173	11,5
CL7. Limestone	12	0,8
CL8. Indeterminate	117	7,8
<b>Total</b>	<b>1503</b>	<b>100</b>

RAW MATERIAL: CORES		
Raw material classes	N.	(%)
CL1. Coarse grained quartzite	0	0
CL2. Fine grained quartzite	3	9,1
CL3. Coarse grained jasper	3	9,1
CL4. Fine grained jasper	17	51,5
CL5. Coarse grained flint	4	12,1
CL6. Fine grained flint	6	18,2
CL7. Limestone	0	0
CL8. Indeterminate	0	0
<b>Total</b>	<b>33</b>	<b>100</b>

Table 3 Classes of raw material Flakes and cores

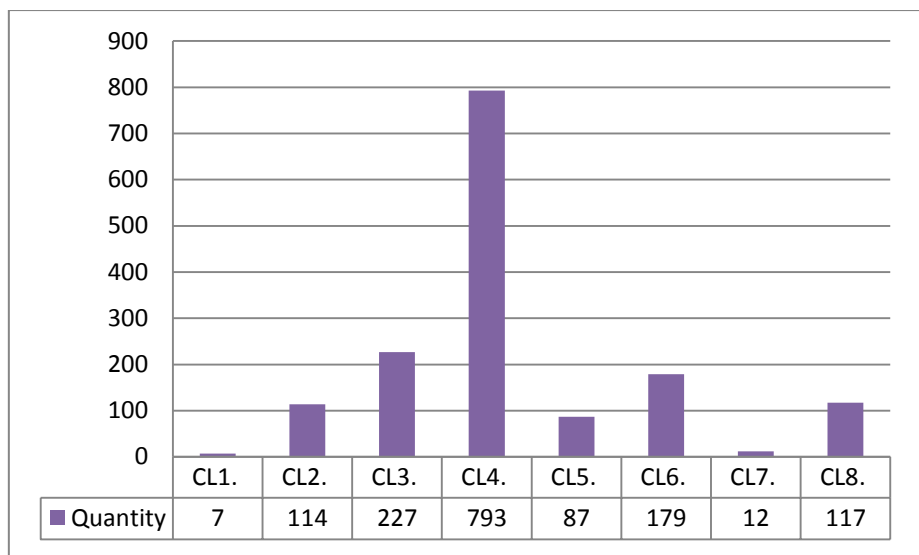


Fig. 15 General graphic of raw material classes for flake and cores

The dominant raw material, as in the upper layer, are jasper and flint found in form of rolled and oblong pebbles, coming from secondary storage like sea-shores or rivers deposits. Probably it was collected locally from the gravel fluvial and sea terraces that still today are visible near the site.<sup>118</sup>

It is clear the choose of fine grained material instead of coarse grained ones and in particular the histogram reveals a massive predominance of fine grained jasper.

The fact that from a quantitative point of view, there exists a significant match between the number of flakes and cores of the same raw material would indicate the import and processing of pebbles in situ.

The state of preservation of the collection is good; in fact the pieces have fresh edges.

We consider here the level of integrity of the flakes, crossed also with the concept of débitage.

Flakes			Integrity			
Concept	N.	(%)	Yes	(%)	No	(%)
Levallois	616	41,0	380	25,3	236	15,7
Volume	20	1,4	15	1,1	5	0,3
Indet.	867	57,6	518	34,4	349	23,2
<b>Total</b>	<b>1503</b>	<b>100,0</b>	<b>913</b>	<b>60,7</b>	<b>590</b>	<b>39,3</b>

Table 4 Integrity of flakes

In total, 60.7% of the industry is composed of intact supports (blank?); on the contrary 39.3% is made of fragmented elements. The elevated degree of fragmentation is due in part to the presence of a great number of indeterminate items, in part to fragmentation of flakes (probably of voluntary nature) and in part to accidents occurred while flaking (refers to paragraph 3.4.5 for the intentional fractures.)

About cores it is interesting that 5 of 33 cores presents inner plan of fracturation that invalidate the production.

In the US 13 nine fire-pits have been found, in facts on the lithic artefacts evidence of combustion has been detected which have altered the surfaces of the pieces. These items are altered in colour and on their surface were identified the typical combustion signs, the so-called fire-cupellas.

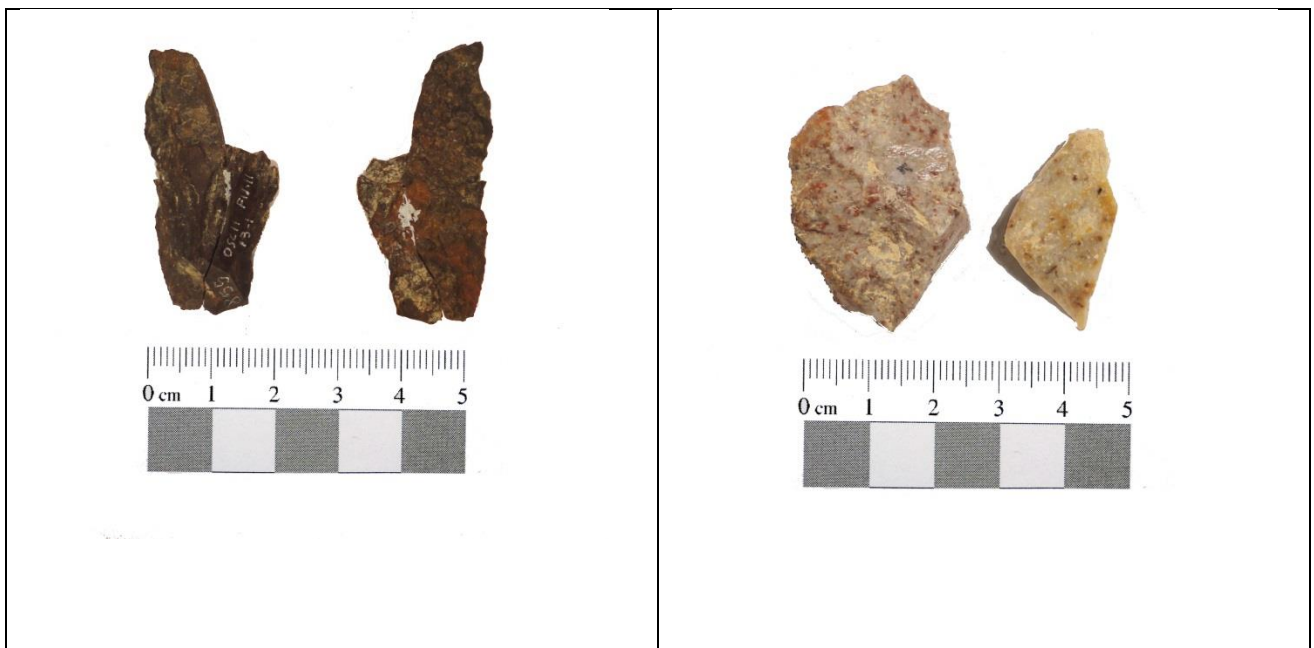
The results about flakes are shown in the following histogram; only one core shows action of fire.

<sup>118</sup> VILLA ET AL. 2008; BOSCATO ET AL. 2011; SPAGNOLO 2013.



**Fig. 16** Fire action on flakes.

The presence of these alterations, thought minimal, is revealing, in fact, 91,7% of the flakes does not present traces of combustion, only about 5.9% and probably 1.9% of the flakes show traces of combustion, but however, this data indicates the proximity and simultaneity existing between the lithic industry and the use of the fire-pits.



**Fig. 17** Fire alteration.

As chemical alteration it is relevant the presence of patinas that in some cases come to constitute real layers of concretion.

### 3.4.4 CORES

Here it is present a general data resulting from the analysis of core, however the particular studies and the diacritical analysis of each core is presented in the schedule at the end of the core's section. In total, 33 cores have been found that represent 0, 4% of the analysed industries. They have been divided in concepts of débitage: Levallois, Volume and Indeterminable, according to the type of volumetric reduction for the production of flakes.

CORE CONCEPT / METHOD					
Concept	N.	(%)	Method	N.	(%)
Levallois	18	54,5	Convergent	6	18,2
			Unipolar	5	15,2
			Indeterminate	7	21,2
Volume	6	18,2	Bladelets	6	18,2
Indeterminable	9	27,3	Indeterminable	9	27,3
<b>Total</b>				<b>33</b>	<b>100,0</b>

**Table 5 Concept and method of core**

18 cores were considered as Levallois due to their techno-volumetric characteristics. For the organization of the management of the detachments, the management of convexities, the type of volumetric reduction, the type of striking platform and research product 3 subgroups were identified that means: convergent Levallois, unipolar Levallois and indeterminable Levallois. We consider a part of this latter group those cores which belong to concept Levallois for the management of volume, but in which it is no longer possible to identify a prevalent method. This is due to the depletion of the cores and to the excessive fragmentation or alteration of the substrate.

The cores with volumetric exploitation are aimed at the production of bladelets, however the degree of exploitation of these cores is poor, and in fact in some it is present only the shaping phase of the nucleus without its real exploitation whereas in others it is possible to identify phases of real exploitation.

The cores too fragmented, too altered by fire, the ones that are too exploited or on the contrary the ones that are still in the first stage of production in which it is impossible to identify

any organization of débitage, but it is still visible the extraction of flakes are considered part of the group of indeterminate items.

The main kinds of blank are shown in the following table.

CORE - BLANK							
Concept	Method	Pebble	Pebble/Flake	Fragment	Flake	Total	(%)
Levallois	Convergent	5	1			6	18,2
	Unipolar	5				5	15,2
	Indeterminate	1		1	5	7	21,2
Volume	Bladelet			2	4	6	18,2
Indeterminable	Indeterminable	3		3	3	9	27,3
<b>Total</b>		<b>14</b>	<b>1</b>	<b>6</b>	<b>12</b>	<b>33</b>	<b>100,0</b>
<b>(%)</b>		<b>42,4</b>	<b>3,0</b>	<b>18,2</b>	<b>36,4</b>	<b>100,0</b>	

Table 6 blank on which core are made

The blank mostly elected to be chipped are pebbles and flake, most of the latter are cortex removal cup, re-used as cores. For one convergent Levallois core there was not enough technical elements to define if the blank was a cortical flake or a pebble so we prefer to call it pebble\flake.

The indeterminate cores present the greater variability of supports, whereas the cores Levallois of the unipolar and convergent method are clearly related to a production on pebble, probably because the pebbles endowed with regular volumes can be hierarchized with greater ease.

On the contrary, the production of blades almost exclusively develops on flakes and fragments, because the volume exploitation provides it is necessarily linked to the control and management of angles which are absent on pebbles.

The table below shows the dimensions.

DIMENSIONS OF CORE											
Concept	N.	(%)	Height	Length	Thikn.	Method	N.	(%)	Height	Length	Thikn.
Levallois	18	54,5	37,2	36,0	15,5	Convergent	6	18,2	37,8	37,59	15,1
						Unipolar	5	15,2	43,2	41	18,2
						Indeterminate	7	21,2	30,6	29,4	13,3
Volume	6	18,2	23,5	22,7	11,3	Bladelet	6	18,2	23,5	22,7	11,3
Indeterminable	9	27,3	27,5	29,7	14,2	Indeterminable	9	27,3	27,5	29,7	14,2
<b>Total</b>							<b>33</b>	<b>100,0</b>			

Table 7 Dimensions of core, all the measurement are taken in mm, here is present the average.

The cores especially the Levallois ones shows a regularity of width and length.

For the study of the degree of predetermination of cores we decided to observe the different preparation of the plans of percussion in relation to the method of débitage used and in consequence to the type of product researched.

The table below shows the degree of preparation of the striking platform, in some cases in on the same core were detected two or more types of partial striking platform, in these cases both of them are indicated in the table (absent\ prepared, cortical\ prepared, and prepared\fracture).

CORE				STRIKING PLATFORM							
Concept	Method	N.	(%)	Absent /Prep.	Cortical	Cortical /prep.	Fracture	Prepared	Prepared /Fracture	Previous removal	Indet.
Levallois	Convergent	6	18,2					5	1		
	Unipolar	5	15,2					5			
	Indeterminate	7	21,2		1	3		2			1
Volume	Bladelet	6	18,2				2	1	1	1	1
Indeterminable	Indeterminable	9	27,3	1	2			1		2	3
<b>Total</b>		<b>33</b>	<b>100,0</b>	<b>1</b>	<b>3</b>	<b>3</b>	<b>2</b>	<b>14</b>	<b>2</b>	<b>3</b>	<b>5</b>
			<b>(%)</b>	<b>3,0</b>	<b>9,1</b>	<b>9,1</b>	<b>6,1</b>	<b>42,4</b>	<b>6,1</b>	<b>9,1</b>	<b>15,2</b>

**Table 8 Type of striking platform.**

42.4% of the cores show a preparation of detachments and then a sort of management of the convexities which blends in well with the information already recorded on the degree of predetermination of Levallois.

In the volume exploitation the striking platform are most of the time flat and prepared by a single removal or a fracture that open the laminar table. The localization of the striking platform for laminar production is in orthogonal to the surface of débitage.

Whereas for surfaces concept of débitage we indicate the localization of the striking platform that can be partial, when it takes only one side of the core or partial large when a larger portion of the core is prepared by continue removals.

CORE				LOCALITATION		
Concept	Method	N.	(%)	Partial	Partial large	Indeterminable
Levallois	Convergent	6	22,2	1	5	
	Unipolar	5	18,5	4	1	
	Indeterminate	7	25,9	4	2	1
Indeterminable	Indeterminable	9	33,3	7		2
<b>Total</b>		<b>27</b>	<b>100,0</b>	<b>16</b>	<b>8</b>	<b>3</b>
<b>(%)</b>				<b>59,3</b>	<b>29,6</b>	<b>11,1</b>

**Table 9** Localization of the striking platform, this table regards only the Levallois and indeterminable concepts

16 cores present partial plans of percussion whereas 8 cores present the partial large ones.

It is relevant that Unipolar Levallois production is most related with a partial striking platform.

From the analysis of each core appears that the unipolar production is managed through the opening of one or two partial striking platform, one preferentially utilized for the production, and the other one usually on the side face use for the orthogonal management of lateral and distal convexity. This model appear also by the studies of the removals on the dorsal surfaces of the flakes, in which the researched unipolar items sometimes present an orthogonal orientation of the removals which are interpreted as the management of convexity.

The convergent method instead is strictly tied to the partial large percussion plan. This means that for the convergent production the convexity are managed by a single plane of percussion rather wide which allows the extraction of management flakes with convergent orientation of the negative. This fact is evident both from the study of cores and from that of the negative on the dorsal surfaces of the flakes.

### *Summary of cores*

The Neandertals group occupying Oscurusciuto rockshelter chosen as supports to be flaked mostly pebbles of jasper and flint from local sources.

They utilized 3 main modes of exploitation of pebbles: unipolar Levallois, Levallois convergent and a volume débitage aimed to produce bladelets. There are also a number of Levallois cores too exploited that it cannot be possible define the method. And on the contrary, a group of indeterminate cores which are in the early stages of exploitation or that are too fragmented and do not have the technical characters to define the method of débitage.

The used blank are pebbles or cortical removal caps for the concepts of surface instead the volumetric production is developed exclusively on flakes.

In the unipolar Levallois it is common have one or more partial striking platform, in which one (usually in proximal position) is used for the extraction of researched products that are long flakes, long flake with back and convergent flake. The other striking platform, usually on the left side is utilized to the management of distal and lateral convexity. The management of the cores takes place according to a sort of asymmetric dynamic, on the right, the craftsman knapped in order to obtain debordant cortical flake: which are predetermined and predetermining. Indeed they absolve a double role, they manage the convexities but they are also researched objectives. On the other hand on the left side the knapper prefer to prepare the convexity with removing little orthogonal flakes. In this way the cores that we found result to be more exploited on the left side compared to the right ones.

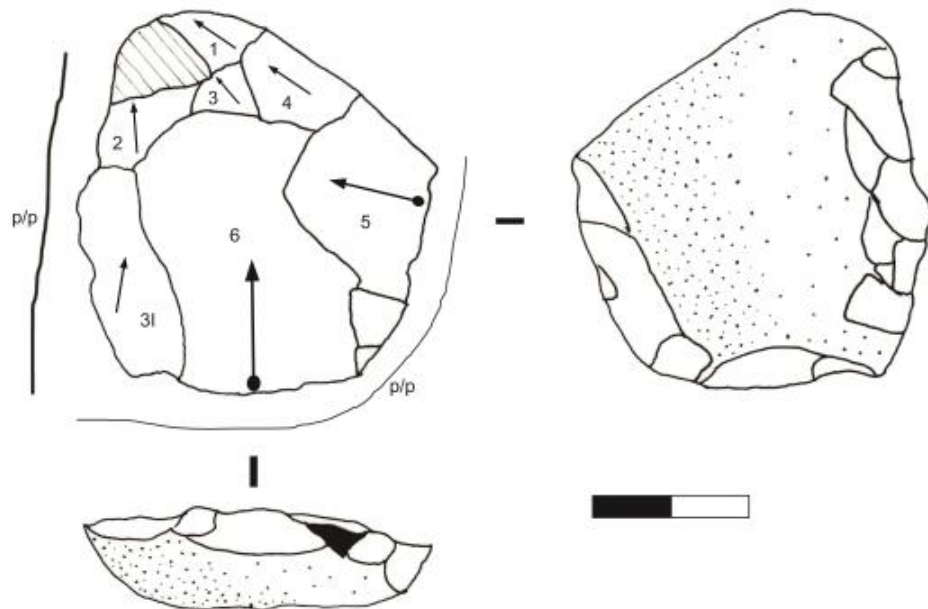
In convergent Levallois instead the plan of percussion is one large partial and both the management and production of flakes takes place according to a symmetric rhythm applied from the same striking platform.

For the volume production, often the cores are only prepared and lacks a real production. The striking platform is positioned perpendicular to the surface of débitage and is opened by one single stroke or on a fracture.

From the study of the diacritical analysis and the chronology of the detachments it is possible to observe that the cores, although incidented, are really exploited till the end of the reserve of material, they were finally abandoned only after a high repetition attempt to rescue. It is attested that only one core is abandoned due to an error in the early stages of exploitation without any other tentative of rescuing.



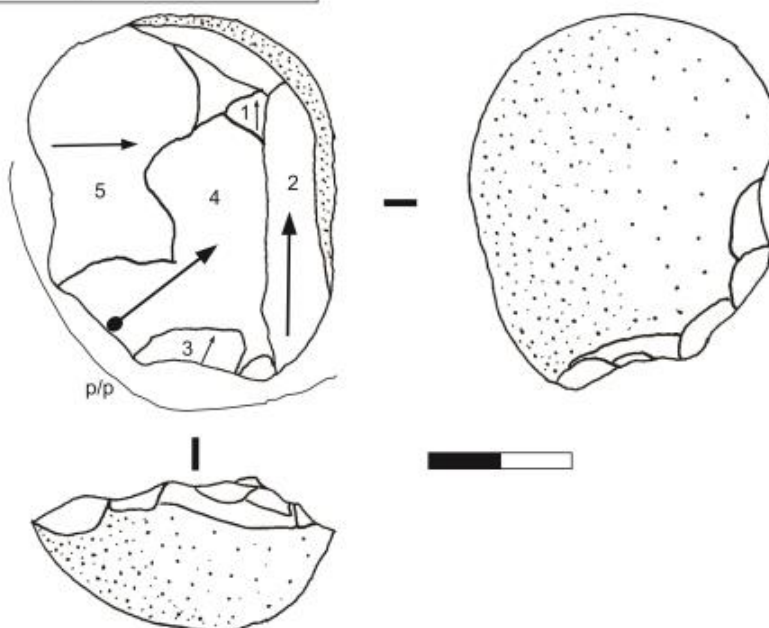
**ID 597**






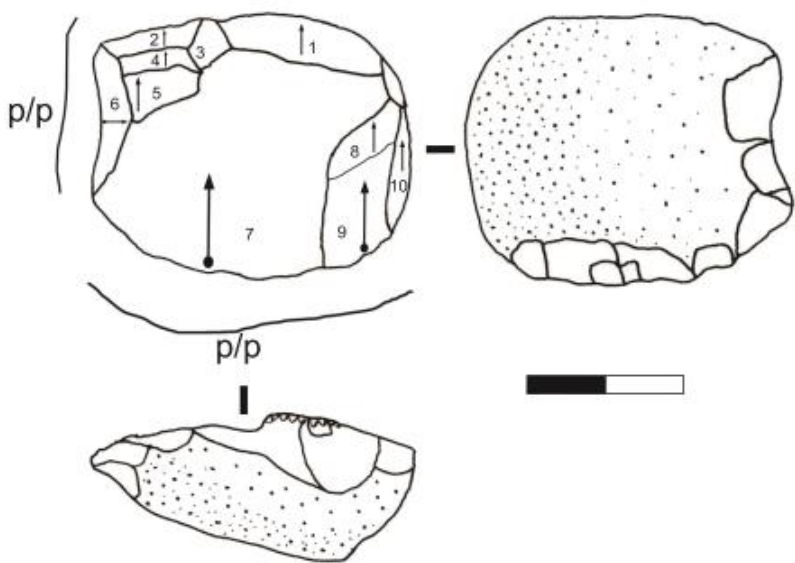
P/P	2 Striking platform: one partial and one partial large. p\p: Prepared large striking platform p\p 1: Partial striking platform. Only prepared, no flakes are removed from that plan.
S\ID	7 Removals have convergent direction. 1, 2, 3, 4: Not researched flakes, management of distal convexities 3l, 5: Management of lateral convexities. 6: Researched convergent flake, incident.
DIACRITICAL ANALYSIS	The blank is a pebble. In a first phase, there is the opening of a large striking percussion, from which comes from the removals for the management of the distal (1, 2, 3, 4) and lateral convexity (3l, 5). This shaping out is made in order to obtain a convergent flake, but this flake due to lack of clear guide ribs and to the too flat surface of the core have not the desired morphology and is partially reflected. The core is abandoned because of its depletion.
METHOD	Convergent Levallois.
OBJECTIVE	Convergent flake.

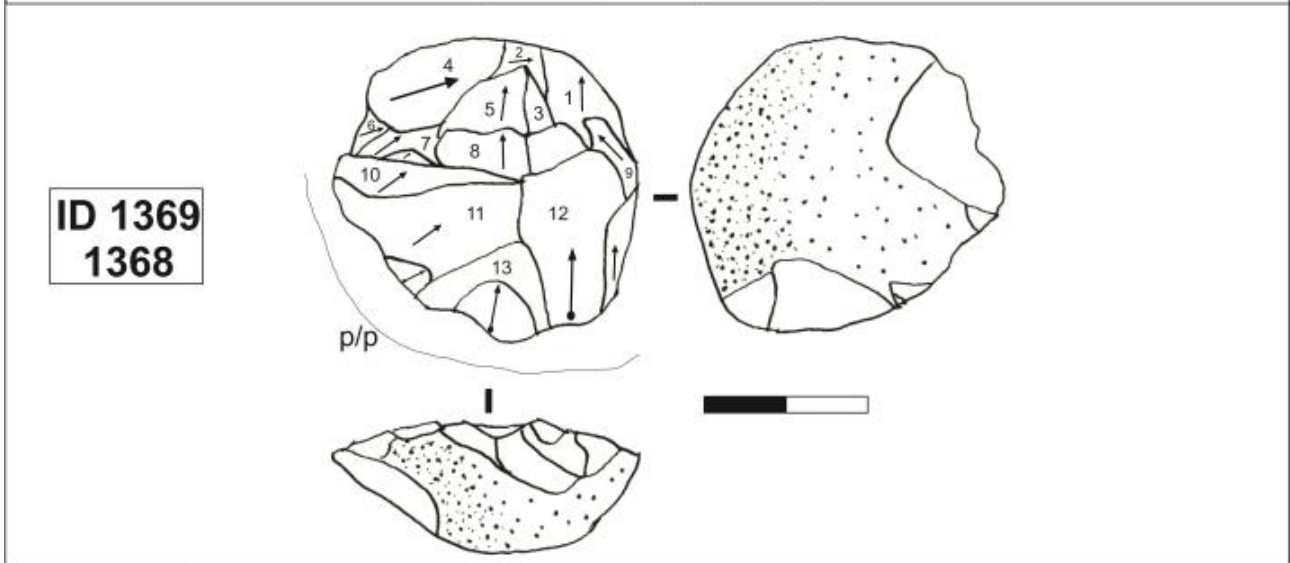


**ID 1627**

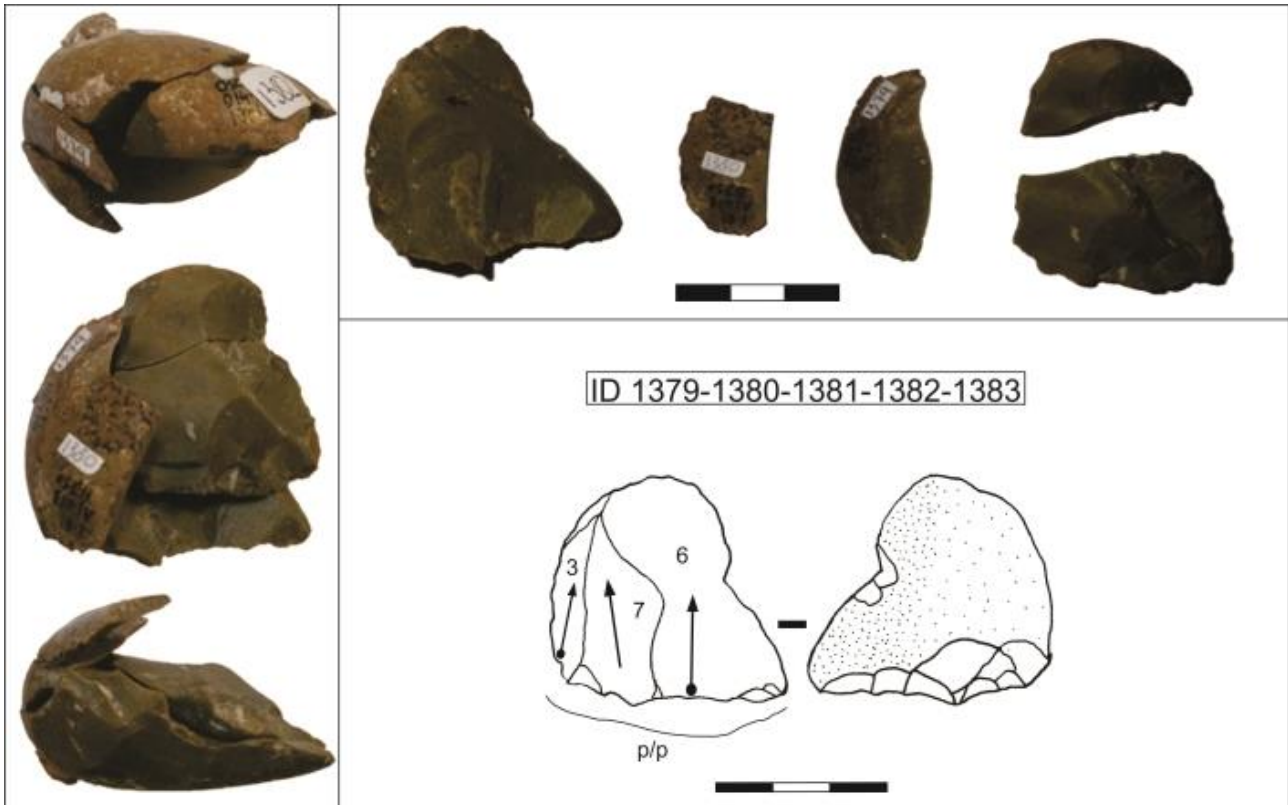


P/P	1 Partial large striking platform: p\p: Prepared by one removal, principal striking platform for the production of researched items.
S\ID	5 Removals that has convergent direction. 1 Predetermined predetermining, long flake. 2 Researched long flake with back, management lateral convexities. 3, 4, 5 : Series of knapping incidents.
DIACRITICAL ANALYSIS	The blank is a pebble. In a first phase are extracted a series of predetermined-predetermining flake by a unipolar dynamic (1,2). Afterwards the opening of a striking platform (p\p) there is the detachment of last 3 large flakes that represents a knapping incident caused by wrong convexities. The core is abandoned because the convexity prevent further management, by the way the reserves of raw material were also depleted.
METHOD	Unipolar Levallois.
OBJECTIVE	Long flake, long flake with back.

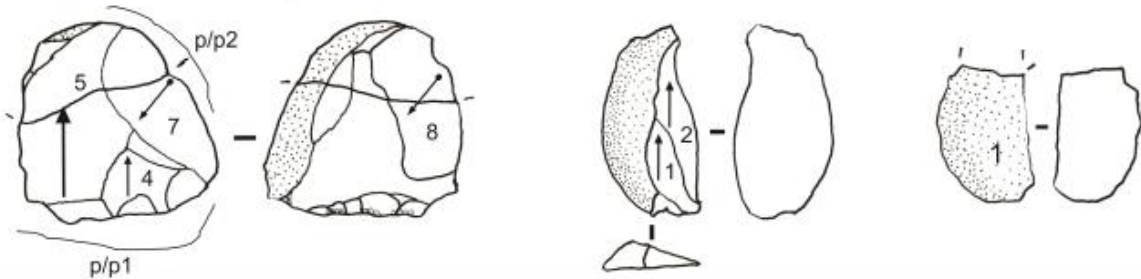
	
	
<p style="text-align: center;"><b>ID 550</b></p>	
<p>P/P</p>	<p>2 Partial striking platform:  p/p: Prepared, principal striking platform for the production of researched items.  p/p 1: Prepared striking platform for the management of lateral convexities.</p>
<p>S\ID</p>	<p>10 Removals mostly with unipolar direction.  1, 2, 3, 4, 5: Series of unipolar removals, predetermined -predetermining, long flake.  6: Not researched flake, management lateral convexities, it comes from the p/p 1  7: Researched flake, preferential flake.  8,9,10: Further not researched removals.</p>
<p>DIACRITICAL ANALYSIS</p>	<p>The blank is a pebble.  Thanks to the refitting is possible to assume the exploitation of the core even in the earlier stages.  From the negative on the dorsal face of the flake it is possible to say that there was two flakes predetermined-predetermining, as the method is Levallois recurrent. After this the flake (ID 549) is removed and the striking platform (p/p) is prepared again, reducing in this way the maximum height of the support.  It is lacking a series of flakes, and then we have the situation visible on the core in which we have a series of unipolar detachments. It is open a lateral striking platform (p/p 1) for the management of lateral convexity, and exactly from this plan comes the removal 6 that manage the convexities for the removal 7 that, taking advantage of the convexity that have been created by the unipolar production (documented also by the refitting), is considered as a preferential flake. A sort of last extraction before the abandon of the core.  The core is abandoned because of depletion of the reserves of raw material and unmanageable convexities.</p>
<p>METHOD</p>	<p>Levallois Unipolare, last removal Levallois preferential</p>
<p>OBJECTIVE</p>	<p>Long flake, long flake with back, preferential flake.</p>



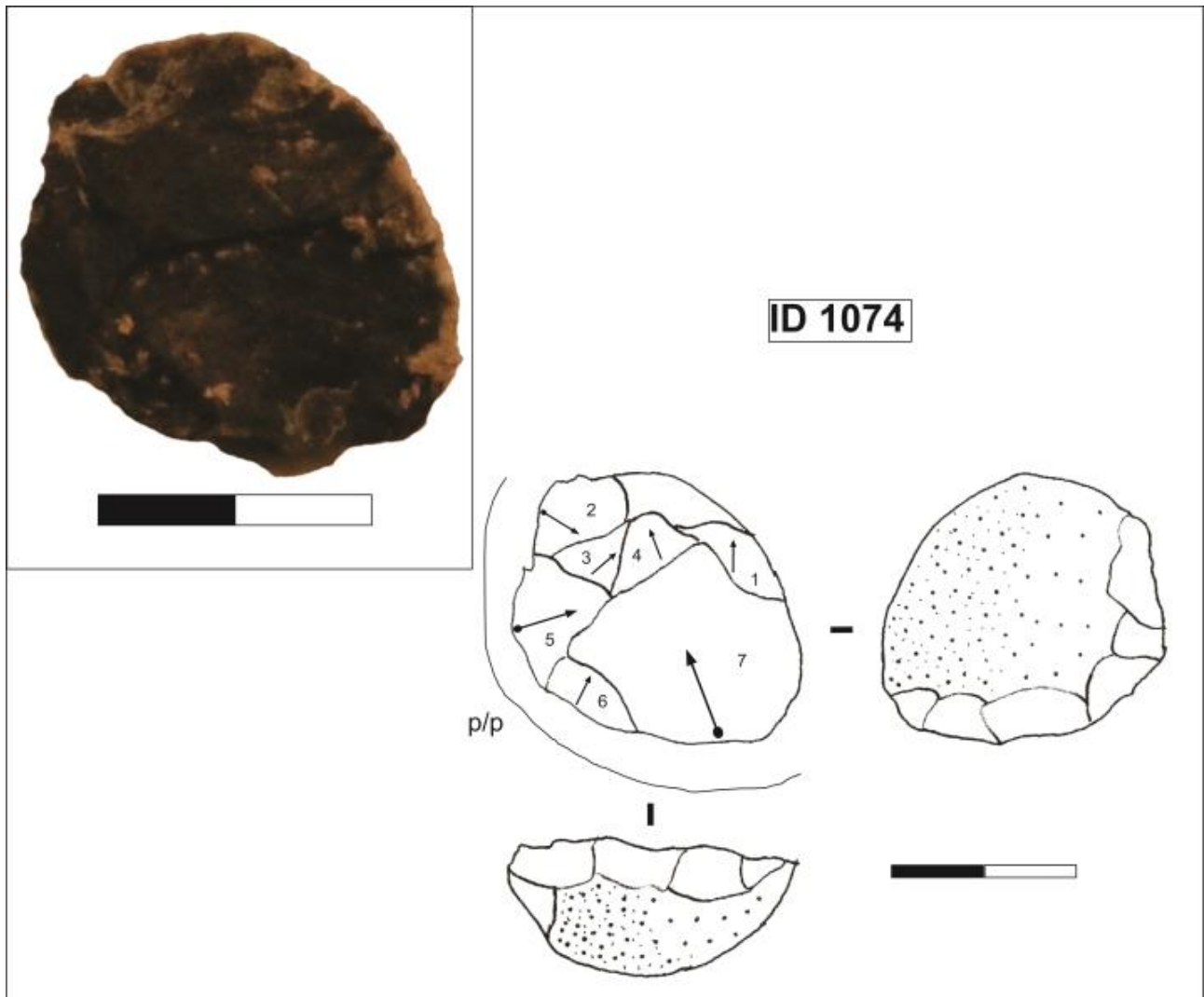
P/P	<p>1 Partial large striking platform:  p/p: Prepared by several little removals, principal striking platform for the production of researched items. The central part of the plan is used for the main production.</p>
S\I	<p>13 Main removal with mainly convergent orientation.  1, 2, 3, 4: Management lateral and distal convexities.  5: Researched convergent flake.  6, 7, 9: Management lateral convexities.  8, 10: Attempt of researched convergent flake, hinged incident.  10, 11, 12, 13: Series of hinged incidents.</p>
DIACRITICAL ANALYSIS	<p>The blank is a pebble really exploited or cortex removal cap.  In a first phase, after the management of lateral and distal convexities (1, 2, 3, 4,) is extracted a convergent researched flake (5).  In second phase there is a trial to repeat the scheme of the first step: management of convexities (6,7,9) and extraction of convergent supports (8,10), but in this way the stage does not goes well and the researched flakes are hinged.  A third phase is characterized by the attempt to rescue the core. The knapper tried several times to re-establish the technical parameters for obtaining researched flakes but it turns out to have a series of strong hinged incidents (8, 10, 11, 12, 13). That cause the abandon of the core.  What it is relevant in this case is that the researched objectives (convergent flakes) are searched in two different size classes: a larger one when it exploited the entire surface of the core, and a smaller one when it is exploited only the proximal portion of the core. What really affects the management of this core is the perseverance in rescue attempt.</p>
METHOD	Convergent Levallois
OBJECTIVE	Convergent flake



ID 1379-1380-1381-1382-1383



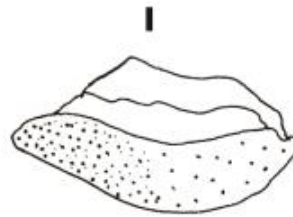
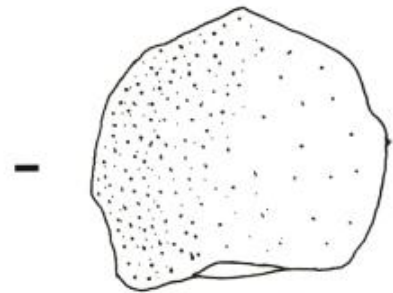
P/P	3 Partial striking platform: p\p, p\p 1: Prepared, principal striking platform for the production of researched items. p\p 2: Not prepared, cortical striking platform (core-flake)
S/D	9 Removals that has convergent direction. 1,2,3: Cortex removal and management of lateral convexities. 4,5: Objective researched, long flake. 6: Incident of plunging. 7: Management. 7 l, 8: Hinged incident (core-flake)
DIACRITICAL ANALYSIS	The blank is a rounded flat pebble.  After the preparation of the striking platform (p\p) for an unipolar production there is the first sequence of removal. 1 2 3 deal with the removal of cortex and also manage the lateral convexity, 4 and 5 represent a phase of production which ends with the large incident of plunging 6.  At this point, from the core there is the removal of the flake 7, that might be a recovery attempt.  Whereas the splinter 6 it is utilized as a core: here there is a preparation of a striking platform (p\p 1) from which are extracted only small debris. On the distal part of the flake from an unprepared striking platform (p\p 2) are detached the flakes 7l and 8 respectively on the dorsal and ventral surface of the flakes.
METHOD	Unipolar Levallois, Levallois Indeterminable
OBJECTIVE	Long flake



P/P	<p>1 Partial large striking platform:  p/p: Prepared by several little removals, principal striking platform for the production of researched items. The central part of the plan concerns the main production, whereas the lateral part is used for the convexities management.</p>
S/D	<p>7: Removals that has convergent direction.  1,2,3, Management lateral and distal convexities.  4: Researched convergent flake.  5,6,7 Series of hinged incidents.</p>
DIACRITICAL ANALYSIS	<p>The blank is a small pebble, probably already exploited by recurrent Levallois method. What we observe it is only the last series of removals before the discard of the core itself.</p> <p>In a first phase, from the lateral part of the striking platform comes a series of removals (1, 2, 3) that manage the lateral and distal convexities of the researched convergent flake (4) knapped from the central part of the large striking platform.</p> <p>In a second phase there is the attempt to re-establish the convexities (5,6) for another researched removal (7). But this test is unsuccessful because all the removal is hinged.</p> <p>The core is abandoned because of this incident .</p>
METHOD	Convergent Levallois.
OBJECTIVE	Convergent flake, long flake with back



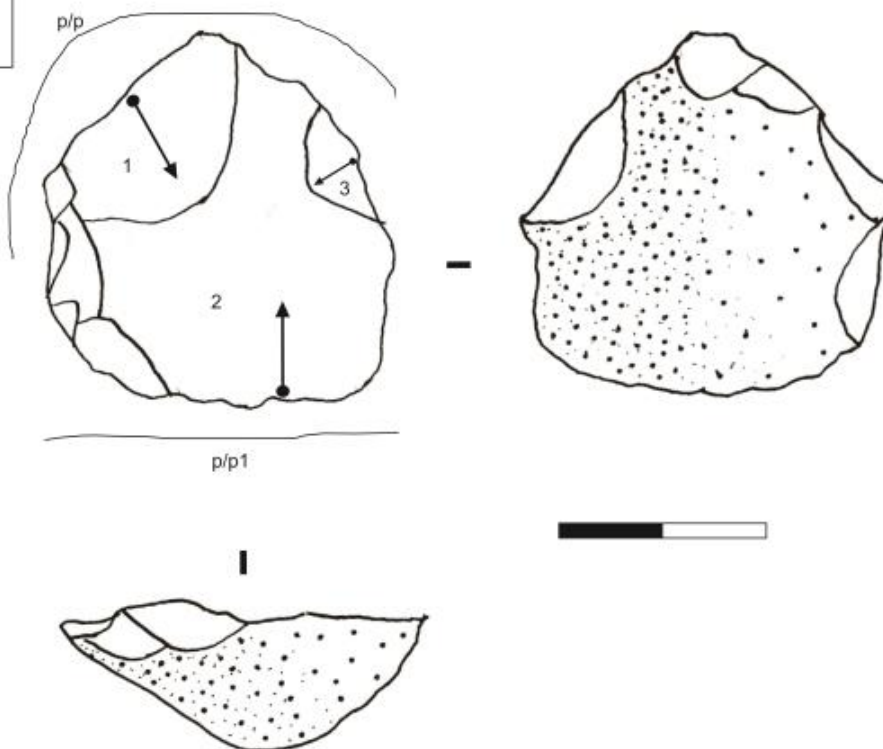
**ID 845**



P/P	1 Partial striking platform: p/p: Prepared by one removal, principal striking platform for the production of researched items.
S/D	8 Removals have convergent direction. 1,2: Management lateral convexities, 2 is also researched long flake with back. 3: Researched objective, convergent flake. 4, 5,5l,6: Hinged incident.
DIACRITICAL ANALYSIS	The blank is a pebble. The first phase of debitage is represented by residual old negative. A second phase is represented by the removals 1,2 for the management of lateral convexity of the core, the flake 2 has also the role of researched objective (long flake with back). A third phase is the production of a convergent flake (3). Then there are a series of hinged incidents. The hinged incident and wrong management of the convexities causes the abandon of the core.
METHOD	Convergent Levallois.
OBJECTIVE	Convergent flake, long flake with back



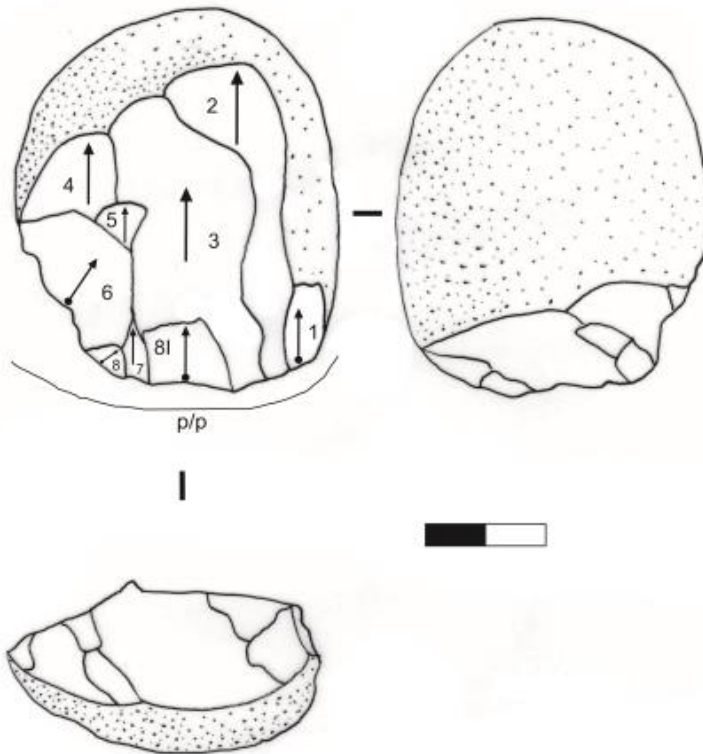
**ID 758**



P/P	2 Striking platform. p\p: Large partial prepared. p\p 1: Cortical not prepared.
S\ID	3 Main removals. 1: Management of the lateral and distal convexities 2: Partially hinged incident 3: Not researched.
DIACRITICAL ANALYSIS	The blank is a pebble or a cortical flake, the stage of exploitation of the core is too advanced so it is not possible to have a sure interpretation. In a first phase there is a management of distal and lateral convexities obtained by the removal 1 and by a series of little removal. Afterwards the removal 2 partially hinged prevents any further action on the core. In fact the Flake 3, although obtained from p/p 1 working in the opposite direction, cannot get over the incident. Consequently the core is abandoned.
METHOD	Indeterminate Levallois
OBJECTIVE	



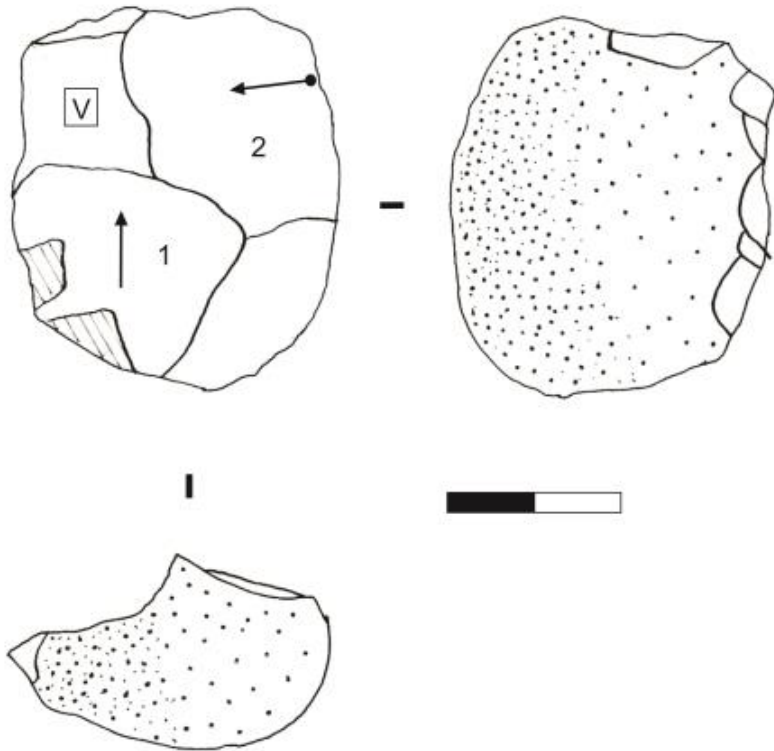
**ID 756**



P/P	1 Partial striking platform: p/p: Prepared principal striking platform for the production of researched items.
S/D	The removals on the debitage surface are 9. 1, 2, 3, 4 Cortex removal. 5: Hinged accident 6, 7, 8, 9: Not researched
DIACRITICAL ANALYSIS	The blank is a pebble. The core is interpreted as a first stage for a production Levallois unipolar, in fact after the opening of the plane percussion is proceeded to the first phase of cortex removal (1, 2, 3, 4). The cortical flake already takes the elongated morphology which in this context is considered researched A second phase is represented by the removal 5 that is a hinged incident, afterwards there are a series of removals trying to rescue the core. Despite the pebble still has reserves of raw material is abandoned.
METHOD	Unipolar Levallois
OBJECTIVE	Long flake



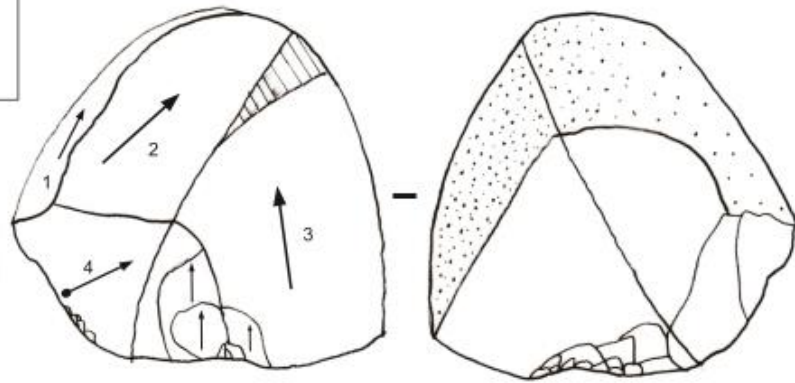
**ID 667**



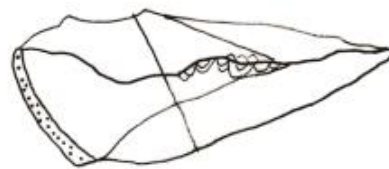
P/P	2 Partial striking platform not prepared.(p\p, p\p 1).
S\D	2 Orthogonal removals Both of them are not researched.
DIACRITICAL ANALYSIS	The blank is a cortex removal cap, in fact some portions of the ventral face are still visible.  In a first phase, there is the extraction of a flake (1), then the core is turned and they tried to detach a flake from the other side of the core, this second detachment is strongly hinged (2).  For this reason the core is abandoned as it is not possible any kind of rescue.
METHOD	Indeterminate Levallois
OBJECTIVE	



**ID 576**



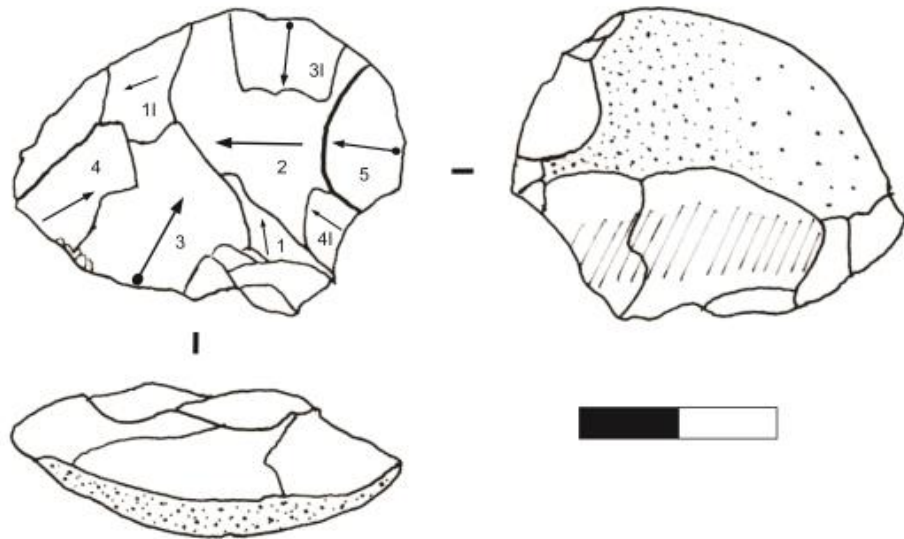
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P/P	1 Partial large striking platform p\p: Prepared by several little removals
S\ID	4 Main removals have convergent direction. 1, 2: Cortex removal. 3: Management lateral convexities, knapping incident due to the presence of an inner cracking plan. 4: Not researched flake, sort of recovery attempt.
DIACRITICAL ANALYSIS	The blank is a pebble. In a first phase a series of removals with convergent orientation (1, 2, 3, 4) try to take advantage of the natural convexities and volumetry of the blank in order to obtain a convergent flake. However, the presence of natural planes internal to the raw material prevent further exploitation of the block, that is abandoned without reaching the production strage.
METHOD	Convergent Levallois
OBJECTIVE	Convergent flake?



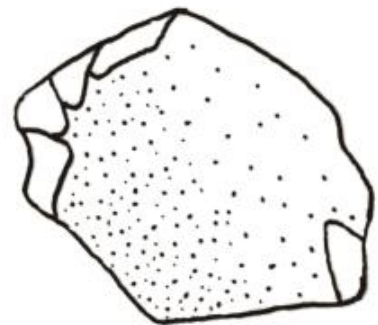
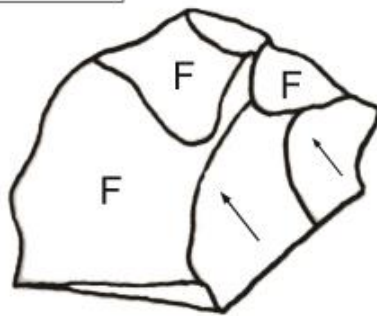
**ID 300**



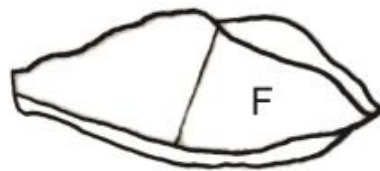
P/P	1 Partial large striking platform: p\p: Prepared by several little removals, it had a natural cracking surface inner in the raw material.
S\D	8 Removals that has convergent direction (almost bipolar). All the removals are used for the management the convexities. 3, 4: Hinged incidents.
DIACRITICAL ANALYSIS	The blank is a pebble. In a first phase, from a large partial striking platform are extracted a series of removals in order to manage the convexities to obtain a convergent flake. This cannot occur because of the incidents (3,4) on the surface of debitage and the cracking plan inner in the raw material For this reason the core was abandoned without reaching the production phase.
METHOD	Convergent Levallois
OBJECTIVE	Convergent flake?



**ID 257**



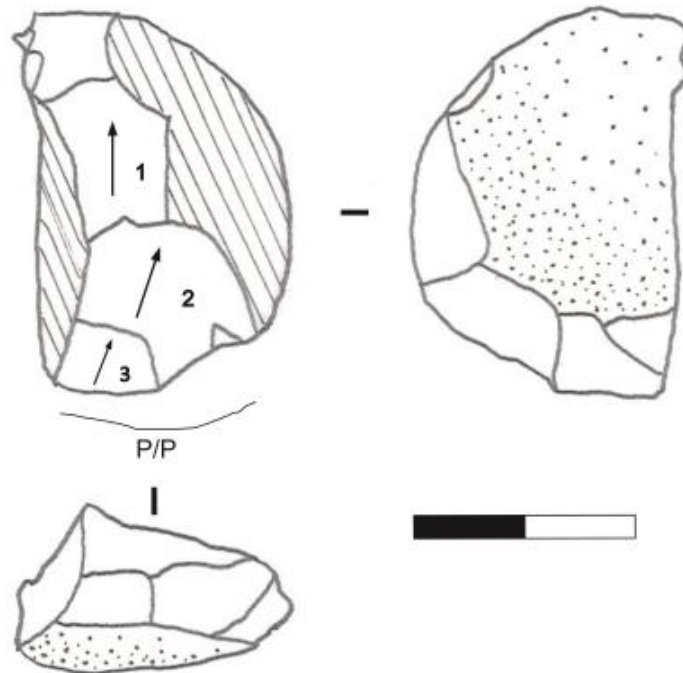
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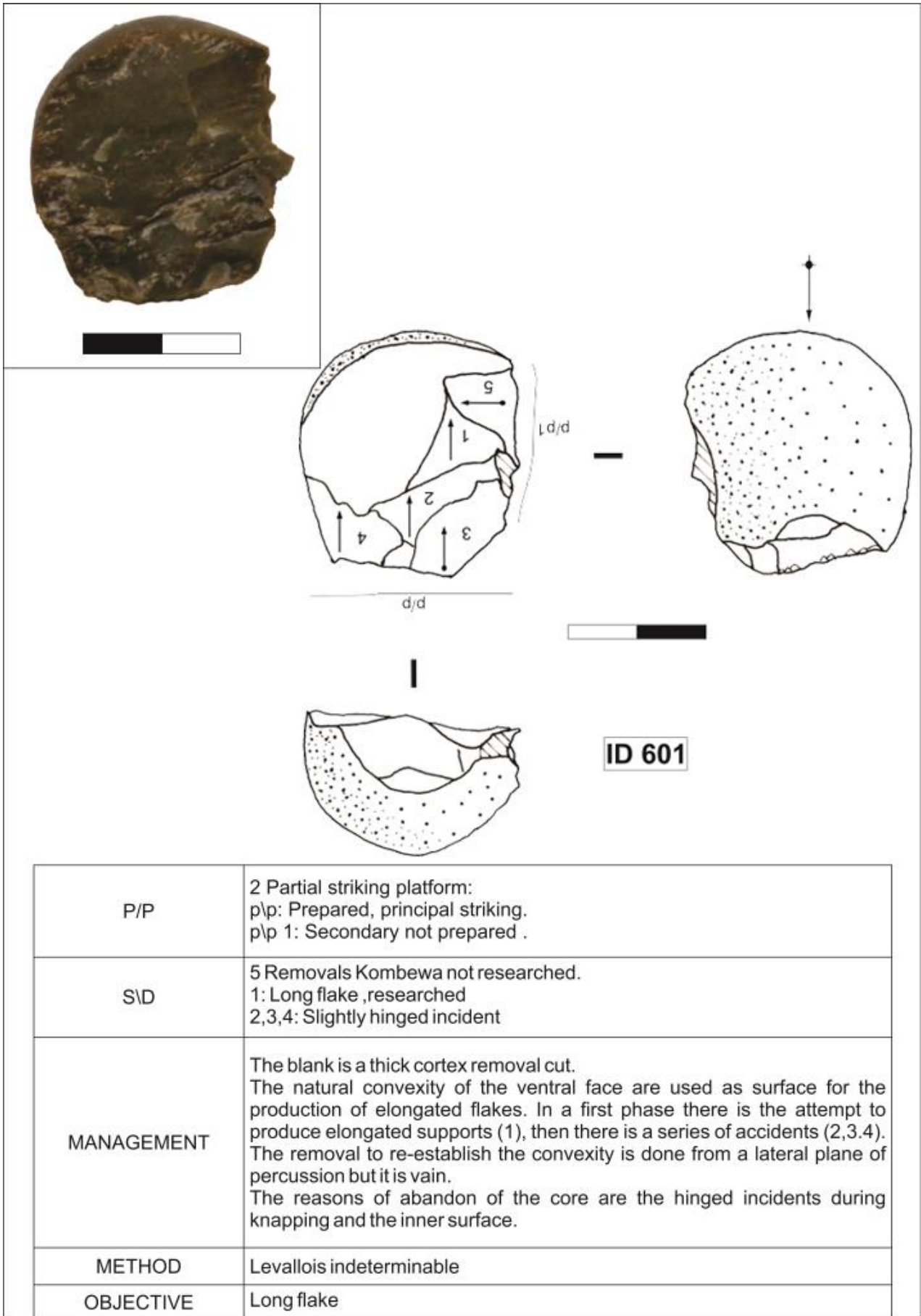
P/P	
S\ID	Unable a further reading because the core is too altered by fire. What is evident are several detachments due to high temperature.
DIACRITICAL ANALYSIS	It is a fragment of core too altered by fire.
METHOD	Indeterminate Levallois.
OBJECTIVE	Indeterminable



**ID 310**

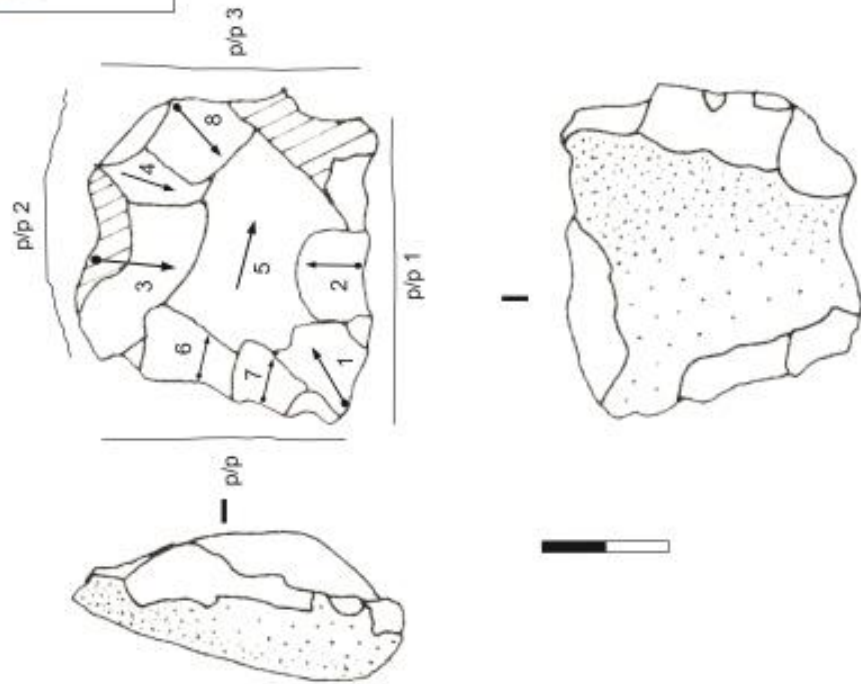


P/P	1 Large partial striking platform. p\p: Prepared.
S\D	3 Removal unipolar. All the flakes are not researched.
DIACRITICAL ANALYSIS	The blank is a fragment of a cortex removal cap. In a first phase, from a prepared p\p come a series of 3 unipolar removals. The presence of natural cracking plan requires the abandon of the core.
METHOD	Indeterminate Levallois
OBJECTIVE	



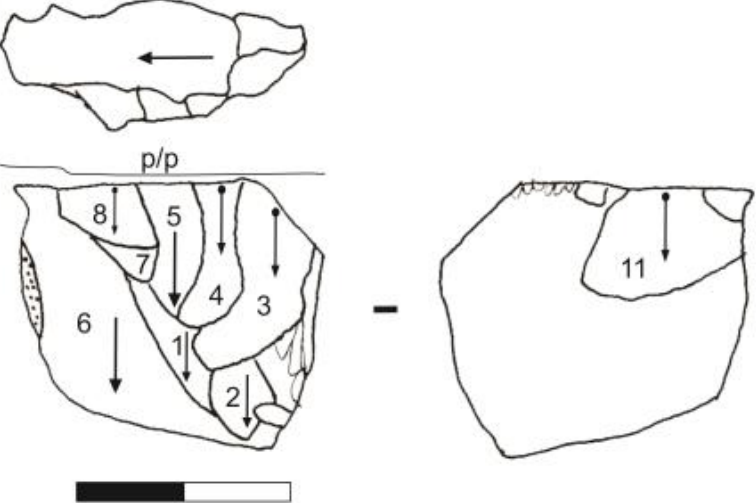




**ID 325**

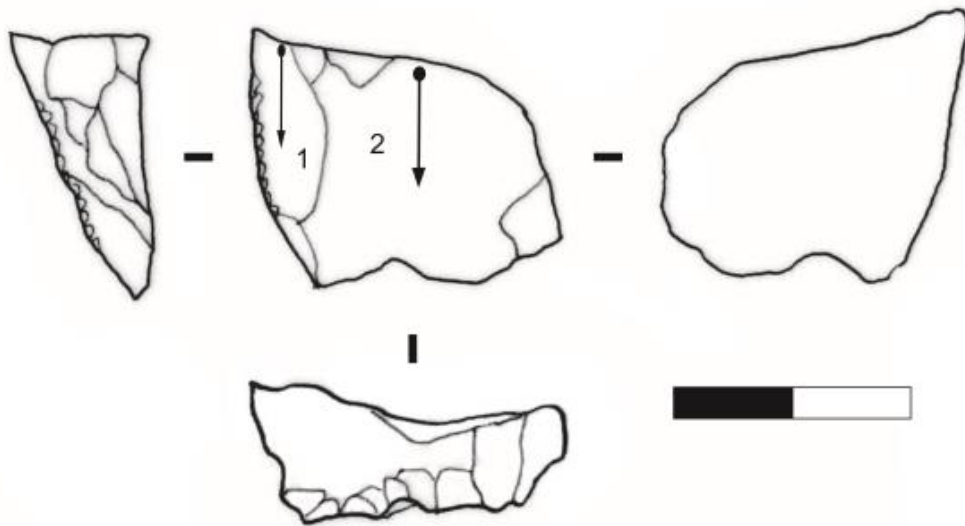


P/P	<p>4 Partial striking platform:  p\p: Prepared, principal striking platform for the production of researched items.  p\p 1, p\p 2, p\p 3: Prepared, secondary striking platform for the management of lateral and distal convexities.</p>
S\I	<p>8 Removals that has orthogonal direction.  1,2,3,4: Convexities management  5: Researched objective, long flake  6,7,8,9: Hinged incident</p>
DIACRITICAL ANALYSIS	<p>The blank is a pebble.  The removals 1,2,3,4 represent a first phase of the management of convexity of the core, a second phase is the production of a long flake (5).  Then, there are a series of hinged incidents due to the extreme central convexity and the cracking plan inner to the raw material.  This leads to the abandon of the core that anyway result really exploited.</p>
METHOD	Unipolar Levallois
OBJECTIVE	Long flake

	<div style="border: 1px solid black; padding: 2px; display: inline-block;">ID 831</div>
	
P/P	1 Prepared. It is made on a fracture. (p\p)
S/D	<p>11 Removals.</p> <p>1: Not researched flake, on the dorsal face of the flake.</p> <p>2: Probably researched flake (bladelet) or bladelet management, on the dorsal face of the flake.</p> <p>3, 4, 5: Series of hinged incident on the dorsal face of the flake.</p> <p>6: Plunging incident, management of the convexities, on the dorsal face of the flake.</p> <p>7, 8: Hinged incident, on the dorsal face of the flake.</p> <p>9: Researched flake. bladelet, on the trenchant.</p> <p>10: Hinged incident, on the trenchant.</p> <p>11: Hinged incident, on the ventral face of the flake.</p>
DIACRITICAL ANALYSIS	<p>The blank is a fragment of flake, used for a volumetric production, whose main goal is the production of bladelet.</p> <p>A first phase is characterize by a series of removal (removal from 1 to 8) that have the role of management of the convexities.</p> <p>The flake 2 might be consider a researched items, a bladelet obtain on the large face of the core.</p> <p>A second phase of the production is made on the trenchant of the flake. The negative 9 is a researched items a bladelet obtained on the short face of the core. Afterward they try to obtain another bladelet on the trenchant but it is hinged.</p> <p>The removal 11 represent a third phase of the exploitation of the core, but also this removal incident.</p> <p>The abandon of the core is caused by the several incidents.</p>
METHOD	Volume
OBJECTIVE	Bladelet



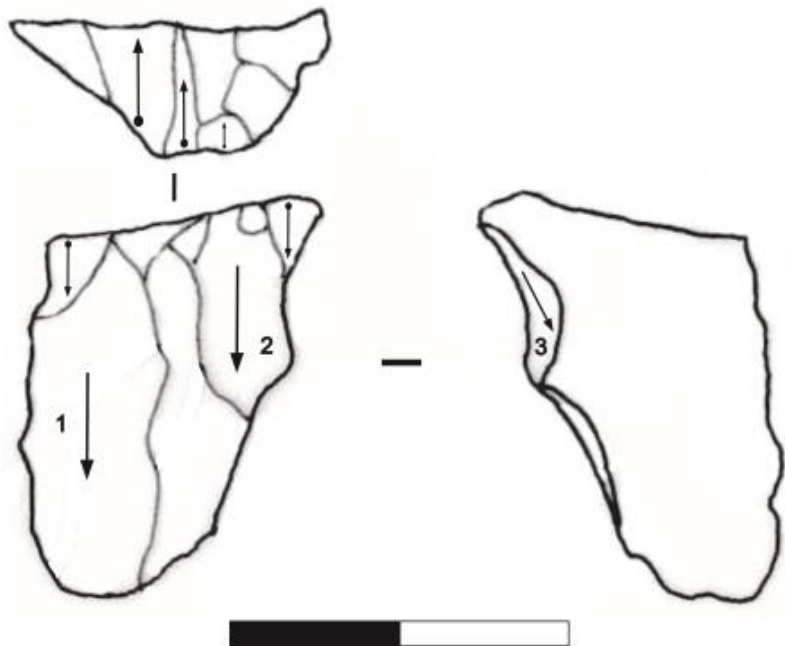
ID 23



P/P	1 Prepared by little removals (p/p).
S/D	2 Removals: 1: On the lateral side of the core, not researched bladelet management 2: On the surface of the core, not researched bladelet management
DIACRITICAL ANALYSIS	The blank is a flake, the dorsal face of the flake is utilized as debitage surface, and on the trenchant a unipolar removal indicates the use for a volume debitage.  The removals (1 2) indicate a management for a laminar production. In particular the removal 1 is detached in order to build a crest.  The core is abandoned without reaching the production stage.
METHOD	Volume
OBJECTIVE	Bladelet



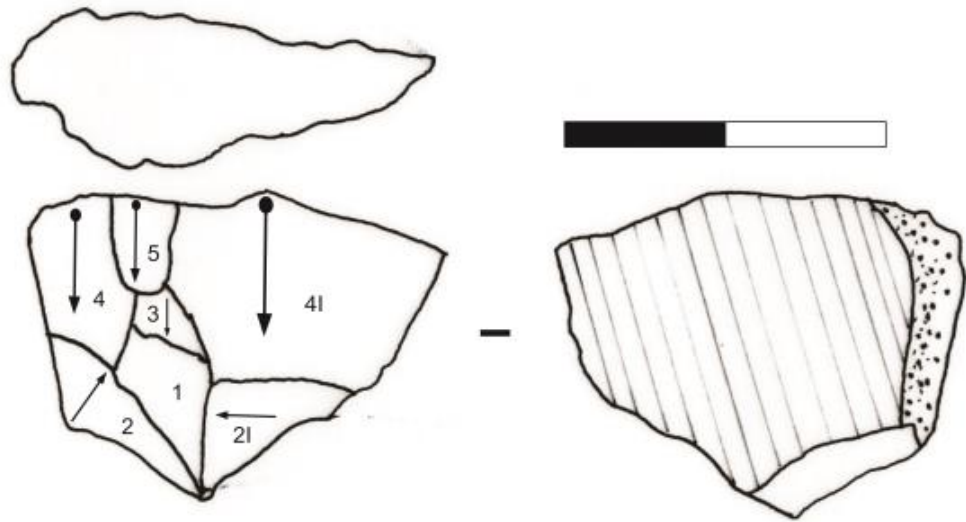
ID 111



P/P	1 Prepared. It is made on a fracture.
S/D	2 Unipolar removals 1: Not researched, management of convexities. 2: Not researched management of convexities. 3: Not researched bladelet management
DIACRITICAL ANALYSIS	The blank is a distal fragment of a flake. On a striking platform (p\p) obtained on a fracture come two removal (1,2) on the surface of the core-flake and one removal (3) on the lateral side (trenchant) in order to build a crest for the laminar production. The core is abandoned without reaching the production stage.
METHOD	Volume
OBJECTIVE	Bladelet.



**ID 1489**



P/P	1 Prepared. It is made on a fracture..
S\ID	7 Unipolar removals 1: Old removal, probably part of the old flake. 2, 2l: Not researched flake, management of distal convexities. 3, 4, 4l: Not researched flakes. 5: Hinged incident.
DIACRITICAL ANALYSIS	The blank is a fragment of flake. All the removals are aimed to the management of the convexities possibly for a volumetric production that does not occur. The core is abandoned after the hinged incident.
METHOD	Volume
OBJECTIVE	Bladelet ?

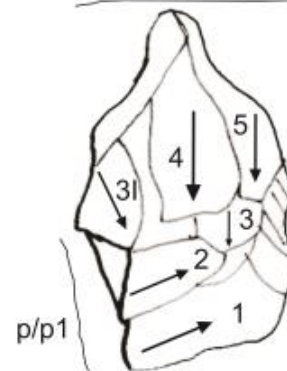


**ID 762**



I

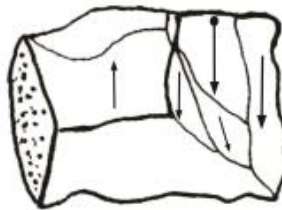
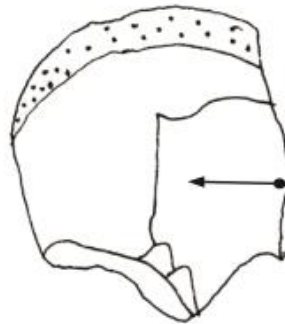
p/p



P/P	2 Striking platform not prepared. (p\p, p\p1 )
S\D	6 removals. 1, 2: Management of distal convexities. 3, 3l: Management of lateral convexities. 4, 5: Hinged incident, might be an attempt for the production of bladelet.
DIACRITICAL ANALYSIS	The blank is a fragment of flake. A first phase (1, 2, 3, 3l ) is characterized by the management of lateral and distal convexities. Part of the second phase are the removals 4 and 5, that are hinged incident but might be an attempt of the production of bladelet. The core is abandon after the incident and also because it is completely depleted.
METHOD	Volume
OBJECTIVE	Bladelet?



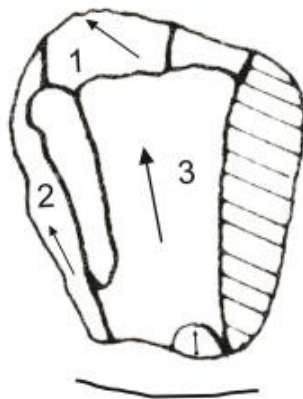
**ID 605**



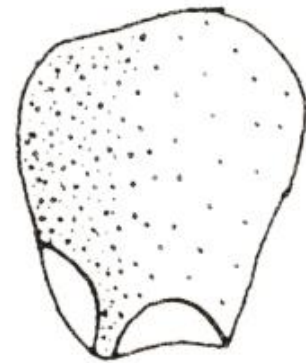
P/P	1 Prepared by one removal.(p\p)
S/D	5 Removals 1, 2, 3, 4, 5: Not researched
DIACRITICAL ANALYSIS	The blank is a flake obtained from a oblong little pebble. All the removals represent the first stage of shaping out of the crest for the production of the bladelet. The core is abandoned before the production of researched items.
METHOD	Volume
OBJECTIVE	Bladelet?



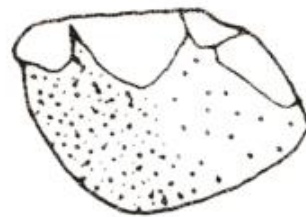
ID 26



-



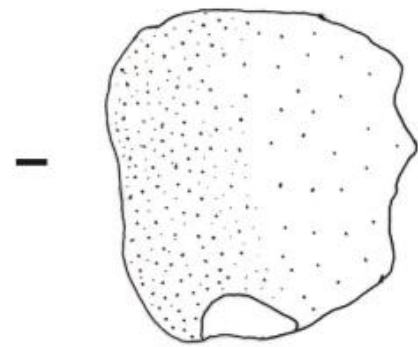
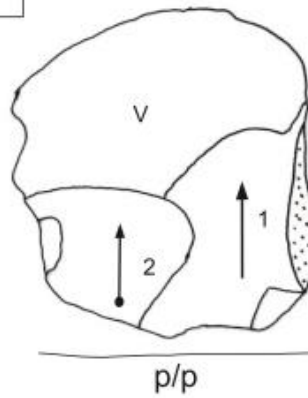
P/P



P/P	1 partial striking platform briefly prepared.
S\D	3: removals that has orthogonal direction. 1,2: residues of a previous stage 3: indeterminable
DIACRITICAL ANALYSIS	The black is a pebbles. The removals 1,2,are part of a first phase of the core that is undeterminable, 3 removes large part of the surface. It is not possible make more hypothesis about this core because it is an stage insufficiently development..
METHOD	Indeterminable
OBJECTIVE	Indeterminable



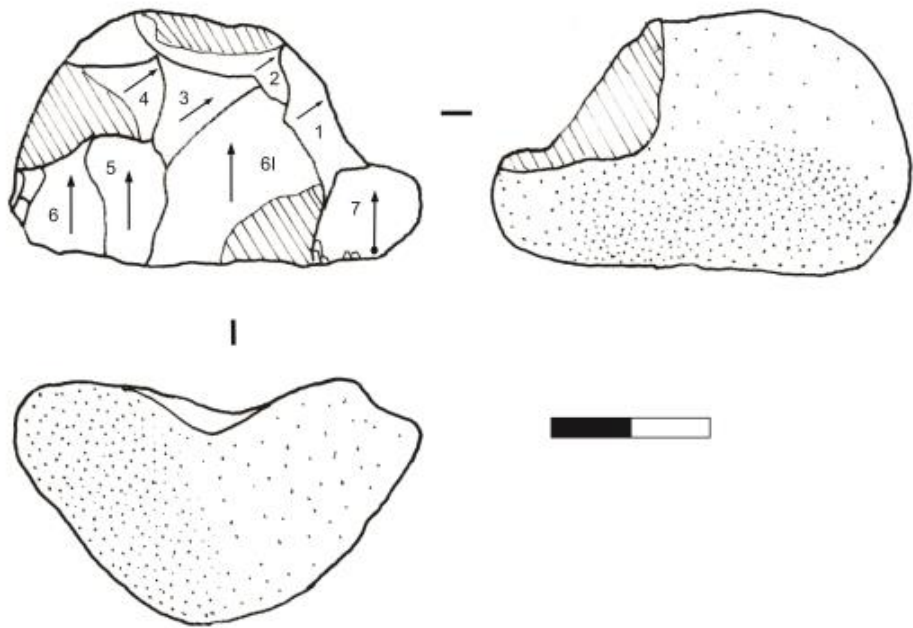
**ID 545**



P/P	1 Partial striking platform. p\p: Slightly prepared.
S\ID	2 Unipolar removal. 1: Not researched . 2: Not researched, hinged incident
DIACRITICAL ANALYSIS	The blank is a fragment of a cortex removal cap. The knapping performed without any management of convexity, the second flake indeed is hinged and consequently abandoned.
METHOD	Indeterminable
OBJECTIVE	



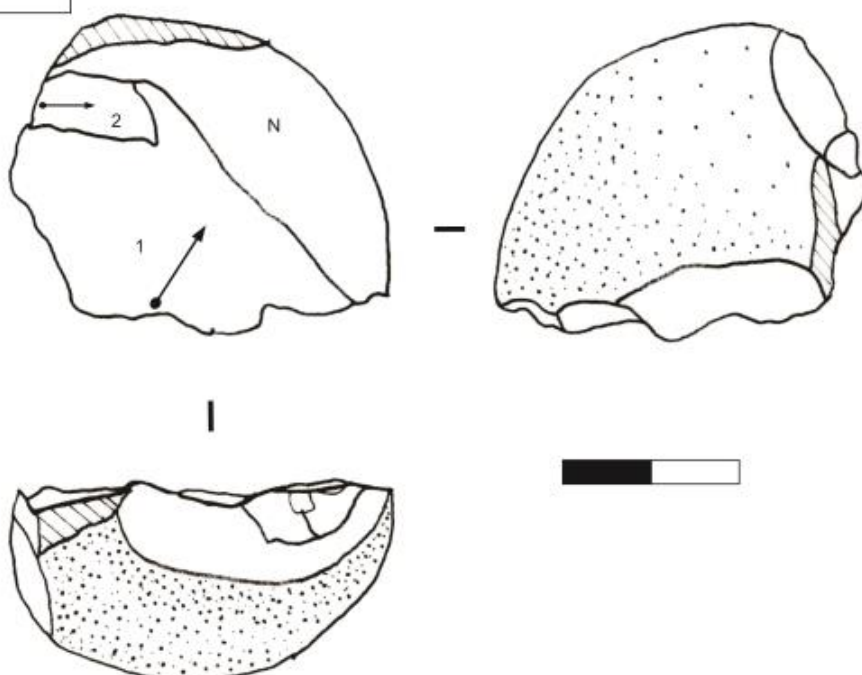
**ID 573**



P/P	1 Partial striking platform. p\p: Not prepared.
S\ID	8 Removals that has mainly unipolar direction. All the negatives are not researched flakes. 2, 4, 6l: They are incident because they intercept a cracking plan.
DIACRITICAL ANALYSIS	The blank is a fragment of pebble. A first phase is characterized by a series of pseudo unipolar removals. The presence of inner cracking surface prevents a further exploitation of the core.
METHOD	Indeterminable
OBJECTIVE	Indeterminable



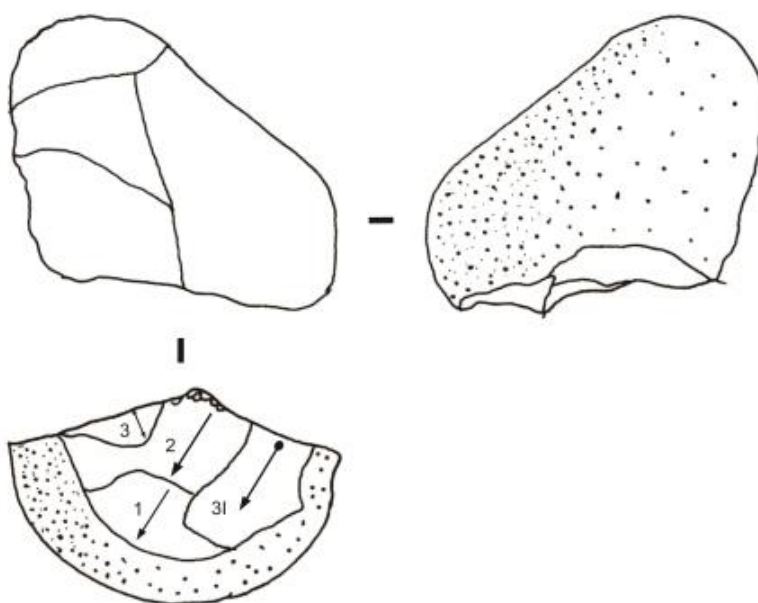
**ID 574**



P/P	2 Partial striking platform. p\p, p\p 1: Slightly prepared by a rough preparation..
S\D	2 Removals that has orthogonal direction. Both of them are not researched flakes.
DIACRITICAL ANALYSIS	The blank is a of pebbles where is present a neocortical surface (N). A first phase is characterized by a rough preparation of the two striking platforms (p\p, p\p 1) and the extraction of 2 flakes, one from each platform. The core is considered as a test, in fact chased these two detaches it was abandoned
METHOD	Indeterminabile
OBJECTIVE	



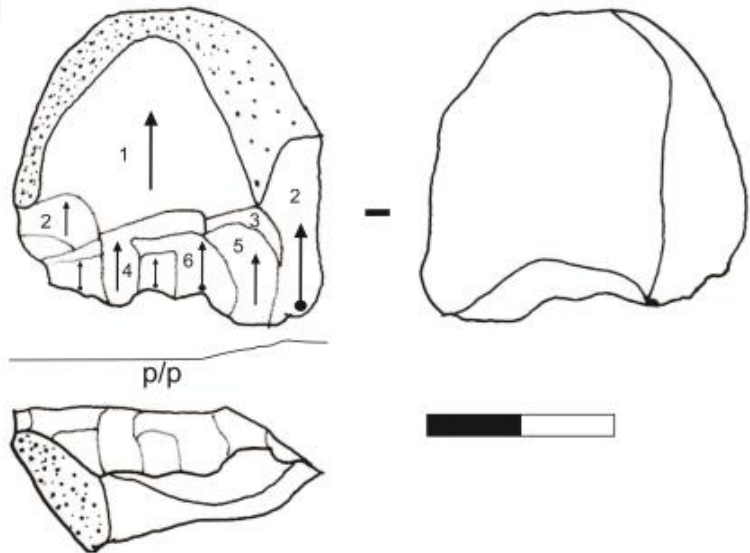
**ID 631**



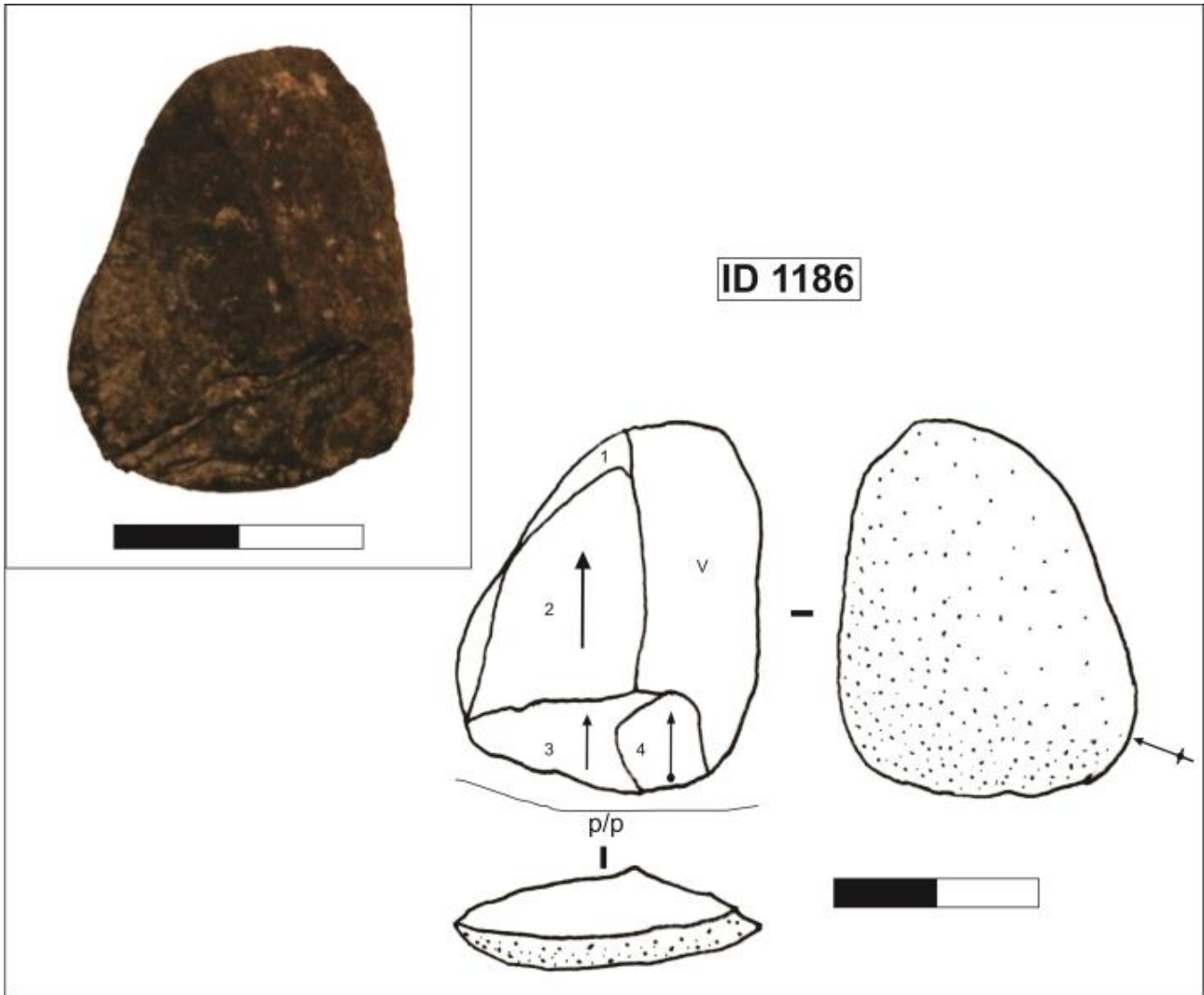
P/P	1 Partial striking platform. p\p: Previous removal.
S\D	4 Convergent removal. All the flake are not researched.
DIACRITICAL ANALYSIS	The blank is a fragment of core, in fact the removal on the striking platform are residues of a previous action. All the removals are not researched flakes interpreted as a preparation for something. The core is abandoned without reaching the production phase.
METHOD	Indeterminable
OBJECTIVE	



**ID 828**



P/P	1 Partial striking platform. p\p: On a previous removal
S\ID	7 Main unipolar removals. 1, 2: Cortex removal. 2l, 3, 4, 5, 6: Series of unipolar not researched removals. Hinged incident.
DIACRITICAL ANALYSIS	The blank is a flake. All the removal are interpreted as a shaping out of the core, anyway the production does not happen probably due to the series of hinged incidents. The core is abandoned for these knapping incident.
METHOD	Indeterminable
OBJECTIVE	



P/P	1 Partial striking platform. p\p: Not prepared.
S\ID	4 Removals that has mainly unipolar direction. All the negatives are not researched flakes of kombewa production.
DIACRITICAL ANALYSIS	The blank is the ventral face of an entame. 4 Flake was removed. The core is abandoned for depletion of the reserve of the raw material.
METHOD	Indeterminable
OBJECTIVE	

### 3.4.5 FLAKES

The group Consists of 1,504 flakes, this quantity Represents 20% of the entire industry. Of this amount only 30 pieces are retouched.

We have taken into account to identify each category the volumetric and morphological characteristics of the flakes, the morphology of the cutting edge, the section of the pieces and the study of diacritical negative on the dorsal surfaces of the supports. So on the base of these technical criterions of each piece it was possible to identify three different concepts of *débitage* in the site: the Levallois, the volume *débitage*, and a rather large class of pieces whose method of *débitage* is indeterminate. This division well agrees with the types of cores found in the site.

The table below shows this composition.

<b>Flakes</b>					
<b>Concept</b>	<b>Method</b>	<b>N.</b>	<b>(%)</b>	<b>TOT.</b>	<b>(%)</b>
Levallois	Convergent	91	6,1	618	41,1
	Unipolar	329	21,9		
	Indeterminate	198	13,2		
Volume	Bladelet	20	1,4	21	1,2
Indeterminable		867	57,6	867	57,7
<b>Total</b>		<b>1505</b>	<b>100</b>	<b>1503</b>	<b>100</b>

**Table 10 Concept and method of débitage of flake**

The concept Levallois contemplates an internal variability of methods, in the site there were found, in particular, flakes from unipolar and convergent *débitage*. The unipolar ones represented 21, 9% of the totality of flakes, Convergent flakes amounted to a percentage of 13.2%. A high percentage of items is considered indeterminate Levallois because of the lack of techno morphological parameters to define the method.

The elevated number of indeterminate flake is possibly due to presence of fragmented pieces.

Regarding fragmented items we decided to interpret as results of a voluntary fracture those pieces showing recurring features such as long flakes and long flakes with back which reveal a visible point of impact. In cases of uncertainty, we preferred to avoid making a rash decision and choose to indicate them by “fragment \ fracture” in the hope of being able to deepen this study in the future.

The table below indicates the nature of the fracture, both natural and anthropogenic. It is also indicated the location of the fracture.

Type of fragment	Levallois		Volume		Indet.		Total Frag.	
	Nat	Antro	Nat	Antro	Nat	Antro	Total	(%)
Composite Frag.	7				63		<b>70</b>	<b>11,9</b>
Distal Frag.	52		3		112		<b>167</b>	<b>28,3</b>
Lateral Frag.	9				30		<b>39</b>	<b>6,6</b>
Mesial Frag.	16		1		38		<b>55</b>	<b>9,3</b>
Proximal Frag.	69		1		88		<b>158</b>	<b>26,8</b>
Frag. Fracture		23				5	<b>28</b>	<b>4,7</b>
Fracture		60				13	<b>73</b>	<b>12,4</b>
<b>Total</b>	<b>153</b>	<b>83</b>	<b>5</b>	<b>0</b>	<b>331</b>	<b>18</b>	<b>590</b>	<b>100,0</b>
<b>(%)</b>	<b>25,9</b>	<b>14,1</b>	<b>0,8</b>	<b>0,0</b>	<b>56,1</b>	<b>3,1</b>	<b>100,0</b>	

**Table 11 Nature and type of fragment**

It is evident that fractures due to natural causes prevail on the anthropogenic one. As already noted, the indeterminate pieces show the greatest degree of fragmentation, followed by Levallois flakes and volume items. The half of lateral fragments is attributable to the accident of Siret.

The analysis of the support showing intentional fractures comes next.

Flakes		Fracture	
Concept-method	Tec. Cat.	N.	(%)
Unipolar Levallois	Researched flake	43	58,9
	Not researched flake	1	1,4
	Cortical flake	3	4,1
Indeterminate Levallois	Researched flake	4	5,5
	Not researched flake	2	2,7
	Cortical flake	3	4,1
	Indeterminable	4	5,5
Indeterminable	Researched flake	2	2,7
	Not researched flake	2	2,7
	Cortical flake	6	8,2
	Indeterminable	3	4,1
<b>Total</b>		<b>73</b>	<b>100,0</b>

**Table 12 Intentional fracture**

More than an half of the intentionally fractured elements, as we already said, are long flakes and long flakes with back. We have considered those categories as researched objects in the recurrent unipolar Levallois *débitage*.

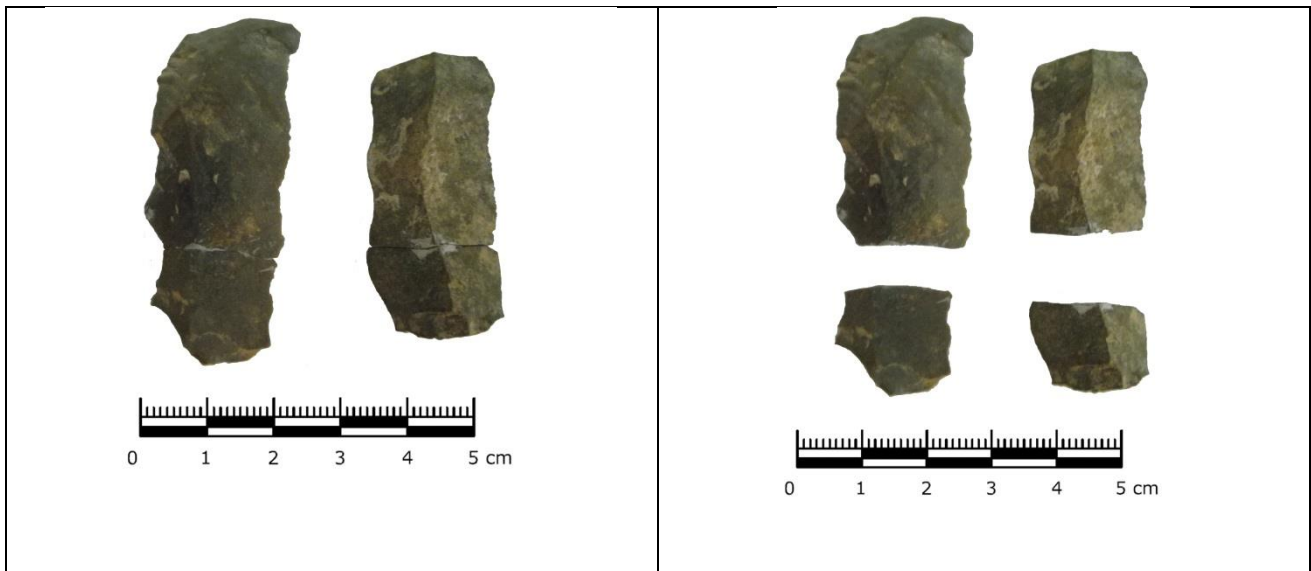


Fig. 18 Fig. 20 Refitting , long flake with intentional fracture

Now we introduced as series of tables containing general information such as the orientation of negatives, the presence and position of the cortex on dorsal surface of flakes and the description of the plan of percussion. As far as these tables are concerned we decided to cross the data by using the method of *débitage*, in order to have specific information about each table and get able to understand the differences between quantitative and qualitative information.

The following table deals with the orientation of the negatives.

ORIENTATION OF NEGATIVES											
Concept-Method	Bipolar	Cent.	Conv.	Cortex	Indet.	Multi.	Ortho.	Uni.	Kombewa	Total	(%)
Convergent Levallois			76		2		1	12		91	6,1
Unipolar Levallois	6	1	8	5	3	2	29	275		329	21,9
Indeterminate Levallois	6	4	35	9	12	11	23	98		198	13,2
Volume			1		2		3	12		18	1,3
Indeterminable	10	1	41	85	295	18	48	368	1	867	57,6
<b>Total</b>	<b>22</b>	<b>6</b>	<b>161</b>	<b>99</b>	<b>314</b>	<b>31</b>	<b>104</b>	<b>765</b>	<b>1</b>	<b>1503</b>	<b>100,0</b>
(%)	1,5	0,4	10,7	6,6	20,9	2,1	6,9	50,9	0,1	100,0	

Table 13: orientation of negative.

More than 50% of the industry is composed by flakes with a unipolar management of the convexities; the majority of them are included among indeterminate pieces and unipolar Levallois. The following 20.9% is indeterminate, this high percentage, however, is composed almost exclusively of indeterminate elements.

In 10.7% of flakes the orientation of the negative is convergent, followed closely by the presence of orthogonal negative 6.9%. Excluding the indeterminate items, it is interesting to notice that Levallois unipolar flake sometimes present a management of convexities done by removal organized in orthogonal orientation, this data is consistence with the result of diacritical analysis of unipolar core, in which the lateral and distal convexities was manage by orthogonal removal.

Finally we notice that mainly 6.6% of the collection present a fully cortical dorsal surface.

Following the table of the position and amount of cortex on the dorsal surfaces of flakes.

<b>CORTEX</b>											
<b>Concept-Method</b>	<b>Absent</b>	<b>Total</b>	<b>Semi-total</b>	<b>Distal</b>	<b>Lateral</b>	<b>Lateral - back</b>	<b>Median</b>	<b>Mist</b>	<b>Proximal</b>	<b>Total</b>	<b>(%)</b>
Convergent Levallois	74			4	9		1		3	<b>91</b>	<b>6,1</b>
Unipolar Levallois	194	6	23	28	43	25	1	6	3	<b>329</b>	<b>21,9</b>
Indeterminate Levallois	122	9	19	6	30	8		1	3	<b>198</b>	<b>13,2</b>
Volume	15		1	1	1					<b>18</b>	<b>1,3</b>
Indeterminable	408	91	144	55	115	8	1	13	32	<b>867</b>	<b>57,6</b>
<b>Total</b>	<b>813</b>	<b>106</b>	<b>187</b>	<b>94</b>	<b>198</b>	<b>41</b>	<b>3</b>	<b>20</b>	<b>41</b>	<b>1503</b>	<b>100,0</b>
<b>(%)</b>	<b>54,1</b>	<b>7,1</b>	<b>12,4</b>	<b>6,3</b>	<b>13,2</b>	<b>2,7</b>	<b>0,2</b>	<b>1,3</b>	<b>2,7</b>	<b>100,0</b>	

**Table 14 Position and amount of cortex**

During a *débitage* production it is possible to get firstly completely cortical flake, secondly flakes with portion of the dorsal surface covered by cortex and then flakes without cortex that correspond with the phase of plain *débitage*. Almost 20% of the industry is it concerning cortical and half cortical flakes. In the partially cortical flake (that means all the flakes with less than 50% of the dorsal surface covered by cortex) there is a majority of the pieces with cortex in distal position followed by flake with cortex -cover on dorsal lateral side and proximal, both with 2, 7%.

The flakes related to the phase of plain *débitage* prevail over the other classes constituting 54% of the whole.

The following table gives a sketch of the typology of the butts.

<b>BUTT</b>											
<b>Concept-Method</b>	<b>Absent</b>	<b>Cortical</b>	<b>Dihedral</b>	<b>Facetted</b>	<b>Faccetted CDG</b>	<b>Indt.</b>	<b>Linear</b>	<b>Flat</b>	<b>Point form</b>	<b>Total</b>	<b>(%)</b>
Convergent Levallois	13	1	10	44	5	3	2	12	1	<b>91</b>	<b>6,1</b>
Unipolar Levallois	82	5	27	111	1	17	15	61	10	<b>329</b>	<b>21,9</b>
Indeterminate Levallois	38	8	17	54		14	9	50	8	<b>198</b>	<b>13,2</b>
Volume	5	1		2		2		2	6	<b>18</b>	<b>1,3</b>
Indeterminable	239	50	31	86		161	42	200	58	<b>867</b>	<b>57,6</b>
<b>Total</b>	<b>377</b>	<b>65</b>	<b>85</b>	<b>297</b>	<b>6</b>	<b>197</b>	<b>68</b>	<b>325</b>	<b>83</b>	<b>1503</b>	<b>100,0</b>
<b>(%)</b>	<b>25,1</b>	<b>4,3</b>	<b>5,7</b>	<b>19,8</b>	<b>0,4</b>	<b>13,1</b>	<b>4,5</b>	<b>21,6</b>	<b>5,5</b>	<b>100,0</b>	

Table 15 Typology of butt

25, 1% of the butts are missing, this data is heavily influenced by the presence of lots indeterminate fragmented items. 21.6% of flakes have flat butt, that means striking platform prepared only by one detachment, whereas 19.8% of butt are facetted, indicating a precisely preparation of the plan of percussion by several removal. 6 flakes present also a facetted butt, moreover with the typical morphology of the Levallois butt, the chapeau de gendarme shape. This morphology seems to be particularly utilized in convergent method.

Also the flake of volume production show differentiate type of butt, from point form to flat and facetted ones.

What follows is the table regarding the indication of the position of the point of impact.

<b>POSITION OF IMPACT POINT</b>						
<b>Concept-Method</b>	<b>Absent</b>	<b>Central</b>	<b>Lateral</b>	<b>Indet.</b>	<b>Total</b>	<b>(%)</b>
Convergent Levallois	13	53	24	1	<b>91</b>	<b>6,1</b>
Unipolar Levallois	82	145	96	6	<b>329</b>	<b>21,9</b>
Indeterminate Levallois	38	94	60	6	<b>198</b>	<b>13,2</b>
Volume	5	10	2	1	<b>18</b>	<b>1,3</b>
Indeterminable	239	293	201	134	<b>867</b>	<b>57,6</b>
<b>Total</b>	<b>377</b>	<b>595</b>	<b>383</b>	<b>148</b>	<b>1503</b>	<b>100,0</b>
<b>(%)</b>	<b>25,1</b>	<b>39,6</b>	<b>25,5</b>	<b>9,8</b>	<b>100,0</b>	

Table 16 Position of impact point

The point of impact, if we consider the entire morphology of the flake, is predominantly in central position in all methods of Levallois, but also well represented are the flakes with impact point in the lateral position and the ones in which this point is completely absent.

The analysis of the type of bulb comes next.

<b>BULB</b>						
<b>Concept-Method</b>	<b>Prominent</b>	<b>Not prominent</b>	<b>Indet.</b>	<b>Absent</b>	<b>Total</b>	<b>(%)</b>
Convergent Levallois	54	23	1	13	<b>91</b>	<b>6,1</b>
Unipolar Levallois	130	113	4	82	<b>329</b>	<b>21,9</b>
Indeterminate Levallois	78	77	5	38	<b>198</b>	<b>13,2</b>
Volume	3	10	0	5	<b>18</b>	<b>1,3</b>
Indeterminable	194	303	131	239	<b>867</b>	<b>57,6</b>
<b>Total</b>	<b>459</b>	<b>526</b>	<b>141</b>	<b>377</b>	<b>1503</b>	<b>100,0</b>
<b>(%)</b>	<b>30,5</b>	<b>35,0</b>	<b>9,4</b>	<b>25,1</b>	<b>100,0</b>	

**Table 17 Type of bulb.**

Regarding the bulb, it must be asserted that there is not a substantial difference between prominent and not prominent ones. It is possible to note, however, that while for the Levallois pieces the bulb tends to be prominent, for the supports obtain by volumetric concept the bulb is not prominent.

These data would indicate the use of hard hammers for the production of Levallois and, by the way, this assumption seems to be well attested also in the bibliography<sup>119</sup>. On the other hand, a smoother hammer seems to be used for the volumetric production. Anyway, unfortunately no hammer was found in the level.

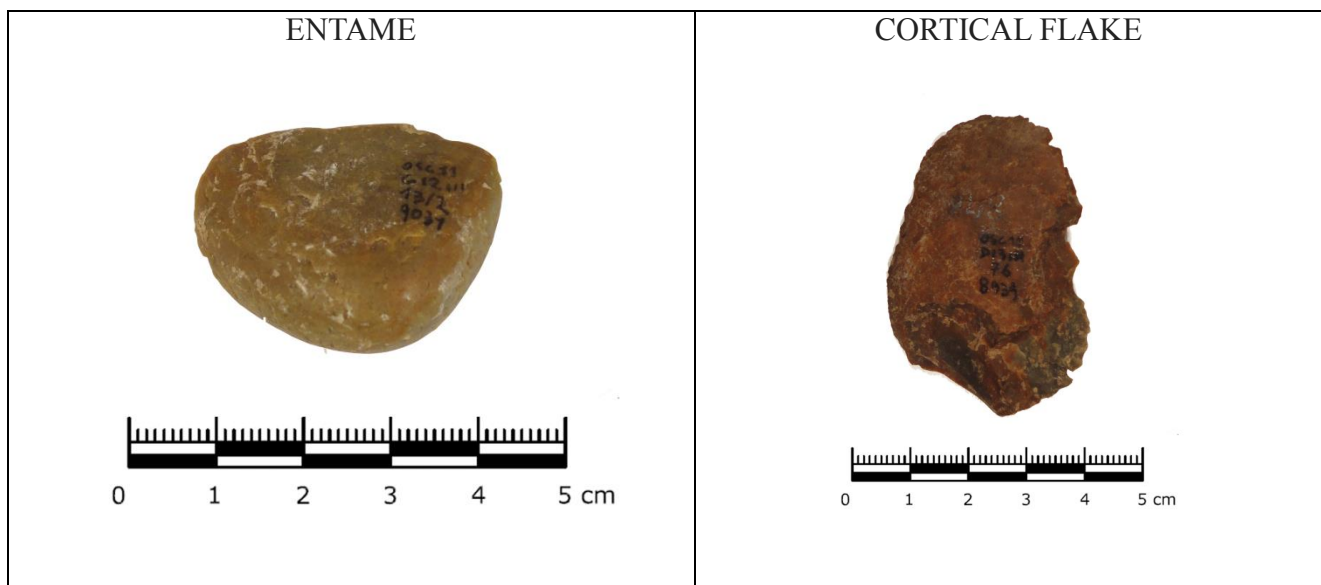
Within the concept Levallois it is possible to identify different ways of organizing and of managing the débitage. The table below supplies us with further details on the subdivision of the modalities related to the concept Levallois and to the technological categories, but our definition of technological category is directly connected to a single phase of the operational chain of flaking: *entame* and cortical flakes are part of the stage of cortex removal while the not researched flakes

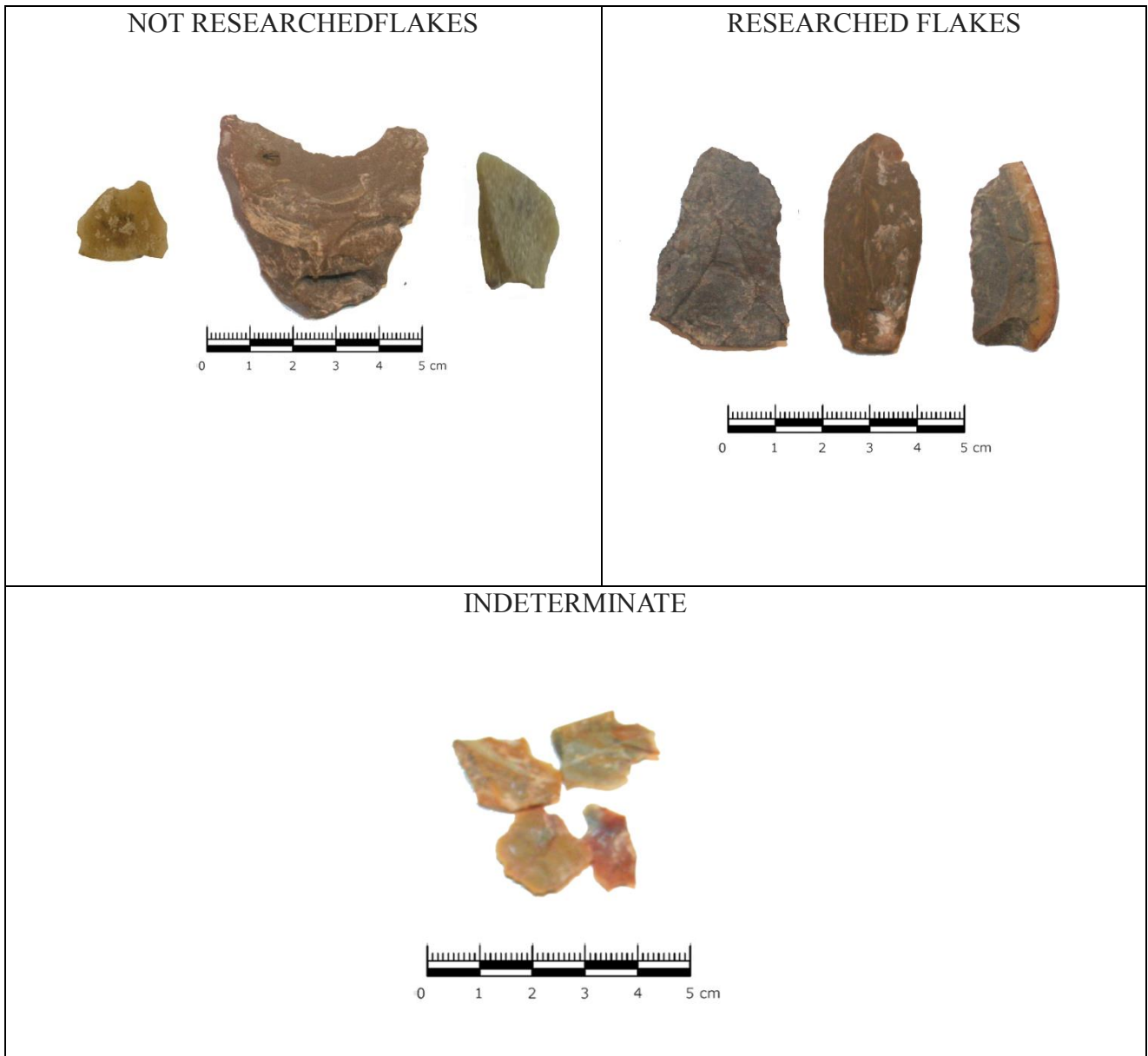
<sup>119</sup> ARZARELLO ET AL. 2011; INIZAN ET AL. 1999.

include the set flakes meant to apply to the management of convexity of the cores. The researched flakes are then the predetermined products pursued by humans.

TECHNOLOGICAL CATEGORY							
Concept - Method	Indet.	Cortical Flakes	Entame	Not Researched Flakes	Researched Flakes	Total	(%)
Convergent Levallois	3			27	61	91	6,1
Unipolar Levallois	30	28	1	62	208	329	21,9
Indeterminate Levallois	37	27		100	34	198	13,2
Volume		1		4	13	18	1,3
Indeterminable	223	201	25	375	43	867	57,6
<b>Total</b>	<b>292</b>	<b>257</b>	<b>26</b>	<b>568</b>	<b>359</b>	<b>1503</b>	<b>100,0</b>
(%)	<b>19,4</b>	<b>17,1</b>	<b>1,7</b>	<b>37,8</b>	<b>23,9</b>	<b>100,0</b>	

Table 18 Technological category





**Fig. 19 Technological Category**

Within the variability of the concept Levallois there is a clear predominance of researched flakes, in particular it turned up that the researched flakes by unipolar method prevail over the other. This data can be interpreted considering that within the recurrence of unipolar Levallois concept flakes with researched technical characteristics at the play a double role: it is a researched purpose and a flake of management of convexity at the same time. Therefore, these flakes can be considered both predetermined and predetermining.

The cortical flakes, which are flakes endowed with a cortex that covers more than half or even the entire surface, are few and, in particular, they are all unipolar or indeterminate. It is interesting that we can detect the absence of cortical flakes produced by convergent Levallois.

It is possible to read this absence by considering that unipolar Levallois is often used to initialize a nucleus and then, in a second stage of production, it passes to convergent modality. This hypothesis seems all the more true when we notice that in this collection the most explored cores are the convergent ones and the only core situated in an initial stage is the of unipolar modality<sup>120</sup>.

It seems convenient to add a greater degree of analysis meant to the identification of flakes with recurrent technical characteristic. This subdivision appears more specific as regards the Levallois débitage which provides a high level of predetermination. We define specification as technological category 2.

From now we will present the data according with the concept and method of débitage, so first of all the unipolar levallois, later on the convergent Levallois, the indeterminate Levallois and finally the volume production.

### *Unipolar Levallois*

The following table gives a sketch of the recurrences regarding unipolar Levallois débitage.

TECHNOLOGIC CATEGORIES 2										
Concept Method	Phases of débitage	Technological category 2	Indet.	Cortical Flakes	Entame	Not Researched Flakes	Researched Flakes	Total	(%)	
Unipolar Levallois	Initialization & Cortex removal	p/p cortex removal						0	0,0	
		s/d cortex removal		26				26	7,9	
	Management & production	Long flake						169	169	51,4
		Long flake with back						29	29	8,8
		Convergent flake						10	10	3,0
		s/d	6	1		23		30	9,1	
		s/d convexity management		1		20		21	6,4	
		s/d debordant				4		4	1,2	
		s/d erase accident				12		12	3,6	
		s/d pseudo levallois point				1		1		
		p/p				2		2	0,6	
Indeterminable	Indeterminable	24		1			25	7,6		
<b>Total</b>			<b>30</b>	<b>28</b>	<b>1</b>	<b>62</b>	<b>208</b>	<b>329</b>	<b>100,0</b>	
<b>(%)</b>			<b>9,1</b>	<b>8,5</b>	<b>0,3</b>	<b>18,8</b>	<b>63,2</b>	<b>100,0</b>		

Table 19 Technological category 2 for unipolar levallois

### Initialization & Cortex removal

<sup>120</sup> BOËDA 1994; CARMIGNANI 2011.

The cortical flakes and entame represent the phase of initialization and cortex removal. Entame of unipolar Levallois were not found in the layer, this absent can be easily solved: opening flakes are very difficult to schedule in a defined method indeed, because of the lack of technical parameters recognizable. In other word it is not possible to understand if an entame opens a unipolar Levallois or a convergent Levallois core, because it is not still developed.

### Management & production

Among the researched flakes the long flakes prevail. This is not surprise since in Levallois recurrent modality the flakes perform the dual function of being researched and that of being predetermined. We dispose of a smaller quantity of flakes of convexity management (lateral and distal) and of generic flakes coming from surface of débitage.

As the long flake also the long flake with back has a dual function that consist first in the maintenance of lateral convexity on the surface of débitage, and secondly in the continuation of cortex removal. As the recurrences of technical character of this kind of flake in this collection we consider it as a researched flake.

Flakes of striking platform are lacking. They would surely be present in a context of Levallois management and their absence here is due to the poor dimension of these flakes we have considered as debris. Furthermore, it is extremely difficult to distinguish flakes of striking platform belonging to the unipolar Levallois from others of a different kind.



**Fig. 20 Refitting: initialization, cortex removal of Levallois unipolar production.**



Fig. 21 Refitting: Unipolar Levallois management and production.

We report below the tables which illustrate the morphology of the pieces of unipolar Levallois *débitage*. In this case only integer pieces were taken into account, even elements bearing reflection accidents were excluded from the analysis in order to avoid any danger of skewing the data with morphologies not caused by intentional actions but by accidents or post depositional phenomena.

The table shows the morphology of unipolar Levallois flakes.

MORFOLOGY UNIPOLAR LEVALLOIS											
Technological category 2	Circular	Irregular	Semi moon	Oval	Quadrangular	Rectangular	Trapezoidal	Triangular	Fan shape	Total	(%)
Long flake		8	2	24	6	15	17			72	44,7
Long flake with back		1	1	6		2	5			15	9,3
Convergent flake							5	3		8	5,0
s/d		4		3	1	2	4	1		15	9,3
s/d convexity management		3			1	1	5	2		12	7,5
s/d debordant		1						1		2	1,2
s/d erase accident		5			1		4	1		11	6,8
s/d pseudo levallois point							1			1	0,6
p/p cortex removal									2	2	1,2
s/d cortex removal			1	10			4	1		16	9,9
Indeterminate						6	1			7	4,3
<b>Total</b>	<b>0</b>	<b>22</b>	<b>4</b>	<b>43</b>	<b>9</b>	<b>26</b>	<b>46</b>	<b>9</b>	<b>2</b>	<b>161</b>	<b>100,0</b>
<b>(%)</b>	<b>0,0</b>	<b>13,7</b>	<b>2,5</b>	<b>26,7</b>	<b>5,6</b>	<b>16,1</b>	<b>28,6</b>	<b>5,6</b>	<b>1,2</b>	<b>100,0</b>	

Table 20 Morphology of unipolar levallois flakes

Oval and trapezoidal, followed by rectangular, are the most recurring forms, this cannot be surprising if only we consider that the unipolar Levallois method produces elongated elements with regular morphologies. The presence of a high rate of items in oval morphology is attributable to the nature of the raw material, which is by nature in the form of oblong and rounded pebbles.

In the following two tables we consider the symmetry and section of the researched items of unipolar débitage.

Researched flake	Symmetry	Section									Total	(%)
		Triangular	Trapeze rectangular	Trapeze	Rectangular	Half circle	Linear	Irregular	Indet.			
Long flake	Si	62		41			14	1		<b>118</b>	<b>56,7</b>	
	No	19	1	24		1	3	3		<b>51</b>	<b>24,5</b>	
Long flake with back	Si	9	5				1			<b>15</b>	<b>7,2</b>	
	No	7	7							<b>14</b>	<b>6,7</b>	
Convergent flake	Si	2		1				1		<b>4</b>	<b>1,9</b>	
	No	3		3						<b>6</b>	<b>2,9</b>	
<b>Total</b>		<b>102</b>	<b>13</b>	<b>69</b>	<b>0</b>	<b>1</b>	<b>18</b>	<b>5</b>	<b>0</b>	<b>208</b>	<b>100,0</b>	
<b>(%)</b>		<b>49,0</b>	<b>6,3</b>	<b>33,2</b>	<b>0,0</b>	<b>0,5</b>	<b>8,7</b>	<b>2,4</b>	<b>0,0</b>	<b>100,0</b>		

Table 21 Section and symmetry in researched unipolar levallois flakes

Symmetrical elements with regular and mainly triangular and trapezoidal sections prevail over the entire production. However there are exceptions such as the case of some convergent, or some long flakes or even long flakes with back. Half of the supports are not symmetrical.

### *Convergent Levallois*

The following table gives a sketch of the recurrences regarding the convergent Levallois débitage.

TECHNOLOGIC CATEGORIES									
Concept Method	Phase of débitage	Technologic Categories 2	Indet.	Cortical Flakes	Entame	Not Researched Flakes	Researched Flakes	Total	(%)
Convergent Levallois	Initialization & Cortex removal	p/p cortex removal						0	0,0
		s/d cortex removal						0	0,0
	Management & production	Long flake					7	7	7,7
		Convergent flake					54	54	59,3
		s/d	2			6		8	8,8
		s/d convexity management				18		18	19,8
		s/d debordant				1		1	1,1
		s/d erase accident				2		2	2,2
	Indeterminable	Indeterminable	1					1	1,1
<b>Total</b>			<b>3</b>	<b>0</b>	<b>0</b>	<b>27</b>	<b>61</b>	<b>91</b>	<b>100,0</b>
<b>(%)</b>			<b>3,3</b>	<b>0,0</b>	<b>0,0</b>	<b>29,7</b>	<b>67,0</b>	<b>100,0</b>	

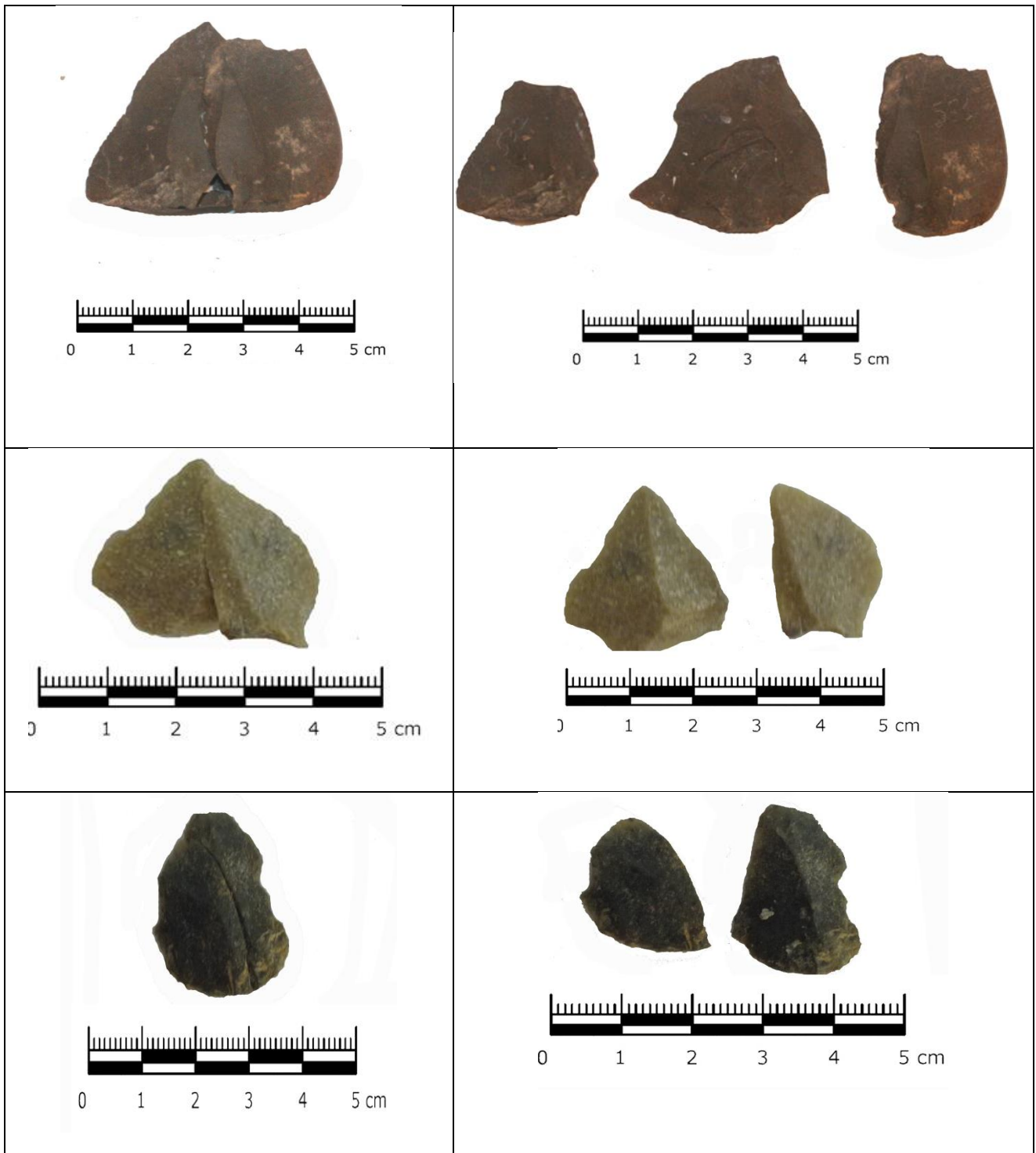
Table 22 Technological category 2 for convergent levallois

#### Initialization & Cortex removal

As for the unipolar Levallois also in the convergent *débitage* the striking platform flakes are missing and the cortical flakes are missing too (we have already assumed the absence of these fragments in the above paragraph).

#### Management & production

As expected, convergent flakes are the main goal of this kind of production; anyway long flakes are not absent.



**Fig. 22 Refittings: Convergent Levallois, management of the convexities and production of convergent flake.**

The table shows the morphology of convergent Levallois flakes

MORFOLOGY CONVERGENT LEVALLOIS								
Concept Method	Technological category 2	Circular	Irregular	Oval	Trapezoidal	Triangular	Total	(%)
Levallois Convergent	Long flake			1	1	1	3	4,5
	Convergent flake	1	10	2	6	26	45	68,2
	s/d debordant						0	0,0
	s/d		1			1	2	3,0
	s/d convexity management	2	5	3	2	3	15	22,7
	s/d erase accident					1	1	1,5
<b>Total</b>		<b>3</b>	<b>16</b>	<b>6</b>	<b>9</b>	<b>32</b>	<b>66</b>	<b>100,0</b>
<b>(%)</b>		<b>4,5</b>	<b>24,2</b>	<b>9,1</b>	<b>13,6</b>	<b>48,5</b>	<b>100,0</b>	

Table 23 Morphology of convergent levallois flakes

The majority of the flakes, in particular the converging ones, have a triangular morphology. Irregular morphology follows closely.

The following table is concerning the convergent Levallois.

Researched flakes	Symmetry	Section									
		Triangular	Trapeze-ret.	Trapeze	Rectangul	Half circle	Flat	Irregular	Indet.	Total	(%)
Long flaks	Si	1		1						2	3,3
	No	3					2			5	8,2
Convergent flakes	Si	11		10				1		22	36,1
	No	16		12			2	1	1	32	52,5
<b>Total</b>		<b>31</b>	<b>0</b>	<b>23</b>	<b>0</b>	<b>0</b>	<b>4</b>	<b>2</b>	<b>1</b>	<b>61</b>	<b>100,0</b>
<b>(%)</b>		<b>50,8</b>	<b>0,0</b>	<b>37,7</b>	<b>0,0</b>	<b>0,0</b>	<b>6,6</b>	<b>3,3</b>	<b>1,6</b>	<b>100,0</b>	

Table 24 Symmetry and section of convergent Levallois flakes

Once again the triangular and trapezoidal sections prevail; in this case, however, the majority of the supports is not symmetric.



**Fig. 23 Refitting: management and production of recurrent convergent Levallois.**

*Indeterminate Levallois*

Part of this group are all the flakes that are consider Levallois but there are not enough technical parameters to define to which method they belong.

Technologic Categories										
Concept Method	Phases débitage	Tec. Cat. 2	Indet	Cortical Flakes	Entame	Not Researched Flakes	Researched Flakes	Total	(%)	
Indeterminate Levallois	Initialization & Cortex removal	p/p cortex removal		1				1	0,5	
		s/d cortex removal		25		1		26	13,1	
	Management & production	Long flake						28	28	14,1
		Long flake with back						2	2	1,0
		Convergent flake						4	4	2,0
		s/d	21				34		55	27,8
		s/d convexity management			1		36		37	18,7
		s/d debordant					11		11	5,6
		s/d erase accident					17		17	8,6
		s/d pseudo levallois point								
	p/p							0	0,0	
Indeterminable	Indeterminable	16				1		17	8,6	
<b>Total</b>			<b>37</b>	<b>27</b>	<b>0</b>	<b>100</b>	<b>34</b>	<b>198</b>	<b>100,0</b>	
<b>(%)</b>			<b>18,7</b>	<b>13,6</b>	<b>0,0</b>	<b>50,5</b>	<b>17,2</b>	<b>100,0</b>		

Table 25 Technological category Levallois indeterminate

#### Initialization & Cortex removal

A large amount of cortical flake are considered part of indeterminate Levallois because there are not enough parameters for attributing the method.

#### Management & production

Not researched flakes include various kind of flake with different functions and characteristic. Therefore they are more likely to be confused.

Levallois Indeterminate/Morphology											
Technological category 2	Circular	Irregular	Semi moon	Oval	Quadrangular	Rectangular	Trapezoidal	Triangular	Fan shape	Total	(%)
Long flake		2	2	6	2	2	3			17	14,2
Long flake with back			1							1	0,8
Convergent flake						1		3		4	3,3
s/d	1	5		1	2	3	8	5		25	20,8

s/d convexities management		8	1	4	1	2	9	6		<b>31</b>	25,8
s/d debordant		4				1	2	1		<b>8</b>	6,7
s/d erase accident		8		1			3			<b>12</b>	10,0
s/d pseudo levallois point										<b>0</b>	0,0
p/p	1									<b>1</b>	0,8
s/d cortex removal		1		6		1	3	1		<b>12</b>	10,0
p/p cortex removal	1									<b>1</b>	0,8
Indeterminate		1		1		6				<b>8</b>	6,7
<b>Total</b>	<b>3</b>	<b>29</b>	<b>4</b>	<b>19</b>	<b>5</b>	<b>16</b>	<b>28</b>	<b>16</b>	<b>0</b>	<b>120</b>	<b>100,0</b>
(%)	<b>2,5</b>	<b>24,2</b>	<b>3,3</b>	<b>15,8</b>	<b>4,2</b>	<b>13,3</b>	<b>23,3</b>	<b>13,3</b>	<b>0,0</b>	<b>100,0</b>	

Table 26 Morphology of Levallois indeterminate flakes

Researched flake	Symmetry	Section									
		Triangular	Trapeze rectangular	Trapeze	Rectangular	Half circle	Linear	Irregular	Indet.	Total	(%)
Long flakes	Si	4		5			3			<b>12</b>	<b>35,3</b>
	No	8		5			1	2		<b>16</b>	<b>47,1</b>
Long flakes with back	Si	1								<b>1</b>	<b>2,9</b>
	No	1								<b>1</b>	<b>2,9</b>
Convergent flakes	Si	3								<b>3</b>	<b>8,8</b>
	No			1						<b>1</b>	<b>2,9</b>
<b>Total</b>		<b>17</b>	<b>0</b>	<b>11</b>	<b>0</b>	<b>0</b>	<b>4</b>	<b>2</b>	<b>0</b>	<b>34</b>	<b>100,0</b>
<b>(%)</b>		<b>50,0</b>	<b>0,0</b>	<b>32,4</b>	<b>0,0</b>	<b>0,0</b>	<b>11,8</b>	<b>5,9</b>	<b>0,0</b>	<b>100,0</b>	

Table 27 Section and symmetry in researched indeterminate Levallois flakes

### Volume

Compared to the production Levallois the presence of volumetric exploitation is merely marginal, only 18 flakes and 6 cores indeed attest the presence of this concept of débitage. However this data is present and it is relevant to show it.

The raw material chosen for volumetric production is mostly fine grained flint and fine grained quartzite.

The following table gives a sketch of the recurrences regarding the volume débitage

Technological category									
Concept	Phase of débitage	Technological category	Indet.	Cortical flake	Entame	Not researched flake	Researched flake	Total	(%)
Volume	Initialization & Cortex removal	p/p cortex removal						0	0,0
		s/d cortex removal						0	0,0
	Management & production	Bladelet					13	13	72,2
		Bladelet management		1		4		5	27,8
	Indeterminable	Indeterminable						0	0,0
<b>Total</b>			<b>0</b>	<b>1</b>	<b>0</b>	<b>4</b>	<b>13</b>	<b>18</b>	<b>100,0</b>
<b>(%)</b>			<b>0,0</b>	<b>5,6</b>	<b>0,0</b>	<b>22,2</b>	<b>72,2</b>	<b>100,0</b>	

Table 28 Technological category of volume débitage

Initialization & Cortex removal:

For the volumetric production cortical flakes are completely missing, the bladelets are obtained from flakes in a phases of plain *débitage*. as it is evident also from core.

Management & production:

There are 13 bladelets in the layer, the technical parameters that define this category are, a pseudo rectangular and symmetrical morphology of the support, the presence of a central guide rib and usually two detachments for side management. Supports of this kind are obtained by a volumetric *débitage* on flake-blank. If it is utilize as S\D the surface of the flake this bladelets come from the large face of the core. Whereas if it is utilize the trenchant of the flake-blank as S\D the bladelet come from the short face of the core.

However similar supports can accidentally be obtained during *débitage* surface. Hence we consider bladelet only support that fully satisfy our parameters.

To corroborate the hypothesis of a volume production in the site, there is the presence of lamellar management and cores.

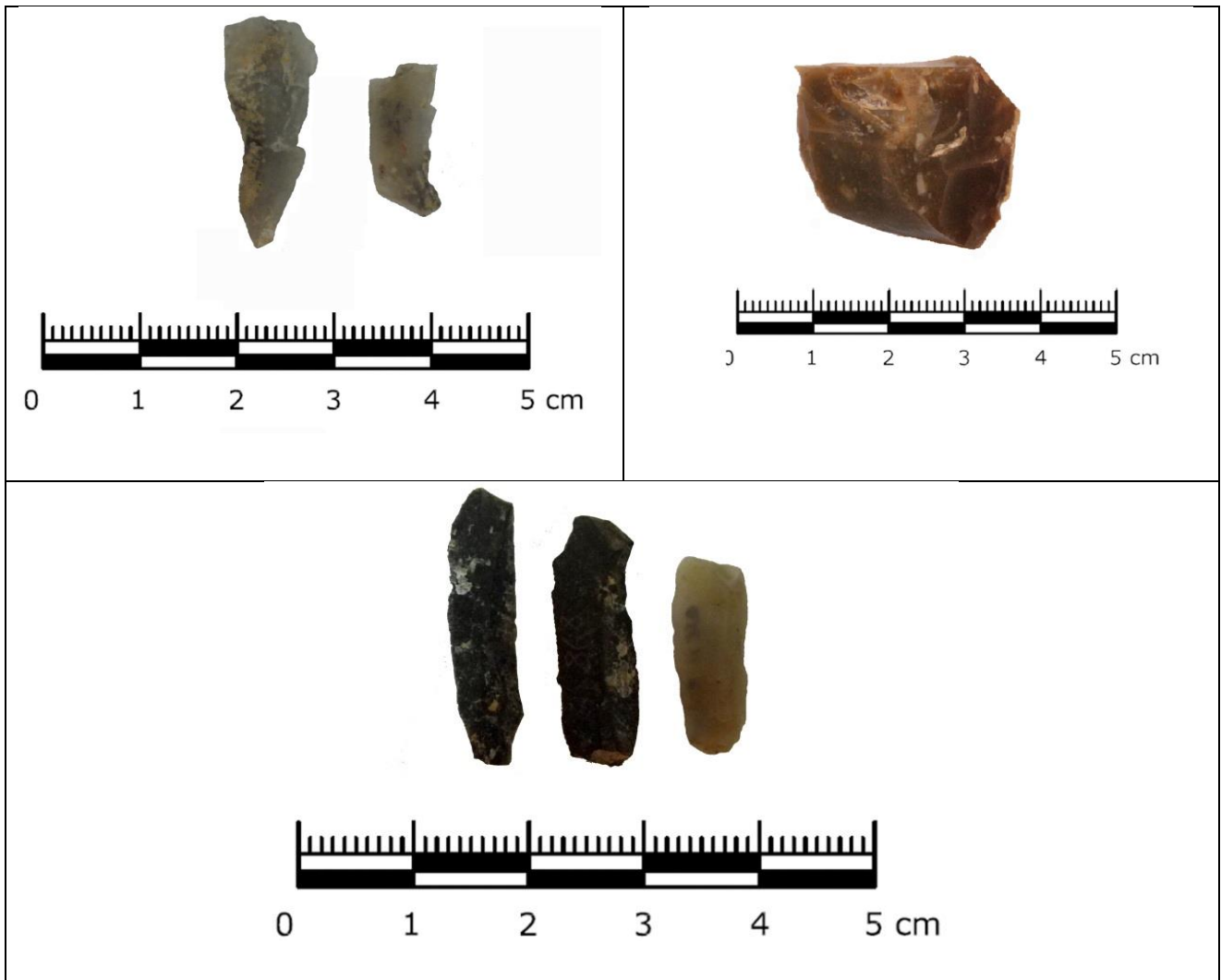
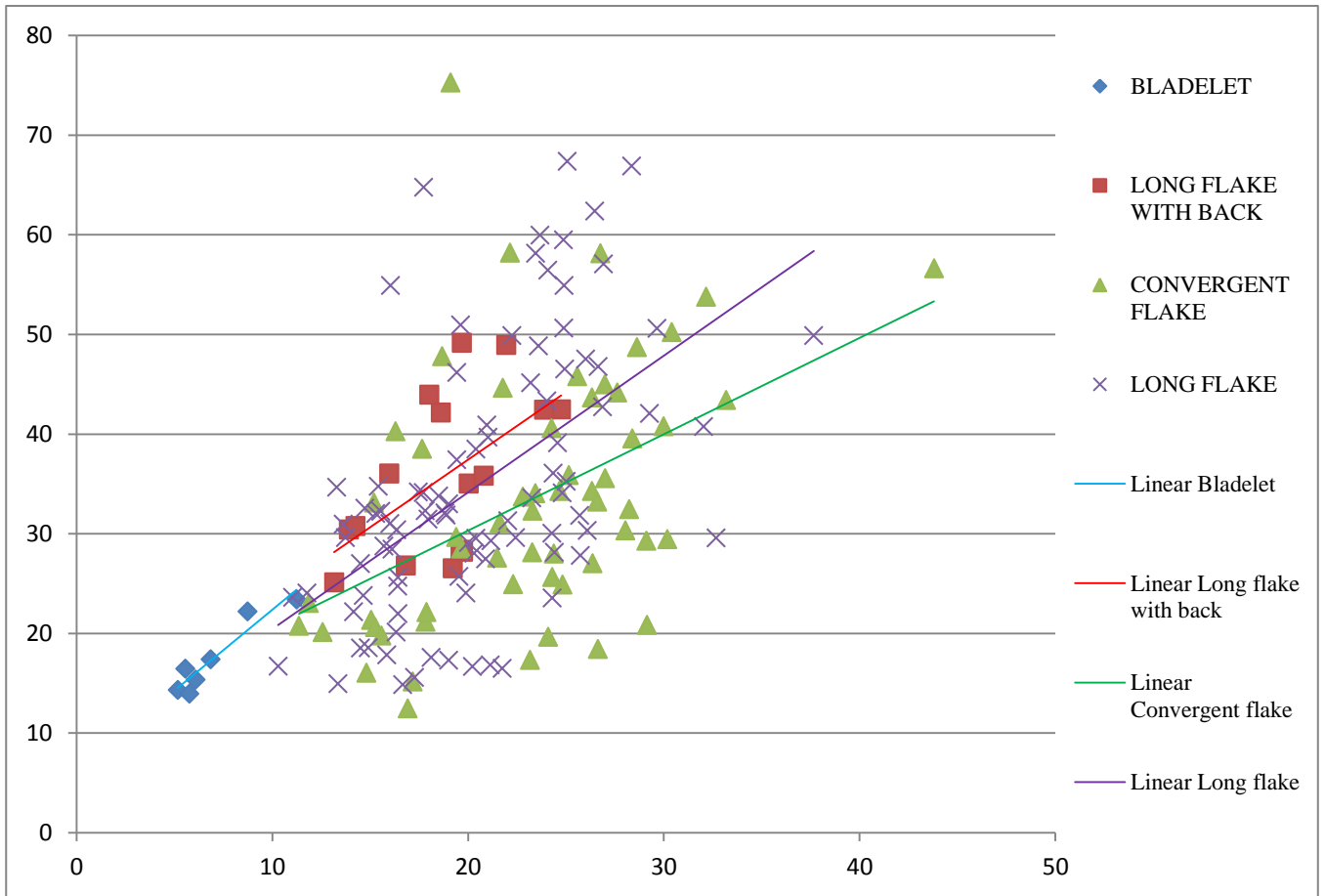


Fig. 24 Fig. Volume production: 1. bladelet management; 2. core volume débitage;3. researched flake: bladelets.

### *Researched flakes*

The following table display the height/width relation concerning the researched supports. All the fragmented items and the pieces showing hinged accidents have been excluded from the counting.



**Fig. 25 Graphic of dispersion of the dimension of researched flakes**

It was decided to isolate the categories of researched items to identify any recurring dimensional pattern that can highlight specific forms of predetermination in the production of those categories. Although the amount of flakes convergent Levallois and flakes unipolar Levallois are not enough for a relevant comparison there is a full metric correspondence among the researched products of different methods. This means that different methods lead to the creation of similar products.

Therefore, in the graph we consider the researched products regardless of the production method.

The blades have a rather small dimensional modulus and this data well agrees with the size of the core (volume débitage), all obtained on flake blank. The linear shows that height and length only are linked by a directly proportional relationship, i.e. the ratio between height and width is constant.

Long flakes can be produced from convergent and unipolar Levallois, the variability of methods also shows a certain dimensional variability: from rather small supports close to lamellar

supports, to rather large artefacts. The relationship between height and length of the pieces, however, appears almost constant. One explanation for the dimensional variability of these researched objects is that the Levallois both convergent and unipolar is a recurrent method that follows a sort of rhythm. After the extraction of a first generation of supports there is a further preparation and a subsequent production of secondary generation and so on. Thus it is leading to a progressive reduction of the core and of refined products.

The same applies to the long flakes with back that besides being a researched products (predetermined) they have also the function of predetermining and re-establish the right convexity for the successive removals. However, compared to elongated flake they have a range of lower price dispersion.

The convergent flakes, researched objective by unipolar and convergent Levallois production, shows a ratio of height to width which is inferior to that of the other flake, therefore they result more stocky. Nevertheless they have a quite great grade of dispersion.

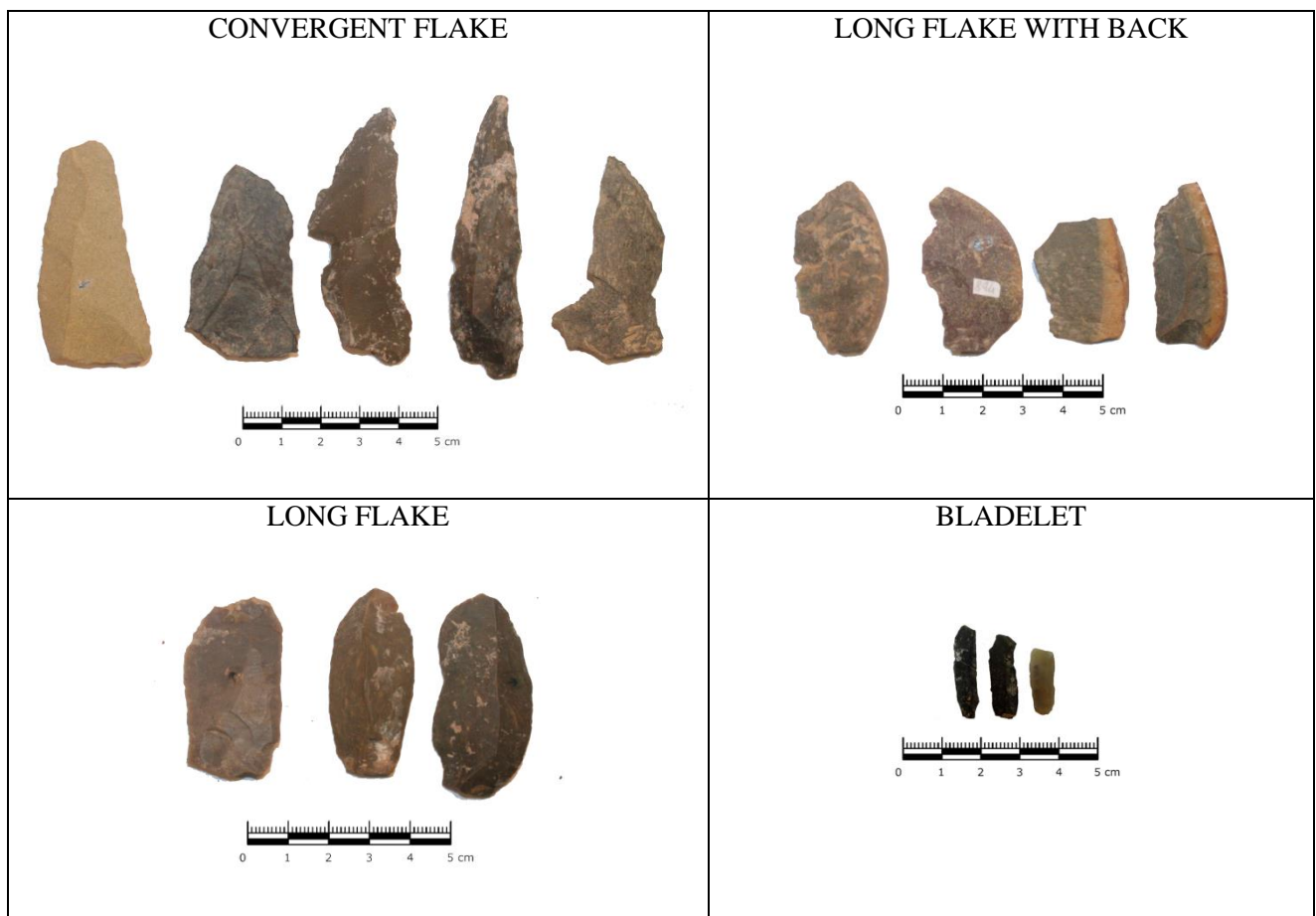


Fig. 26 Researched flakes.

### Retouched tools

30 elements were chosen to be further processed *via* retouching.

The table below indicates their typological classification. It is also indicated the kind of flake that had been chosen to be retouched, and to which phase of the *chaîne opératoire* they are related.

RETOUCHED TOOL									
Phase of débitage	Technological category	Inch	Denticulate scraper	Lateral scraper	Denticulate point	Grattatoio	Retouched fragment	Total	(%)
Initialization	s/d cortex removal	1		2				3	10,0
Management	s/d		1					1	3,3
	s/d erase accident	1						1	3,3
Production	Long flake	1	3	6	1	2	2	15	50,0
	Convergent flake			2	1		2	5	16,7
	Long flake with back			3				3	10,0
Indet.	Indeterminate						2	2	6,7
<b>Total</b>		<b>3</b>	<b>4</b>	<b>13</b>	<b>2</b>	<b>2</b>	<b>6</b>	<b>30</b>	<b>100,0</b>
<b>(%)</b>		<b>10,0</b>	<b>13,3</b>	<b>43,3</b>	<b>6,7</b>	<b>6,7</b>	<b>20,0</b>	<b>100,0</b>	

Table 29 Type of retouched tool

Of these 30 retouched tools 28 are from Levallois *débitage* and 2 are indeterminate pieces.

The technological category most elected to be retouched is long flake, with a total number of 15 tools, hereinafter 5 tools made on convergent flakes. Consequently it is possible to notice that more than 75% of the retouched piece are made on researched flake, in other words flakes that was already the aims of the production before the transformation by retouch.

However, there are also few retouched tools made on not researched flakes, such as cortical and generic flakes.

It is evident that the most common retouched tool is side scraper with 13 items in a total of 30 retouched pieces (43, 3 % of the total). Of this 13 the majority was obtained on the category of long flakes and long flake with back that represent the major aims of this production.

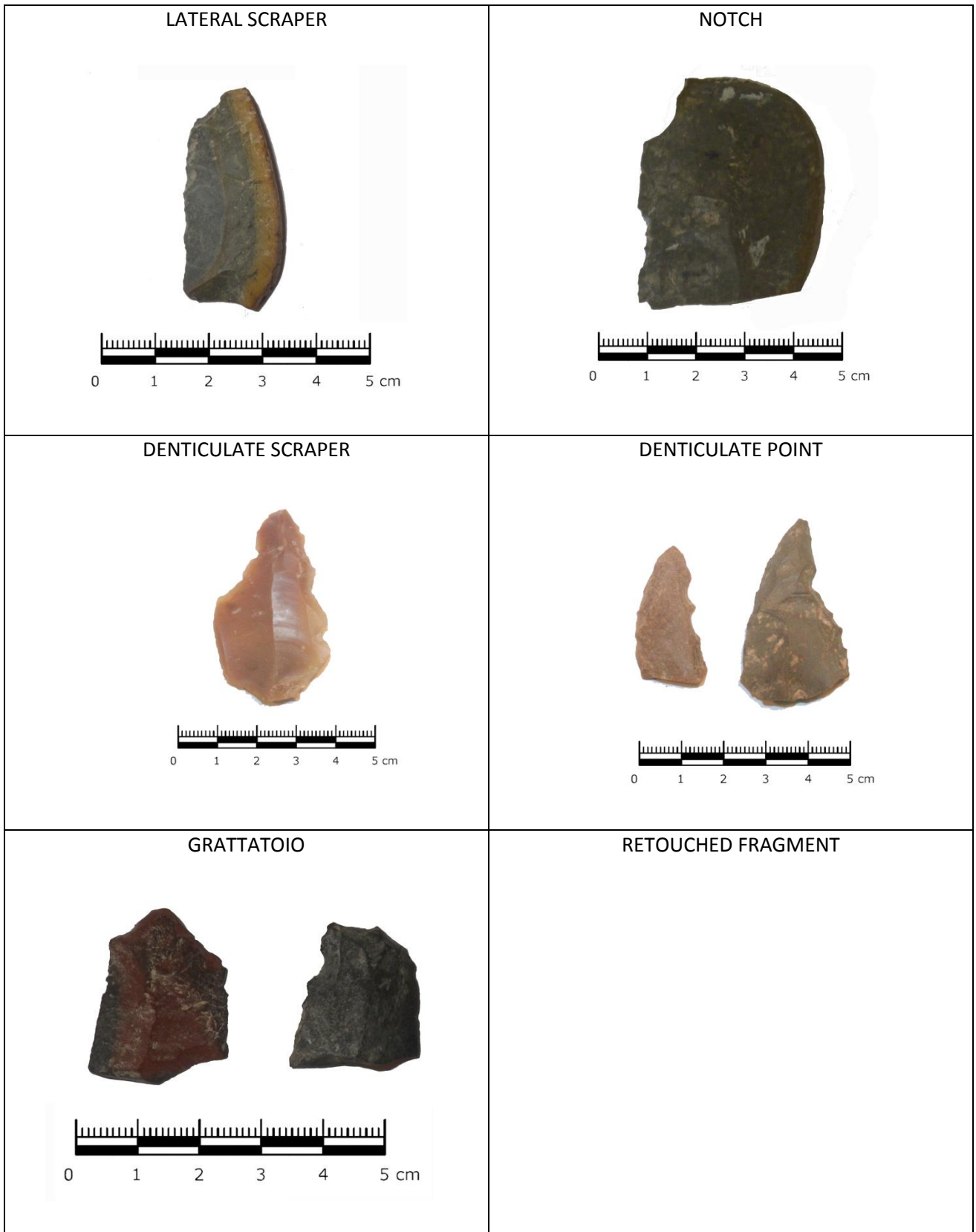


Fig. 27 Transformation phase: Retouched tools.

### 3.4.6 PEBBLES

In the level 8 pebbles were found, 7 of them were intact while 1 was fragmented. 2 are made of fine jasper, 2 of coarse grained jasper, 2 of coarse grained flint, 1 of fine flint and there was a pebble impossible to identify in raw material.

The orientation of the pebbles is conventionally regarded as the greatest measures i.e. as the length. The table below shows the dimensions. For each descriptor we considered the maximum number the minimum number and the average values among those dimensions.

DIMENSION										
Class	Height (mm)			Length (mm)			Thickness (mm)			Total
	Min	Max	Average	Min	Max	Average	Min	Max	Average	
Pebbles	24	42	35,5	17	44	29,7	13	24	17,6	<b>8</b>

**Table 30 Dimension of Pebbles**

The pebbles do not show any trace of percussion, which indicates that they are a sort of as raw material supply. These pebbles are of small dimension, those used in most of the production are bigger but signs of exploitation of smaller pebbles are recognizable, too.

There are been found 4 pebbles made of jasper, 3 made of flint and one made of an indeterminable raw material. The source of these blocks is local; they all came from sea and river terraces which are still recognizable.



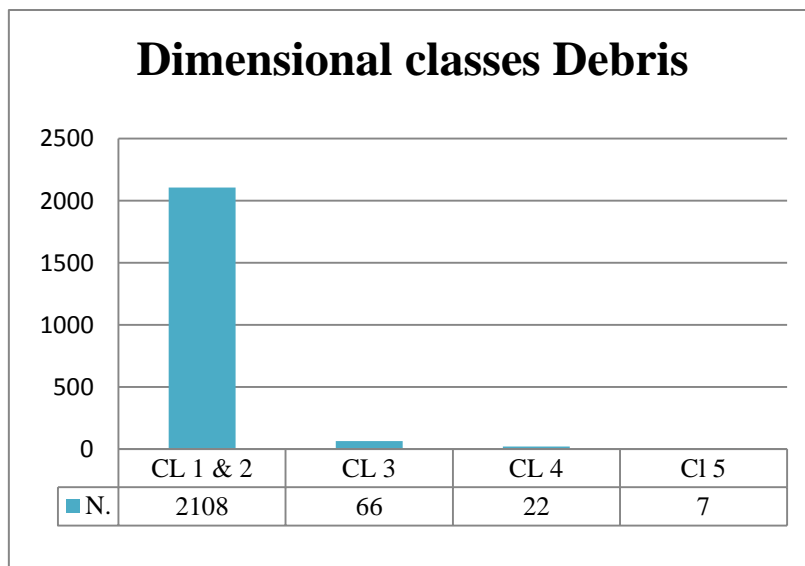
Fig. 28 Pebbles

### 3.4.7 DEBRIS

For the group of Debris, representing 29.3% of the collection, we take into account completely integer items of a size smaller than 12mm so that a technologic orientation is made possible (this measure corresponds to the length of the pieces taken in their technological orientation). 197 of them were identified as components of the RMU.

Considering the small dimensions of the pieces and the large quantity of them, we have analysed them taking into account the size-class, we considered 5 size class using as a reference the total area occupied by a flake. The first and second classes (CL1 & 2) include pieces with total area surface of a size between 0 and 100mm<sup>2</sup>; the third class (CL 3) include pieces with a total area between 100 and 150 mm<sup>2</sup>; the fourth class (CL 4) comprehends pieces between 150 and 200 mm<sup>2</sup> and finally the fifth class (CL 5) include pieces whose area is bigger than 200 mm<sup>2</sup>.

Above it is possible to see the histogram of this subdivision.



**Fig. 29 Histogram of dimensional classes of debris**

Most of these pieces are very small in size; they are in fact part of the first and of the second dimensional classes.

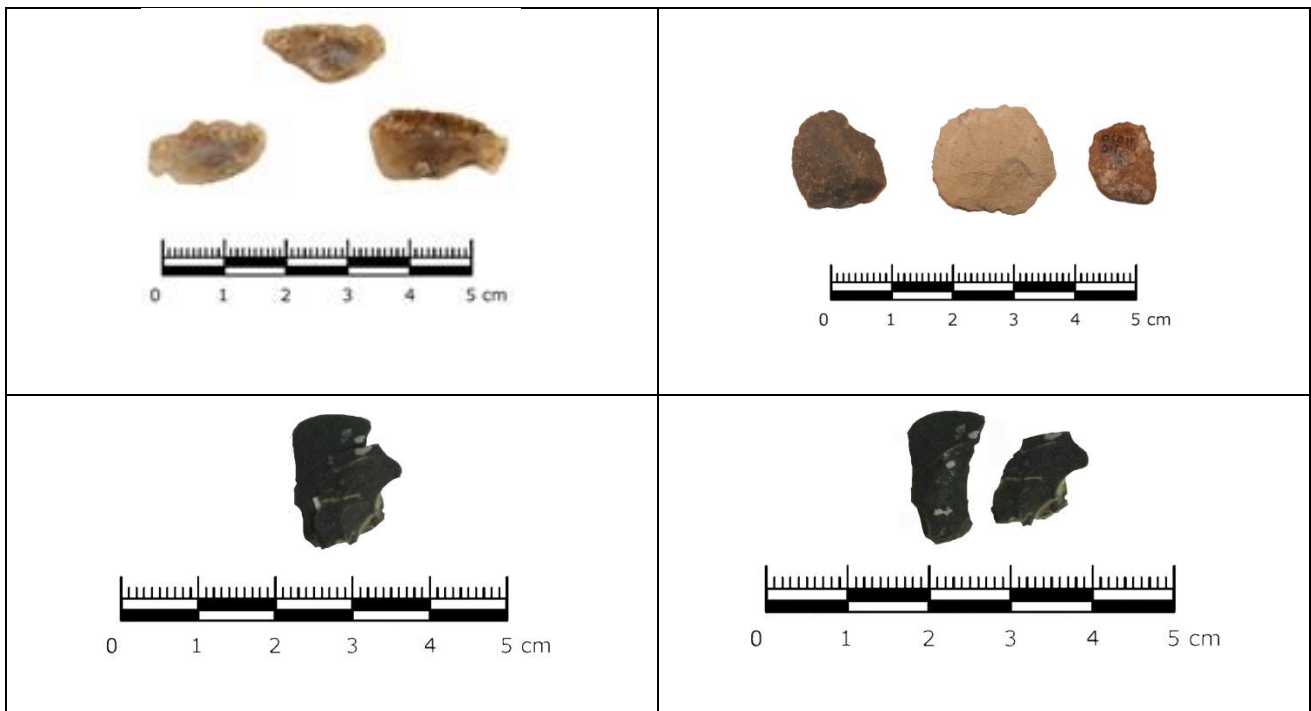
Most of these materials of such a small size have been found in sieves, hence the importance of the methodology of excavation in order not to miss any information needed for the reconstruction of the *chaîne opératoire*. As a matter of facts, the presence of such a large number of small fragments and debris in a deposit that measures only 10 cm in thickness indicate a *débitage* occurred in the site. This finding is also corroborated by the high presence of refittings.

The division according with the technological categories to which the pieces belong are set out below:

<b>DEBRIS TECHNOLOGICAL CATEGORIES</b>					
Technological categories	Total	(%)	Technological categories 2	N.	(%)
Flakes	<b>1961</b>	<b>89,0</b>	S/D	<b>1830</b>	<b>83,1</b>
			P/P	<b>131</b>	<b>5,9</b>
Cortical Flakes	<b>234</b>	<b>10,6</b>	S/D	<b>228</b>	<b>10,3</b>
			P/P	<b>6</b>	<b>0,3</b>
Indeterminable	<b>8</b>	<b>0,4</b>	Indet.	<b>8</b>	<b>0,4</b>
<b>Total</b>	<b>2203</b>	<b>100,0</b>		<b>2203</b>	<b>100</b>

**Table 31 Technological categories of Debris**

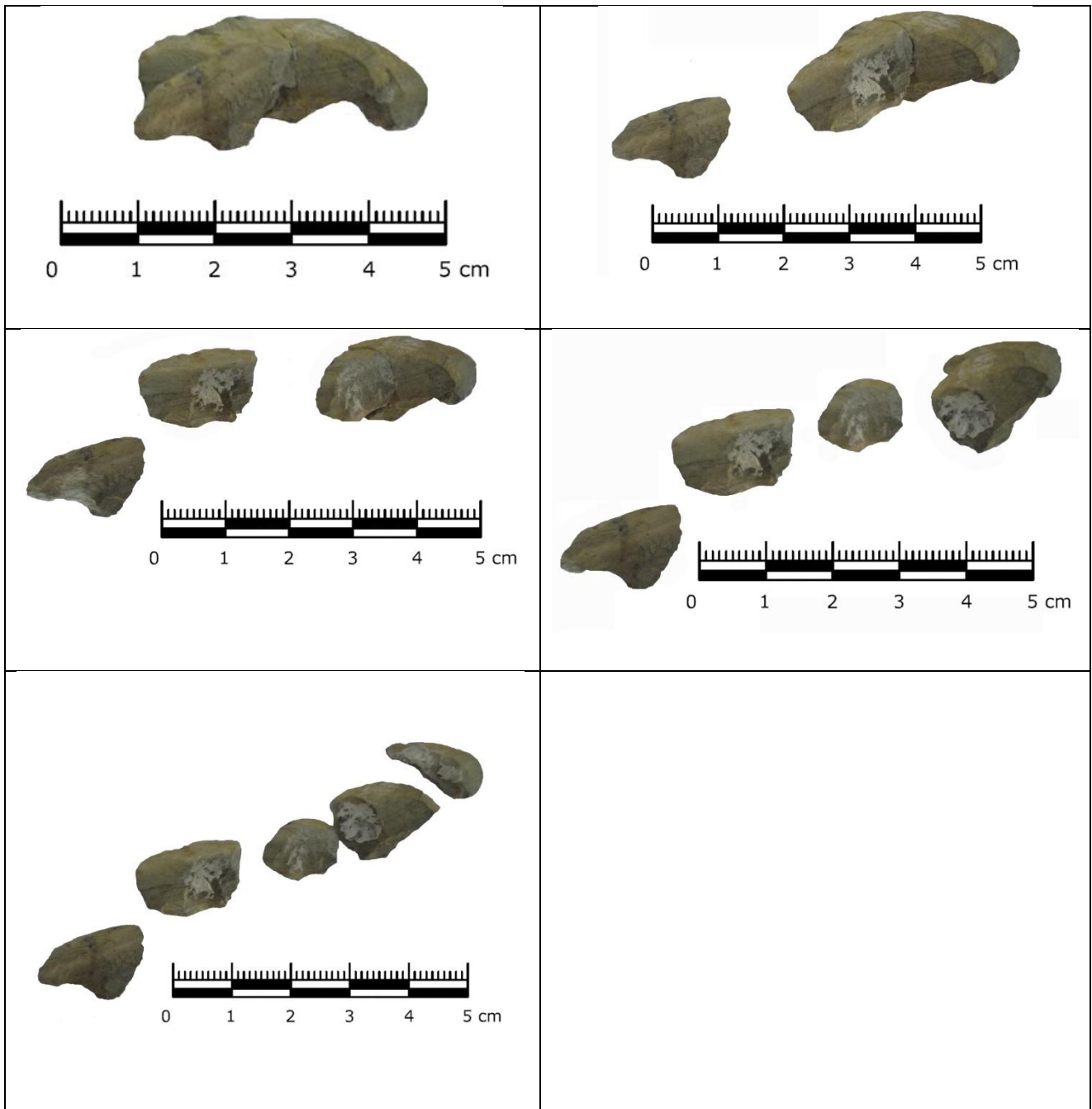
On a total of 2.203 pieces 89% is made of flakes; 83% of which were interpreted as flakes coming from the surface of *débitage* (*s\d*) and nearly 6% comes from the striking platform (*p\p*). Afterwards, it was observed that 10.6% of the total amount of debris has been identified as cortical flakes.



**Fig. 30 Debris: 1. Flake p\p; 2 cortical Flake; 3, 4 Refitting between flake s\d.**

To the flakes coming from S\D (*débitage* surface) belongs abrasion flakes, retouch flakes, parasite flakes separate while flaking and flakes of regulation of the frame of the core. Given that the characters of these small pieces are not very distinguishable they are considered altogether. (Fig.30 3, 4)

To the flakes coming from p\p (striking platform) belongs of course flakes of percussion plan cortical and not cortical. The last usually is easily identifiable because of the van shape morphology and the presence of a little line of cortex in the distal portion. (Fig. 30 1, 2)



**Fig. 31 Refittings: Preparation of a striking platform.**

### 3.4.8 INDETERMINATE ITEMS

The group of indeterminate items represents 50.1% of the collection, this group is made of those elements with an elevated level of fragmentation and also pieces with surface alterations which prevented any technological orientation. This group is mostly made up by tiny fragments that doesn't reach more than 13mm. However, for the study of the RMU, 77 pieces were sorted because

in those was possible to identify the raw materials in line with the parameters used for the study of the RMU.

The presence of such a large number of indeterminate elements is directly linked to the fact that the débitage occurred in the site, indeed during this operation a large amount of pieces are flaking from a single pebble.

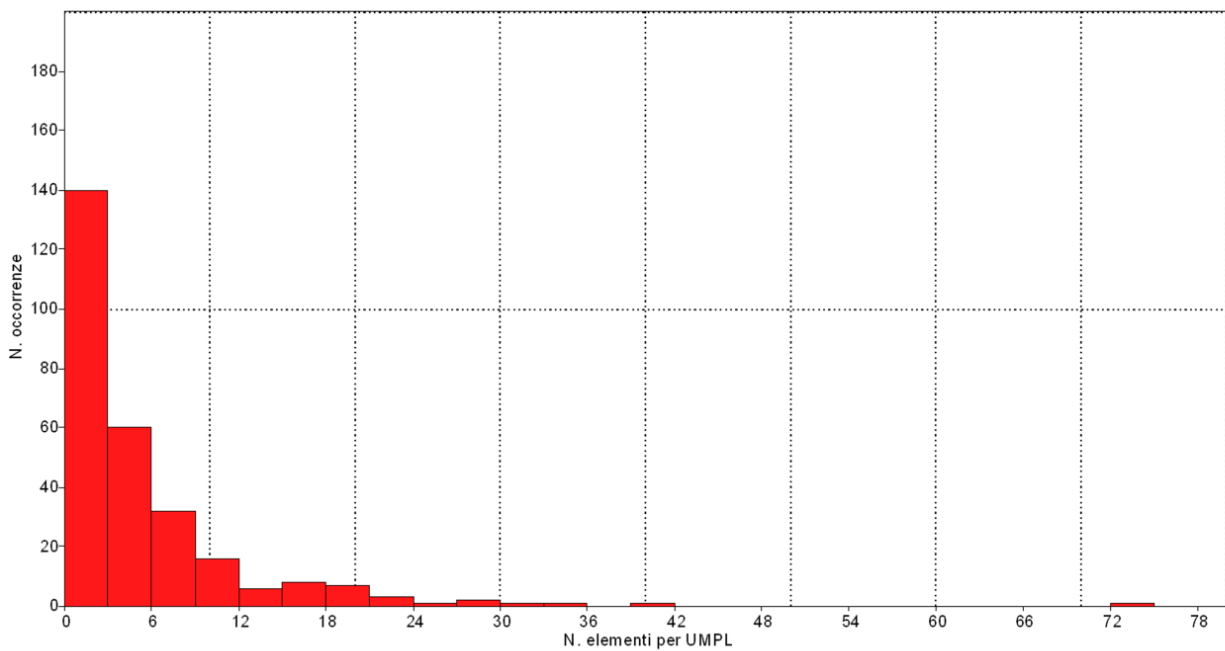
By the way, also post depositional factors can increase the fragmentation of the industry. Also chemical agents such as fire alterations and the high grade of concretion of some pieces invalidate the reading of some support that although their great dimension must be eliminated from the analysis. These pieces, although not considered in the technological analysis, however, give information relating to the dislocation of the phases during the knapping activity, especially from a spatial point of view. Actually in this case they return to be valuable information.

#### 3.4.9 RMU: RAW MATERIAL UNITS

After explaining in a larger grade of magnification the operational chains and the dynamics of flaking identify in the layer we are going to move on to a scale smaller scale that is within individual blocks (single nodule, pebble ).

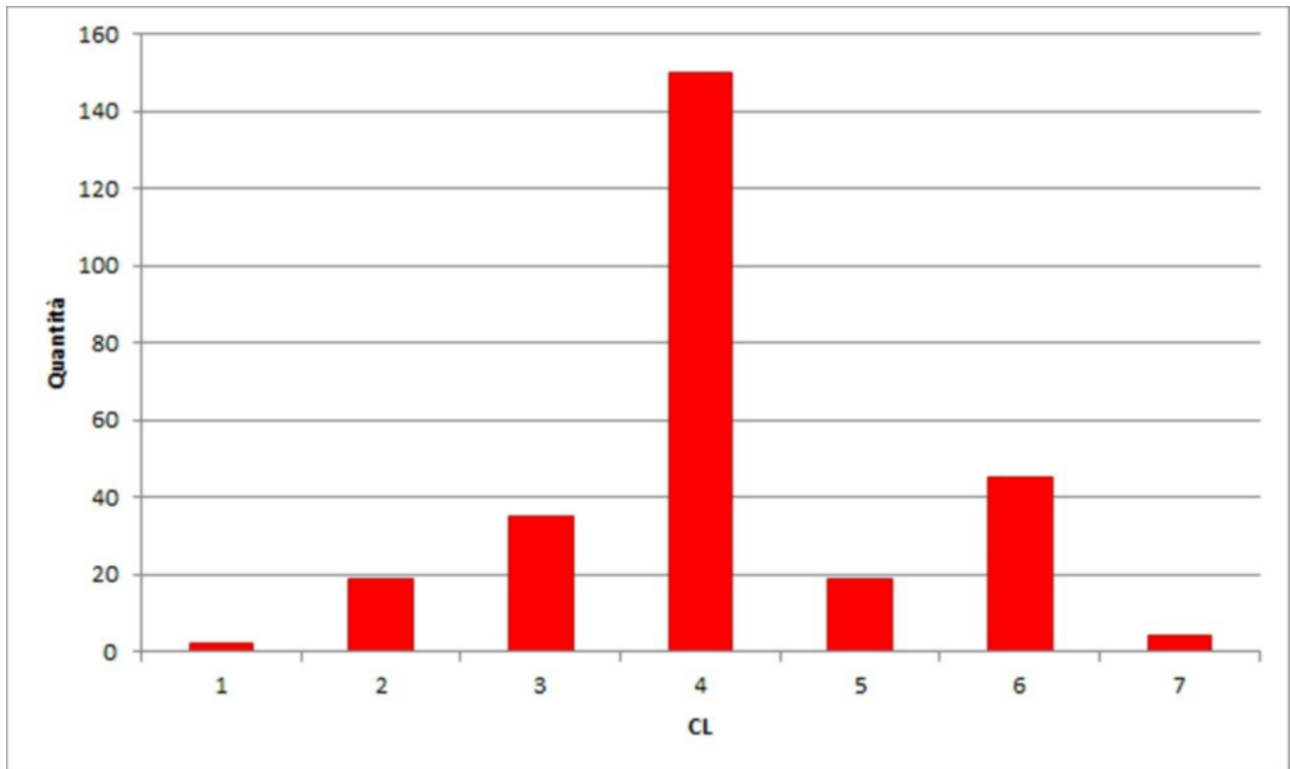
Of 7505 pieces which composed the lithic collection of the layer US 13 of Oscurusciuto site were selected 1487 pieces that make 279 blocks. The presence of these sub-groups permit the detection of 53 refitting set up from 128 pieces.

The follow the chart show the amount of pieces part of each block.



**Fig. 32 Number of elements in block.**

It is clear that a large amount of blocks is composed of a single element or a few pieces. While the blocks arranged by a large number of pieces are few. It is immediate questioning about this relevant presence of block composed by a single element. This is due to several factors, first among everyone the partiality of deposit which original extension has been deeply eroded, then the post-depositional factors comprehending, activities such as water and of animals and roots, which may have moved the pieces. One interesting factor can be the cleanliness of the space, this hypothesis based on the spatial distribution of the blocks will be explained in more detail in the next chapter.



**Fig. 33 Histogram of quantification of the classes of raw material (1: Coarse grained Quartzite; 2: Fine grained Quartzite; 3: Coarse grained Jasper; 4: Fine grained Jasper; 5: Coarse grained Flint; 6: Fine grained Flint; 7: Limestone).**

As was already know by the result of technology analysis, in the layer prevail fine grained raw material in particular jasper and flint.

Given the degree of subjectivity of the analysis we calculated the degree of reliability of the blocks, the result was satisfactory in fact had 50, 2% of the blocks (RMU 140 to be exact) have a high degree of reliability. 30.8 good (86 RMU), and 19% have a low degree of reliability (53 RMU). (For complete profiles of analysis of the blocks refers to the annex )

#### 3.4.10 COMPARATIVE ANALYSIS TECHNOLOGY AND RMU

The presence of the blocks was indispensable aid in the identification and interpretation of each piece in particular as regards the flake of management whose technical character are not so clearly recognizable as the researched object.

Systematic research and study of refittings and minimum analytical nodule analysis are two approaches of study that using together allow the best outcome for both, in fact to find a large amount of refittings is useful the subdivision of blocks which decreases the set of pieces to reassemble. And vice versa the blocks that contains refitting acquire a higher reliability.

In addition the interpretation of a technological analysis can really benefits of the blocks and refitting as in this way it is allow viewing a larger portion of the operational chain. If the goal of the technological analysis is to understand operational chains through the mental reconstruction of gestures and action of production, refitting and blocks allows narrowing the range of interpretative variables present.

### 3.5 TECHNOLOGICAL COMPOSITION AND *CHAINED OPERATIVE OF THE INDUSTRY OF US 13*

As can be seen on examining the technological data presented above, the lithic assemblage from the layer 13 of Oscursciuto rockshelter shows a variability referable to different conceptual behaviour, related to multiple choices in the management and exploitation of raw material.

Owing to this analysis, we can assume that the whole process took place at the site. In fact all stages of the production are represented in the collection. A more immediate overview of the technological composition of the industry is exemplified in the following table.

<b>Technological composition</b>		
	<b>N.</b>	<b>(%)</b>
<b>Phase 1: ACQUISITION</b>		
Pebbles	8	0,1
<b>Phase 2: PRODUCTION</b>		
<b>2.1 INITIALIZATION AND CORTEX REMOVAL</b>		
Cortical flakes	280	3,7
Semi cortical flakes		
<b>2.2 MANAGEMENT</b>		
Not researched flake	567	7,6
Debris	2203	29,4
Indeterminate flake	291	3,9
<b>2.3 PRODUCTION</b>		
Researched flakes	335	4,5
<b>Phase 3 TRASFORMATION</b>		
Retouched tools	30	0,4
<b>Phase 4: ABANDON</b>		
Cores	33	0,4
Indeterminable items		
Indeterminable	3758	50,1
<b>Total</b>	<b>7505</b>	<b>100,0</b>

Table 32 Technological composition

## PHASE 1 ACQUISITION

This is the starting point of the *chaîne opératoire* and provides us information on the recovery and introduction on the raw material by groups Neanderthals.

At Oscurusciuto level US 13 the raw material is local and probably occurs in the fluvial and marine terrace near the site. Neandertals choose pebbles of various sizes, both small and quite large, though they preferred fine grained material, especially jasper and flint.

## PHASE 2: PRODUCTION

This central phase of the sequence is divided in different sub-phases, according to the techno-morphological characteristics observed on the elements.

### 2.1 INITIALIZATION AND CORTEX REMOVAL

The knapping activity takes place at the site, as revealed by the presence of entame and semi cortical flake, which attests the very early stages of production through the opening of the starting support. Anyway we did not find a great number of these artefacts, probably because here Neandertals used cortex removal cap as blank.

For these early stages of cortex removal is not possible to determine the specific methods of débitage. However in this case it is possible to assume a cortex removal mostly unipolar, thanks the RMU approach that attest the presence of a unipolar Levallois and convergent Levallois in the same block. Moreover some refitting attest that unipolar cortical flakes already have technical character which predetermines the convexity and the guide ribs for next flakes production.

### 2.2 MANAGEMENT

During this phase are all the flakes involved in the management of lateral, proximal and distal convexity, in the preparation of striking platform and in the general management of the core. These flakes have the function to create the technical characters to allow the extractions of predetermined items.

Each method builds the convexity in a different way also adapting to the morphology of the raw material. For this reason there is an extreme variability of the flakes provided in this sub phase and it is not possible to define a generic character for these flakes. However, the presence in the level US 13 of various technology categories of this type indicates that this phase happened in situ.

This data is also corroborated by the presence of high quantity of debris and indeterminate fragmented that constitute the smallest residues of the flaking activity.

### 2.3 PRODUCTION

The main production is obtained by Levallois concept, both unipolar and convergent; the objectives that Neandertal pursue are long flake, long flake with back and convergent flake. Interesting is that Neandertal obtained here the same goals with different methods.

Parallel to this production, is also identified a volumetric manufacture for the production of bladelet.

### PHASE 3: TRASFORMATION

This moment of *chaine operatoire* is really important for the identification and definition of the objectives researched from the Paleolithic craftsmen. The transformation action here is identified in the retouched tool and in the supports intentionally fractured.

Only 30 results to be retouched and this is a minimum number compared to the amount of pieces of the industry. Therefore it is clear that the Neanderthals in this site did not feel the need to retouch the supports, but used the sharp edges directly obtained by débitage.

### PHASE 4: ABANDON

This stage is documented by all lithic assemblage. Within it is recognizable different stages of abandonment; first of all it is possible to consider the category of core as the terminal phase of production. The majority of cores are rather exploited and only some elements are abandoned in the early stages of production.

#### *Chaine operatoire*

The graphical representation of the entire *chaine operatoire* this site is illustrated by the following figure

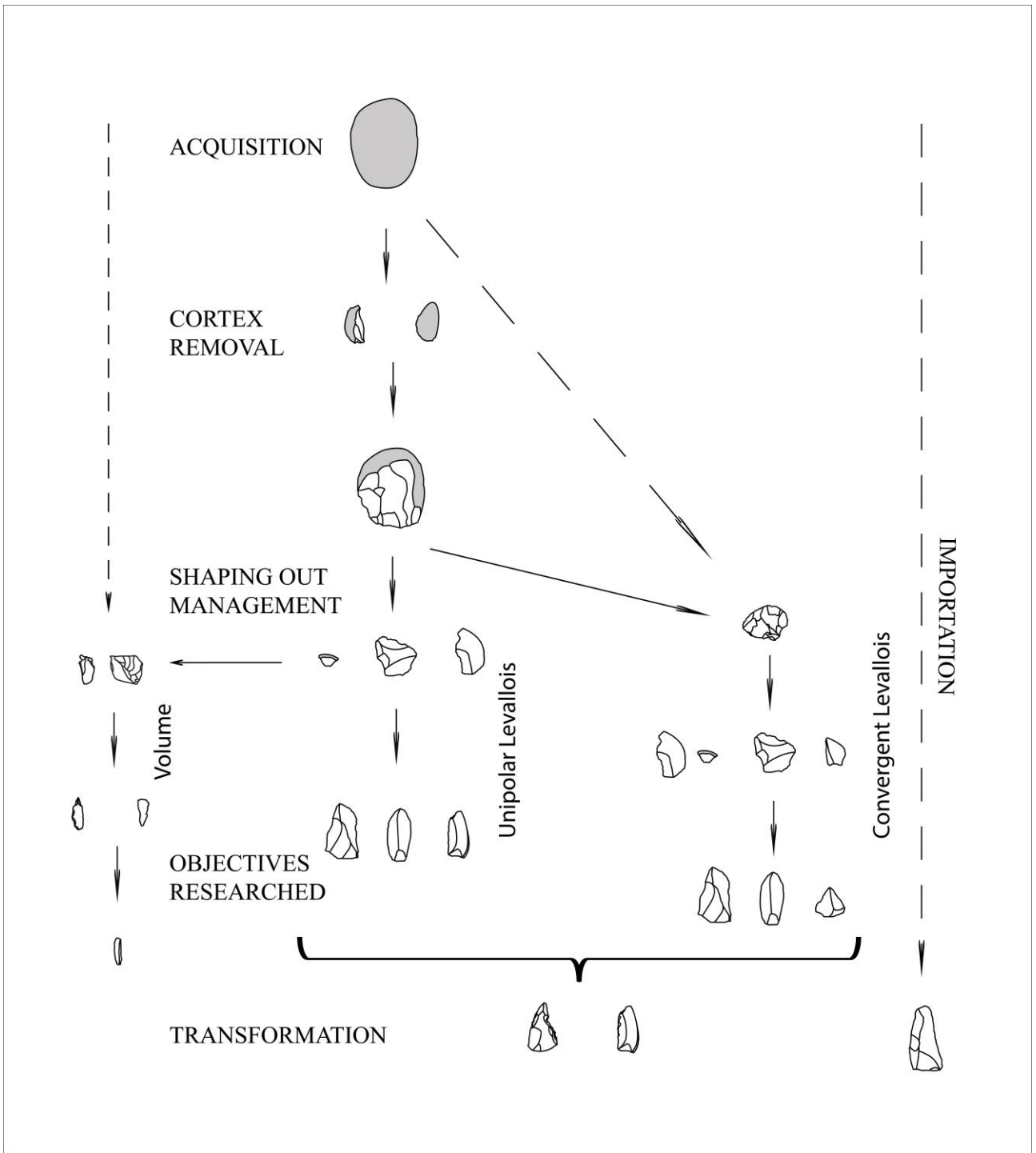


Fig. 34 *Chaine opératoire.*

#### 4. A SKETCH OF THE SPATIAL ANALYSIS

The contribution of spatial analysis can be particularly significant to understand the archaeological contexts. In terms of research objectives, a site such as the Rockshelter Oscurusiuto can be investigated under different analytical scales.

To a large territorial scale (macro-level) it is possible to correlate the site with a series of topographical, geomorphological, paleoenvironmental, paleoecological and paleosettlement studies. Starting from understanding the current landscape and the transformations that it has undergone over time, it is possible to define an approximate model of what could have been the ancient landscape from the geomorphological point of view.

The Knowledge of paleoclimatic conditions of the site, supported by paleoecological analysis (in sediment cores of lakes, soil analyses, palynological analyses, and anthracologic archaeozoological materials from individual Stratigraphic Units) contributes to the reconstruction of what might have been the spatial distribution of landscape units and, consequently, of the types of habitat.

At this point, the analysis of the site within a clearer paleogeographic framework can contribute to the understanding of the settlement strategies, especially in terms of paleoeconomic strategies (subsistence economy and predation strategies, procurement of raw materials). However, if we consider the contexts of these phases, it is much more complicated to understand the settlement framework in a "synchronic" way, because of the obvious impossibility to correlate two sites chronologically.

Some impressive results are derived from micro-level spatial analysis. Within a single Stratigraphic Unit the conceptual model of spatial organization (established) adopted by Neandertals at a particular site at a particular time is indeed more readable especially within particular stratigraphic contexts (paleosurfaces and "small palimpsest" obtained by few "cycles of settlement"). Spatial analysis can provide interesting data, as it has been highlighted in a recent paper by MA thesis of Vincenzo Spagnolo about the study of this US<sup>121</sup>.

Because of its particular features, the US 13 offers the opportunity for investigations at the micro-level aimed at understanding how the space was used inside the rock-shelter. While the amount and localization of the hearths appears incompatible with their synchronic use (highlighting

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<sup>121</sup> SPAGNOLO 2011-2012.

the nature of the palimpsest of this US), on the other hand the systematic repetition of use of the space in the same manner suggests that the formation of the US has taken place within a reasonably short time span.

The results of the spatial analysis showed a clear subdivision of the rockshelter in two sectors, as evidenced both by the alignment of the fire-pits and the density gradient distribution of the finds. In the area between the wall of the shelter and the alignment of the hearths there are no materials. On the other hand the "outside" (between the fire-pits and the erosion surface), is characterized by an abundance of artefacts (lithic and faunal). In detail we observe that, within this range "outside" of the shelter, it is possible to recognize several small areas of concentration of materials, significantly correlated, in terms of space, with fireplaces.

To sum up, in this dual space-distribution it is possible to identify a subdivision of space into "areas of activity" correlated with the fireplaces (hearth-related activity areas) and "rest area" bound between the wall of the shelter and fire-pits.

The areas of activity do not seem the product of specialized activities; on the contrary, they seem multifunctional areas. In addition to knapping in situ, there are not any recognizable evidence related to the processing fauna and the preparation and consumption of animal products. There is also some interesting signs of maintenance of living spaces through more or less systematic cleaning. On the contrary, the materials of the area between the wall of the shelter and the hearths do not reflect the evidence of a use correlated with the above activities. So we can suppose that this space was used as sleeping area.

The results obtained from the micro level spatial analysis are made possible by the application of multiple techniques of statistical display of the space, but also by a multi-analytical approach to the data.

In the specific case of the lithic industry, for example, the technological approach is fundamental to understand the distribution of assets from the spatial perspective, because it allows the recognition of significant accumulations of elements related to technically consistent activities. The high concentration of very small debris into small areas can be correlate to the knapping in situ; the presence of small clusters of retouched elements with possible traces of use could be correlated with the activity of transforming products of organic origin; the concentration of cores and other waste products (often large) on the margins of the areas of activity could be related to preventive maintenance and cleaning of living spaces.

Also the study of the RMU can significantly enrich the cognitive framework defined by the technological approach, not only providing further evidence to the possible interpretations of the technological data, but also highlighting unclear aspects of the behaviour of Neandertals who occupied the site.

The high percentage of RMU composed of very few elements can depend on the incompleteness of the layer (subject to erosion) but we can also put these data in relation with cleaning/maintenance operations (in particular in the case of cores and products waste of the knapping, or importing objects from other sites (especially in the presence of retouched items).

If we consider the RMU with a high number of elements, the spatial analysis highlights pattern of distribution concentrated or dispersed, and allows to "see", in relation to the study of refitting, the "displacement" of the materials in relation to the chronology of the disconnect between the elements. The dispersion of the elements from the same starting block should be greater for blocks knapped at the initial stage of a new cycle of occupation compared to that of the blocks knapped in the last phase of the same cycle of occupation of the site. This would result from a contingent factor very simple: the longer the exposure time of the artefacts over an area inhabited, the higher the degree of dispersion from scuffage.

Here is present an image showing the result of the spatial analysis and the identification of the different activity zone.

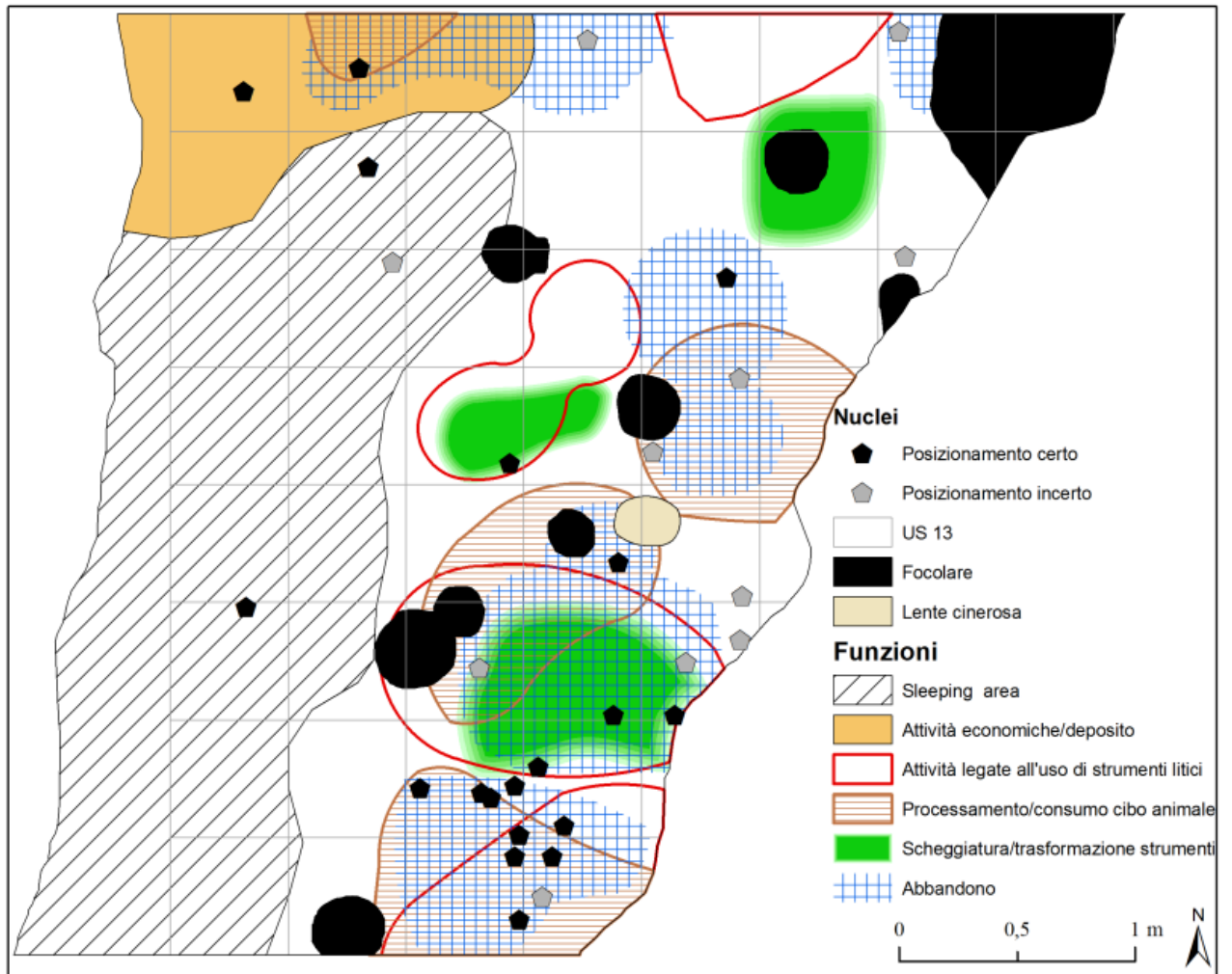


Fig. 35 Distribution of core and the functional areas identified. (Spagnolo 2011-2012)

## 5 COMPARISONS IN THE SITE AND IN THE REGION

### 5.1 OTHER LEVEL OF THE SITE

So far, even though the peculiarity of each level, there is a substantial uniformity in the lithic's manufacturing of Oscurusciuto rockscelter.

In all the studied levels the acquisition of raw material is local, the blank choice for the exploitation are oblong pebbles of jasper, flint and less attested quartzite. Sometimes also cortex removal caps are utilized as a blank.

All the phases of the débitage happened is situ, beside for some retouched tools that probably are imported in the site.

The recurrent Levallois is the most attested concept of débitage . It is present especially in its unipolar modality once the production of elongated supports, both convergent or not.

Secondary there is the volumetric exploitation aims to the production of bladelets.

The lithic materials from the upper levels US 1 and US 4<sup>122</sup> are mainly made by recurrent unipolar Levallois, less represented the bipolar modality. In the final knapping phases the production is converted into a centripetal method. Among the retouched tools scrapers result dominant follow by denticulates and points. The discoid production is slightly present in the US 4 but completely absent in the US 1.

The lithic production of the US 8<sup>123</sup> can also be assimilate to the production of the upper levels (US 1, US 4). The débitage recurrent Levallois is dominant; there is a bladelets volumetric production, and a more generic débitage from surfaces. Almost insignificant are the items from discoid débitage. Among the retouched tools scrapers prevail on denticulate and points are also presents. The researched objectives of the production are long flakes and convergent flakes. Precisely the convergent tools were selected to be analyzed with a techno functional approach in order to understand more about the functionality of those tools and therefore the hunting strategies and habits of Neandertal people that lived in the Oscurusciuto rockshelter. From these studies result that the points seems to be more utilize as multitasking tool then as potential armatures<sup>124</sup>.

As attested in the US 1 and US 4, in the final stage of production the recurrent unipolar Levallois is rearranged for a centripetal modality of a preferential one for the production of flakes.

The lithic materials studied in this thesis so can be assimilated for some aspect to the other layer of the site, in fact the raw material are pebbles of flint, jasper and quartzite; the production unipolar recurrent Levallois is dominant, marginal but still present are the volume débitage and completely absent is the discoid production.

The researched objectives are mainly elongated flakes and convergent ones. The presence of retouched tools it is really marginal, anyway the scrapers prevail among the other types of tools.

A significant difference of the level US 13 from the others is that it is completely absent centripetal modality of Levallois, in the final stages of exploitation of cores the débitage seems to become preferential or convergent.

At the end of this studies we can assert that there are not significant differences from a diachronic point of view in the site. The *chaîne opératoire*, the procurement of raw material and management of the production shows a great grade of similarity during the time.

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<sup>122</sup> RANALDO IN PRESS; BOSCATO 2011.

<sup>123</sup> RONCHITELLI ET AL. 2011.

<sup>124</sup> VILLA ET AL.:2009, RONCHITELLI ET AL. 2011.

## 5.2 THE REGION OF PUGLIA

Once we reach the goal to understand the management of the production of tools in the level US 13, and in the Middle Paleolithic site of Oscurusciuto we are going to compare these with those coming from the other contemporaneous site in the region of Puglia.

The site to which we refer for comparisons is Grotta del Cavallo. This decision is based on two reasons: one is that the stratigraphic sequence of the Grotta del Cavallo is the most important reference for the evolution of the Middle Paleolithic of Puglia; and secondly because there are recent studies of technological approach that offer date similar to those outlined here.

The concepts of débitage individuated at Grotta del Cavallo, levels FIIIe and FIIId<sup>125</sup>, are Levallois and volumetric as well as Oscurusciuto. Anyway the only real similarity between the two sites is that the production is mainly aimed to the realization of elongated supports, in fact for the other aspect two sites follow a different way of management of the débitage.

The levels FIIIe and FIIId are rich in materials that can be consider in the variability of the débitage Levallois. While in the Oscurusciuto the recurrent unipolar method is the most attested, the most represented modality of reduction in Grotta del Cavallo (FIIIe, FIIId) is centripetal Levallois but it is also attested the uni-bipolar Levallois and a slightly reduce presence of convergent ones.

The volume débitage is well attested and aimed to the production of blades in Grotta del Cavallo while at Oscurusciuto the presence of this concept is marginal and in particular in the level US13 it is aimed to the production of bladelets. The production of long flake at Oscurusciuto happened by the unipolar Levallois method, whereas at Grotta del Cavallo the unipolar Levallois produce quadrangular flakes, rarely laminar.

It is well to remember that at Oscurusciuto the natural shape of the raw material (oblong pebbles) may have affected the choice of modality exploitation. Indeed the unipolar modality it is used from the phase of cortex removal. On the other hands the presence of these kind of raw material (rounded oblong pebbles) in the upper layer of Grotta del Cavallo (FIIIa, FII, FI) does not appear to be a conditioning factor, the pebbles are utilized here for a discoid concept.

Regarding the Levallois' *chaîne opératoire* we have a great differences between their management in the two sites. While at the Oscurusciuto it is observable a beginning of exploitation with a unipolar method and the final stages most prepared for a convergent or preferential flake, this

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<sup>125</sup>

situation does not happened at Grotta del Cavallo, where the centripetal and uni-bipolar method seems to not be two different and complete operational chains.

## 6 FINAL CONSIDERATION AND FUTURE PROSPECTIVE

At the end of this study we have come to the following conclusions:

### I. TECHNOLOGICAL\TECHNO-ECONOMICAL GOAL

As regards the description of the technical behaviors through the reconstruction of the *chaîne operative* we understand that the Neandertals group occupying Oscurusciuto rockshelter had surely chosen as supports to be flaked mostly pebbles of fine jasper and flint gained from local sources.

Owing to this analysis, we can assume that the whole process took place at the site. In fact all stages of the production are represented in the collection.

The recurrent Levallois is the most attested concept of débitage in the site. It is present especially in its unipolar modality on the production of elongated supports, both convergent or not. Secondary, we observed volumetric exploitation aims concerning the production of bladelets.

The objectives that Neandertal pursue by Levallois concept are long flakes, long flakes with back and convergent flakes. It is very interesting the fact that Neandertal obtained here the same goals with different methods.

As a matter of fact, long flakes can be produced from convergent and unipolar Levallois. The variability of methods also shows a certain dimensional variability: from rather small supports close to lamellar supports, to rather large artefacts.

The long flakes with back besides being a researched products (predetermined), have also the function of predetermining and re-establishing the right convexity for successive removals

The convergent flakes are researched objective obtained by unipolar and convergent modality.

A secondary production is represented by the volumetric débitage; the objectives researched are little thin bladelet, obtained using the flakes as blank. The presence of some volumetric cores shows that it was utilized for débitage not only the dorsal face of a flake but also the trenchant.

The phase of transformation here is identified in the retouched tool and in the supports intentionally fractured.

By the way, only 30 pieces result to be retouched and this is a minimum number compared to the amount of pieces of the industry. Therefore it is clear that the Neanderthals in this site did not feel the need to retouch the supports, but used the sharp edges directly obtained by débitage.

Among the retouched pieces scrapers prevail.

All this data clearly pointed out the high grade of predetermination and control of the procedure of knapping by Neandertal.

## II. METODOLOGICAL GOAL

From a methodological point of view we tested the applicability of the innovative approach of technological studies and minimum analytical nodule analysis, which has really showed a great potential.

Actually, regarding the identification and the interpretation of each piece we must consider that, if it is part of a block, the interpretation is much easier and more reliable, especially if there are refitting or conjoin in the block.

The level of understanding of the site has become more accurate. It takes into account the analysis of the elements that made up a single unit (RMU). For example, we notice that the two main concepts, Levallois and Volume, coexist in the same block.

The spatial analysis highlights patterns of distribution that consent to have a better understanding of the dynamics of occupation and management of the space by Neandertal population.

## III. CHRONOCULTURAL GOAL

In term of comparison the exploitation of the stone material in the level US 13 of Oscurusciuto rockshelter proves very interesting and we can assert that there are not significant differences from a diachronic point of view in the site. The *chaîne opératoire*, the supplying of raw material and management of the production, indeed, shows a great grade of similarity during the time.

The site Oscurusciuto is fully integrated in the scenery of late Middle Paleolithic in southern Italy with the large predominance of Levallois débitage (as Grotta del Cavallo, Castelcivita<sup>126</sup> in Puglia and Riparo del Poggio <sup>127</sup>situated in the province of Salerno).

On the other hand it maintains a degree of originality probably due to the adaptation of the canons of the Levallois to the local raw materials and to the contingent necessities. It demonstrates thus a great range of versatility and variability of the technical behaviors of human groups during the Middle Paleolithic.

The work is only at its preliminary stages, in fact it is still possible to improve the knowledge about the technical behavior and management of the space.

In particular, it will be interesting a further development of the analysis of distribution of each RMU. We notice that lots of researched pieces show macro traces and will be interesting have more information about the functionality of the site.

For a more general point of view, it could be interesting a further development of this integrated approach not only in this site but also in other archaeological contexts. By the way, it would be interesting to apply this integrated approach also to the level US 15 of the Oscurusciuto rockshelter that is a paleosurface which is currently being excavated.

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<sup>126</sup> GAMBASSINI 1997.

<sup>127</sup> CARAMIA & GAMBASSINI 2006

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