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From the watershed to the Great Adriatic Plain: an investigation on humans and landscape ecology during the late Upper Paleolithic. The significance of lithic technology.

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abstract

Methodology. In chapter 1, METHODOLOGY, the theoretical and methodological frame of reference is outlined. In chapter introduction a rapid *excursus* of the main directions followed by prehistoric hunter-gatherers archaeology is provided, with special reference to the informative potential of the lithic industries. In what follows the main descriptive and interpretive standards adopted in the analysis of the archeological material are provided.

Analysis. Chapters 3, 4 and 5 are devoted to the analysis, description and interpretation of the lithic assemblages of the sites of MADONNA DELL'OSPEDALE, FOSSO MERGAONI and GROTTA DI POZZO. The structure is the same for each chapter. First, a general description of the site is provided (*presentation of the site*), along with its geographic localization, the research activities carried out on it and the chronological and stratigraphic data. The main section of each chapter is represented by the lithic artefacts technological analysis (*lithic production*), whose description follows the theoretical phases of the reduction sequence. Contextually, morpho-technical and morpho-metric data are provided. The conclusive section of each chapter (*synthesis and discussion*) aims to organize data in a synthetic and organic frame, as well as to provide a behavioral interpretation of the circumstances leading to the assemblage formation.

Discussion. Chapter 5, THE EARLY EPIGRAVETTIAN OF THE NORTHERN ADRIATIC FRINGE: DISCUSSION, aims to put data within the frame of the human frequentation of the northern fringe of the Adriatic at the end of the LGM, along the borders of the once exposed Great Adriatic Plain. After a general introduction on the LGM at European scale, the archeological evidence from three study areas is synthesized: central Apennine (Marche and Abruzzi regions), Berici hills (Venetian region) and North-western Balkans (Slovenia, northern Croazia and northern Bosnia).

On the basis of edited data and those from the present work, it has been tried to contribute to the discussion about whether the Great Adriatic Plain could have represented a favorable environment for human groups in conditions of climatic worsening. A possible affirmative answer is advanced, because the supposed borders of such physiographic element bear evidence of contingent brief visits finalized to resource sacquisition, which implies, at least, the existence of some more stable settlement areas, somewhere else. Data about mobility strongly point towards an East-west shifting direction followed by Epigravettian collectors, which suggests an active role of the once exposed Great Adriatic Plain.

riassunto

Metodologia. Dopo aver sinteticamente delineato gli scopi del lavoro e gli strumenti analitici impiegati, nel capitolo 1, METHODOLOGY, si introducono elementi di inquadramento teorico e metodologico. Nell' introduzione al capitolo si propone un rapido *excursus* dei principali orientamenti adottati nell'analisi archeologica di società di cacciatori-raccoglitori preistorici, con particolare riferimento al potenziale informativo delle industrie litiche. In ciò che segue si presentano gli standard descrittivi e interpretativi adottati nella lettura tecnologica del materiale archeologico in oggetto, al fine di fornire gli strumenti necessari per un'interpretazione univoca dei dati e dei risultati presentati.

Analisi. I capitoli 3, 4 e 5 sono dedicati all'analisi, descrizione e interpretazione di altrettanti assemblaggi litici provenienti dai siti di MADONNA DELL'OSPEDALE, FOSSO MERGAONI e GROTTA DI POZZO. La struttura dei capitoli, eccetto variazioni contestuali dovute alle specificità di ogni sito, è la medesima, e consta di una presentazione generale del sito (*presentation of the site)*, della sua localizzazione geografica e delle attività di ricerca che ivi si sono svolte, presentandone al contempo i principali dati stratigrafici e cronologici. La sezione principale di ciascun capitolo è rappresentata dall'analisi tecnologica dei manufatti litici (*lithic production*), la cui descrizione si articola attraverso le fasi teoriche della sequenza di riduzione, la cui scansione fornisce la struttura per la presentazione ordinata delle caratteristiche morfo-tecniche e morfo-metriche delle classi di manufatti di volta in volta coinvolti. La sezione conclusiva di ogni capitolo (*synthesis and discussion*), si propone di riorganizzare i dati sull'industria analizzata in modo organico e sintetico e di fornire un quadro interpretativo comportamentale per la formazione dell'assemblaggio analizzato.

Discussione. Il capitolo 5, THE EARLY LATE UPPER PALEOLITHIC AROUND THE NORTHERN ADRIATIC FRINGE: DISCUSSION, si propone di inserire i dati emersi dall'analisi dei tre assemblaggi litici nel quadro della frequentazione umana del settore settentrionale dell'Adriatico alla fine dell'Ultimo Massimo Glaciale, ai margini dell'allora esposta Grande Pianura Adriatica. Dopo un'introduzione sulle principali problematiche sull'UMG a livello europeo, si propone una sintesi delle evidenze archeologiche note in letteratura per il periodo in esame, riguardanti tre aree studio: l'Appennino centrale (Marche e Abruzzo), i colli Berici (Veneto), e i Balcani nord-occidentali (Slovenia, Croazia e Bosnia settentrionali).

In base ai dati originali, frutto del presente lavoro, e a quelli editi, in merito alla dibattuta questione relativa alla reale possibilità che la Grande Pianura Adriatica potesse fornire un ambiente e risorse adeguate alla frequentazione più o meno stabile di gruppi umani in condizioni di recrudescenza climatica, si propone un'interpretazione in senso affermativo. Le evidenze provenienti dai supposti margini di questo elemento fisiografico scomparso informano di frequentazioni brevi e contingenti, finalizzate al reperimento di risorse, il che presuppone l'esistenza di insediamenti relativamente più stabili altrove. I dati sulla mobilità indicano chiaramente l'esistenza di una direttrice est-ovest, il che suggerisce un ruolo attivo dell'allora esposta Grande Pianura Adriatica.

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“*…e dirò di pietre consumate, di città finite, morte sensazioni,*
racconterò le mie visioni spente di fantasmi e gente lungo le stagioni
e canterò soltanto il tempo… “

Francesco Guccini, “Il tema”

…x mì…

presentation

The main target of this work is to account for sites function and their role within a settlement system in a given area, so the main object of the analysis has been to detect the peculiarities of selected archaeological assemblages focusing on the possible site functional orientation. The archeological record taken into consideration in this work has been analyzed by means of a techno-economic approach applied to the whole *corpus* of material in order to obtain an as much as possible wide and complete idea of the production, consumption and circulation ways the lithic raw materials and the flaking products underwent. Through the analysis of the reduction sequences, carried out evaluating the differential incidence of diagnostic artefacts, and the assessment of the raw materials economy and flaking products economy, it has been tried to catch a glimpse of the role of the sites during the considered time span.

The archaeological framework, is represented by the modalities of human frequentation of the northern Adriatic fringe around the end of the LGM, in particular the topic of whether the Great Adriatic Plain could have represented a favorable environment for human groups in conditions of climatic worsening. The contribution of the present work is represented by the technological analysis of the lithic sets of three early Epigravettian sites of the central Italy Apennine, Fosso Mergaoni and Madonna dell'Ospedale in the Marche region and Grotta di Pozzo in the Abruzzi region, in order to add further elements, to those already acquired and known in literature, useful to reconstruct the settlement system around the currently submegerged plain or, more precisely, account for the important series of convergencies and similiarities linking the East and West sides of the area.

1. METHODOLOGY

1.1. Introduction

Paleolithic human groups dwelled their natural environment following a way of life scanned by the rhythm of the seasons and based on a *corpus* of rules and behaviors as to maintain the equilibrium with the environment, ensure social stability and, ultimately, survive, according to a way of life currently alien to our experience. Cultural devices, which can be seen as the response to the intellectual, social e technical needing of a group, regulated past activities. Together with natural inputs, they produced the material residues that constitute the archaeological deposits. The study of the ways the material enters the archaeological system, or "middle range theory" (RAAB and GOODYEAR 1984), through processes of transformation of the living system (SCHIFFER 1976), witnesses current research considering archeological data as the result of human and natural interaction, trying to infer behavioral indications from specific observed patterns.

Archeological research is interested in how archeological sites articulated, both each other and with the environment. The net of interconnections represents the settlement system, which can be understood through the creation and progressive refinement of theoretical interpretive models (BIETTI 1986). The principal goals of the research in this direction were achieved since the advent of processual archeology, relying on an approach which implies the human adaptation to natural environment as a system made of differentiated interdependent elements. Very simplistic, the basic assumption is that such differentiation is reflected by its material residues and it is expected that archeological sites variability is a reflection of their function in the past living system (BINFORD 1962, 1979; BINFORD 1980; DUNNELL 1984; SHOTT 1986). Research is accordingly carried out according to a twofold perspective (BURKE 2006), shifting from site to region, trying to infer spatial relations within and between sites, and between these and key elements of the landscape (i.e. the distribution of the raw materials), which can be seen as a series of natural constraints within which the variability of human behavior can be analyzed, in an anthropological perspective, relying on modern geology and actualistic studies (KUHN 2004).

At the site level, research relies on a combination of physic, locational and archeological data to interpret site function within a past landscape. The space of the site, which is known thanks to the excavation, allows partial access to an inferred space, which is not known because of the excavation but can be approached thanks to the data issued from its exploration (BRACCO 2004). Modern archeology strongly relies on off-site research (FOLEY 1981) to be as more as possible aware of the actual landscape in which the occupants of the sites settled in. Geographic, geologic and techno-economic research on prehistoric supply/circulation/consumption of lithic raw materials, i.e., is a fertile topic by which to account for human behavior, in particular regarding the settlement system pattern and land use, or to trace long distance connections between different regions.

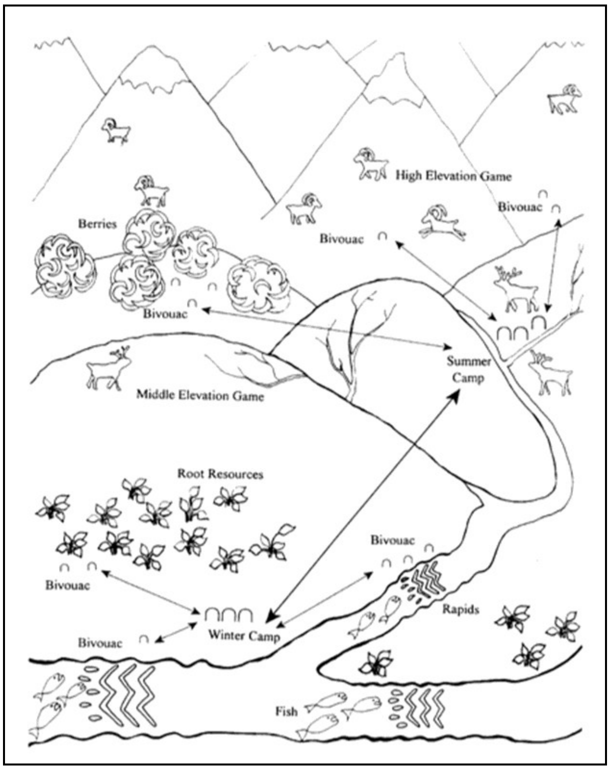


Fig. 1.1 Theoric settlement system pattern (ANDREFSKY 1998)

Except rare exceptions, Paleolithic archaeology deals with severe limitations due to the nature of its record, which is reflected in the progressive refinement of the excavation techniques, the increasingly interdisciplinarity and the application of methodologies drawn from natural sciences. Lithic industries are often the only evidence of the human frequentation of a site. They provide opportunities to partially reconstruct Paleolithic site function and to trace past human technological behavior both in time and space, to create, on a territorial basis, models of peopling, mobility and access to the resources, trying to infer the strategies adopted by prehistoric human groups to accomplish their technological needing. The production, use and maintaining, and the ways these aspects entered the way of life of prehistoric hunter-gatherers, are among the main topics of modern archaeology (MILLIKEN 1998), which relies on both macroscopic and microscopic approaches in order to better answer to the many questions posed by reconstruction of past behavior (ANDREFSKY 1998; MILLIKEN 1998).
Among microscopic approaches, petrography and functional analyses, very different in their methodological bases and research targets, both contribute to approach past human behavior from different perspectives. Functional analyses retain a major role for arguing often unrecognizable complex cultural processes from the artefacts, like the activities performed at a site and how it was used by its occupants (CAHEN, et al. 1979; DONAHUE 1988). The petrographic approach, conversely, accounts for the geographic basin of provenance of the rocks introduced at a specific site on the basis of the mineralogical and micropaleontological content of the lithic artefacts. The studies on mobility find in this approach one of the most fruitful tools, because it provides a spatial dimension to lithic technology.

Studies on provisioning areas constitute the object, since long time, of several specialized works and researches (BINFORD and O'CONNELL 1984; GENESTE 1991; KUHN 2004; TURQ 2000) focused on collecting strategies variability connected with technical tradition, chronology, environment and availability. The aim of such studies is ambitious and points to put in relation humans and environment in an ecological-behavioral perspective (ARZARELLO, et al. 2007). On the basis of generally available data, is often very hard to depict even probable scenarios, considering that the sites and the surrounding environments can currently be substantially different from the time of prehistoric occupation.

Further, the macroscopic perspective, characterized by a comprehensive approach, is targeted to the globality of the lithic assemblages under analysis and guided in its methodological framework by the concepts of reduction sequence, raw materials economy and flaking products economy (JULIEN 1992; PELEGRIN 1995; PELEGRIN, et al. 1988; PERLES 1991; PIGEOT and PHILIPPE 2004). The main goal of the technological analysis should be to reconstruct the choices and strategies, like the selection of the raw material, of the methods and of the techniques, operated by human groups in order to accomplish the needing to provide themselves with a lithic toolkit. The reconstruction of the reduction sequence represents one among the first steps of the technological analysis. It can be conceptualized as a series of extractive actions in charge of a unit of lithic raw material, which, after its procurement, undergoes to a series of culturally conveyed modifications. The identification of the main production objectives represents a second level analytical step, and is carried out by means of the technological analysis of cores, unretouched and retouched blanks, in order to define specific recurrent parameters, like predetermination *criteria*, morpho-metric and morpho-technological features, bearing information about the finalities of the technical processes one is likely to assess.

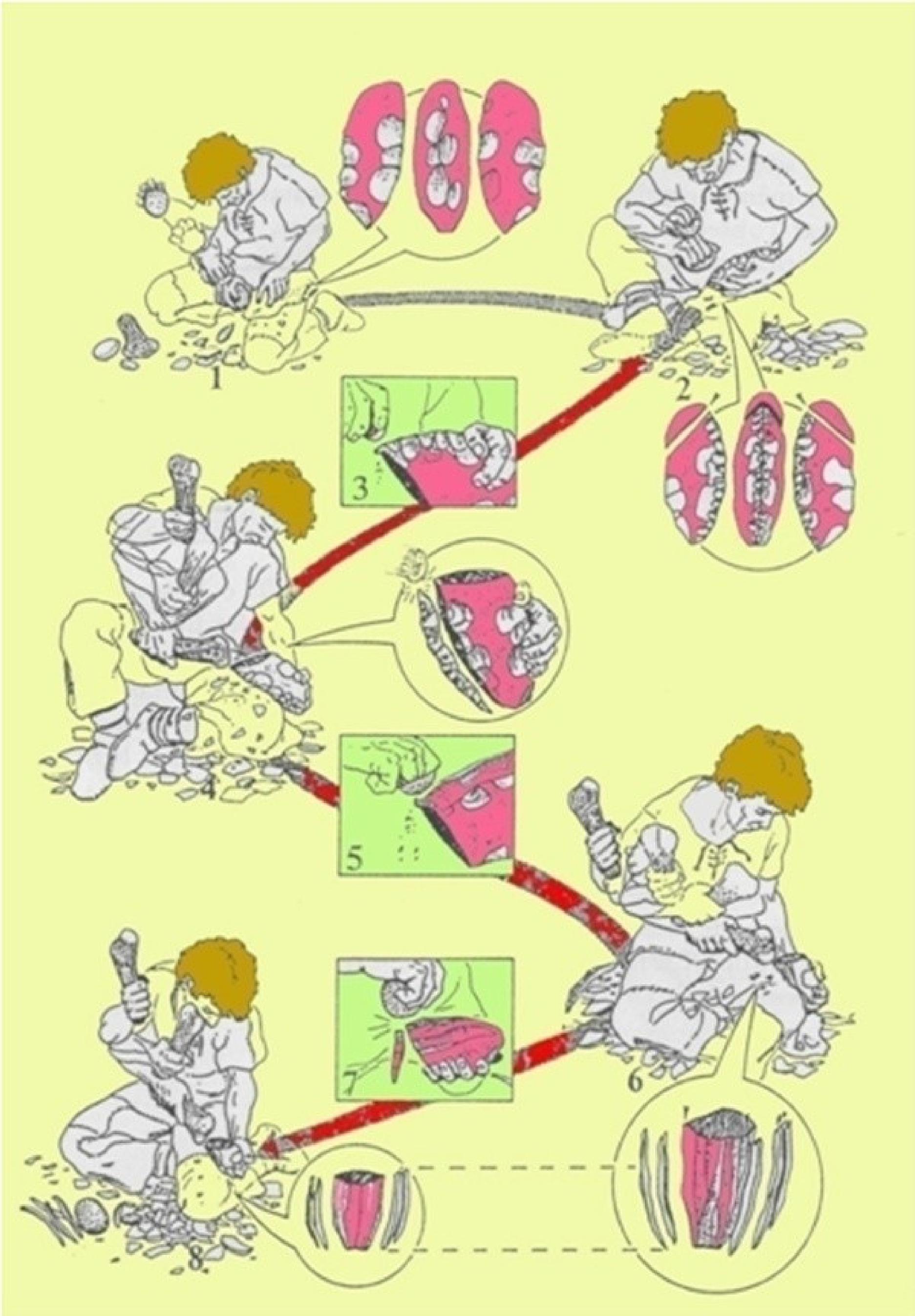


Fig. 1.2: An idealized laminar production sequence (JULIEN 1992)

1.2. Nature of the archeological record and means of data collection

In this chapter the main conventions and *criteria* followed in data collection and interpretation will be clarified. This because of, besides the main conventions and standards adopted by all scholars, there are definitions and *criteria* that often vary from researcher to researcher according to her/his individual thought patterns, as, in example, the placing of certain artefacts along the reduction sequence, the technological significance of some kind of blanks, the typological grouping of the retouched artefacts, etc. The presentation of the techno-economic aspects are subdivided in two major topics: definition of the 1) diagnostic artefacts, informative of the phases of the reduction sequences, and 2) morpho-technical features of the same items. A separate section is dedicated to the typological standards adopted.

Data has been collected by means of a specially predisposed software application database, composed of about 100 different entries, adapted to the specific peculiarities of each assemblage and built in a way to be productively interfaced with a GIS software application, which implemented the study allowing the restitution of the data in the form of thematic maps.

1.3. Scheme of lithic artefacts general classification

Class	Sub-class
Raw/tested blocks	
Ordinary flakes	• *Entame* • Cortical for more than 90% • Partially cortical • Not cortical
Initialization laminar products	• Bilateral crest • Unilateral crest on natural surface • Natural dihedral • Natural convexity
Full production laminar products	• Central semicortical • Central not cortical • Lateral semicortical • Lateral not cortical • *Sous-crête*
Management laminar products	• Neo-crest • Restoration laminar product
Management flakes	• Partial striking platform management flake • Whole striking platform management flake • Fragmented striking platform management flake • Rim product • Management flake from the striking platform • Management flake from an opposite striking platform • Management flake from the back/flank • Management flake from the extraction surface • Opposite striking platform opening flake
Cores and pre-cores	• Pre-core • Initialized pre-core • Core • Reshaped core
Retouched blanks	• Tool • Armature
Transformation diagnostic residues	• Burin spall • Secondary burin spall • Notch adjacent to fracture • Microburin • Krukowsky microburin
Undeterminable items	Undeterminable fragments and chunks, larger than 1,5 or 2,5[2] mm
Debris	Not diagnostic flakes and fragments, Smaller than 1,5 or 2,5[1] mm
Hammerstones/retouchers	

Tab. 1.1: Scheme of general classification

[2] Depending on the assemblage in study

1.4. Definition of the phases of the reduction sequence and pertinent diagnostic artefacts

The reduction sequence is subdivided in theoric discrete phases and subphases, respectively 6 and 15.

1.4.1. Acquisition

Description: the acquisition phase is generally ephemeral and of difficult recognition, but, in some cases, is well identifiable. It consists in the introduction of raw blocks for a delayed processing, at the site or elsewhere.
Diagnostic artefacts: tested blocks, namely, blocks with no or few unpatterned detachments, interpretable as sounding of the raw material suitability.

1.4.2. Shaping

Description: this phase comprises the operations of shaping out the raw blocks in order to arrange the suitable convexities for the laminar production.
Diagnostic artefacts: two classes of artefacts can be attributed to this phase, grouped in two subsets. The first are ordinary flakes, cortical, semicortical or not cortical, direct outcome of the shaping activity, while the second is represented by shaped blocks, initialized or not, predisposed for a delayed use. The matter of whether the latter have been shaped *in situ* or not is a key question, and has to be evaluated case by case. The reason of their inclusion in this phase is due to the fact that they are the product of the shaping out, being the ordinary flakes the by-products testifying its probable occurrence on the site. Another problematic matter is the correct attribution of some ordinary flakes to this phase instead of the management one, in particular when the dorsal scars patterning is not informative of the position of the flake on the core prior to its removal. The question has to be evaluated case by case and, often, it remains unsolved.

1.4.3. Lamino-lamellar production

Sub-phases: initialization, full production, transversal convexity maintenance
Description: the production phase is here considered in a broad sense. The full production starts immediately after the detachment of the crest, or its technological equivalent, and develops until the necessity for some restoration intervention carried out by means of volume reshaping.
Diagnostic artefacts: the blanks considered within this phase are subdivided in 10 different kinds of laminar products, subdivided on the basis of their different technological placing along the disenrollment of the production. The initialization products are represented by crested blades, bifacial or monofacial on natural surface, natural convexities and natural dihedrals. Full production blades are all those specimens showing two sharp sides, here termed "central blades". In this group are comprised the *sous-crête* and subsequent products, both semicortical and not, as well as the "burin spalls", when it can be tentatively argued that they are the outcome of a secondary production on blade or flake. Finally, a class of products termed "lateral" blades, namely debording blades with a natural back, cortical or not, are interpreted as the result of the *in fieri* maintenance of the transversal convexity (*cintrage*).

1.4.4. Management

Sub-phases: extraction surface management by means of laminar detachments, extraction surface, back and sides management by means of flake detachments, striking platform management, changing of the flaking orientation
Description: phase in which the reshaping of the core volume is involved. Is usually carried out removing selected portions of the core that need to be reconfigured because of loss of the necessary parameters (angles, convexities, regularity) to continue the laminar extraction. The recognizable areas of the core that have been reshaped are suggested by the patterning of the rejuvenation flakes dorsal scars and by the type and morphology of the butts. After the analysis of these flakes it has been possible to group such management interventions in four classes, distinguished according to the issued

by-products and in base of the area that has been managed. The first class includes the interventions finalized to the regularization of the extraction surface or the restoration of its longitudinal convexity through laminar removals; the second is the class of management, by flake removals, of the extraction surface, the back and the sides of the core; a third class is formed by the striking platform rejuvenation while the fourth is the core reorienting through changing the extraction direction.

Diagnostic artefacts: the products which carry information about management are both blades and flakes. The reshaping of the extraction surface by means of blade detachments produces two recognizable items: the neo-crests and the restoration blades, the first being blades showing removals which follow and are perpendicular to the longitudinal detachments while the second ones are blades with a very rear point of impact, large butt, sometimes bearing, i.e., strongly hinged scars or a very irregular dorsal face.

The flake products issued by the surface managing can be grouped in four classes, according to the core area from which the flake departed and to the dorsal scars patterning: flakes from the striking platform, from an opposite pole, from the surface or from the flank. In the first two cases, the patterning and features of the dorsal scars are usually mono or bidirectional, showing some kind of flaking accident or, as in the case of the flakes form an opposite pole, the loss of longitudinal convexity (*carénage*). Is frequent the case of lateral flakes extraction from the striking platform with the clear intention to remove a substantial part of the flank in order to manage the transversal convexity. The third class of management flakes are the ones from the extraction surface towards the flank. Their aim is generally the conformation of a neo-crest to manage in this way the loss of longitudinal convexity. The distinctive mark of this kind of flakes is the presence on the butt of laminar scars whose direction is perpendicular to the flaking direction of the flake and parallel to its transversal plane, perpendicular to the flaking direction of the blank. Finally, a set of flakes showing laminar scars on the dorsal face, perpendicular to the flaking direction of the blank, are interpreted as surface management products from the flank aimed to reshape that part of the core probably, during the fashioning of a neo-crest or to remove some kind of accidents like hinging.

The striking platform management is signaled by a series of very distinctive products. The flakes of this class show laminar scars on the butt or on the lateral sides, perpendicular both to the flaking direction and to the transversal plane. They are usually debording and are aimed to remove a more or less substantial part of the core which holds the striking platform. These products are distinguished in three classes: total, partial and fragmented. The total striking platform rejuvenation flakes are those showing an at least latero-distal debording, which signals the precise intention to remove great part of the area subject to reshaping. The partial ones, conversely, are aimed to remove only a small part of the striking platform and should be interpreted as punctual and circumscribed interventions finalized to improve the detachment of few blanks. The third class groups the fragments of such products.

The last group of management diagnostic artefacts is represented by the flakes removed from the side of the core, exploiting its rim as a crest, often producing laminar products, other than flakes, showing on their dorsal face two series of removals perpendicular to the flaking direction. They cannot always be discriminated from crests. These interventions are not related to striking platform management but, rather, with the 90° rotation of the core surface exploitation

1.4.5. Transformation

<u>Description:</u> the transformation phase groups all the blanks that have been modified by retouch or use, and their recognizable by-products. As previously observed, the presence of retouched artefacts doesn't imply their on site manufacture. The attribution to the transformation phase means that they are the product of the retouch, whose spatial and temporal articulation must be evaluated case by case. It can be reasonably argued that some kind of implement has been manufactured on the site in the case of recovery of burin spalls and ordinary and Krukowsky microburins.
<u>Diagnostic artefacts:</u> retouched blanks, retouch by-products, and *a posteriori* tools, or blanks modified by use, like the *pièces esquillée* and *pièces machurée.*

1.4.6. Deactivation of production

Description: interruption of blanks production and abandon of the core after at least one series of blanks extraction and eventual rejuvenation. Several reasons for laminar extraction to stop can occur, not easily identifiable. Among these there are the occurrence of flaking accidents, presence of impurities and natural fracture plans, exhaustion, unsuitability of the potentially available volume to the extraction of specific blanks. The last occurrence is the most difficult to recognize, because of the absence of clear reasons for the abandon. It should be traced back to the whole production system, taking into strict consideration the production objectives and the corresponding reduction sequences.

Diagnostic artefacts: initialized cores, abandoned after at least one removal; cores abandoned after reconfiguration (recycle).

1.5. Main conventions adopted in morpho-technical and morpho-metric data collection

1.5.1. Raw materials and state of entry

The geological attribution of the lithic implements has been traced only in the case of Fosso Mergaoni assemblage. This has been carried out macroscopically on the basis of color, texture, cortex and not formalized micropaleontological observations, supported by the direct experience of the author on the local selciferous formations acquired on the field.

The state of entry of the lithic remains has been determined by cortex presence and amount, the latter distinguished in four classes, from totally cortical (*entame*) to not cortical specimens. The pedological and depositional environment of collection has been recognized on the basis of the morphology and degree of elaboration of the residual natural surfaces, whose morphology is due to the alterations caused by the natural environment where the flint blocks lied after their detachment from the parent rock. These have been subdivided in the following main types: primary calcareous (nodules and slabs); neo-cortex (rounded and sharp edged); neo-cortex associated to calcareous primary cortex; round-edged (rolled) calcareous cortex. The little or not elaborated calcareous cortex has been associated to collection places close to primary outcrops. The others to secondary outcrops like soils, debris, stream beds and fluviatile deposits.

1.5.2. Technique

The determination of the flaking technique has been made according to the suggestions proposed by J. Pelegrin (PELEGRIN 2000) through the combined observation of the following features of the flaking products proximal end: platform morphology, bulb prominence, flaking angle, rim abrasion, presence of a leap, butt/platform *esquillement*.

As regards platforms, these have been classified according to what proposed in (INIZAN, et al. 1999): cortical, flat, dihedral, faceted, *en chapeau de gendarme*, winged, linear, punctiform and *en éperon*. Butts have been only distinguished in prominent and flat. The flaking angles have been grouped in four classes, (1) 50°-70°, (2) 70°-90°, (3) equal to 90° and (4) more than 90°. The abrasion of the rim has been also registered, as was the presence and position of a leap and the *esquillement* of the butt or platform.
The determination of the flaking techniques should be generally advanced after a quite large number of observations and has to be conceived in the light of the whole assemblage. For this reason it has been tried to diagnose it for every piece, or proximal portions, except for the ones with very damaged or absent platform,. Of course there is a degree of under- or over- estimation of the incidence of a technique rather than of another, but the general trends, if measured over large numbers, should lead to correct interpretations.

The flaking technique indentified in the examined assemblages is direct percussion carried out by means of hard stone, soft stone and organic hammer. The hard hammer direct percussion is generally identifiable by: wide, cortical, flat or prepared platforms, a well delineated point of impact, developed fracture waves, flaking angles around 90° and relatively prominent bulbs. The considered diagnostic features of the soft stone direct percussion are: relatively thin butts, even linear or punctiform, abrasion of the rim, not much developed bulb, frequent *esquillement* of the butt or the bulb, flaking angle between 70° and 90°. Finally, the features considered as representative of the direct percussion by organic hammer are: thin prepared or not prepared butts, generally linear or punctiform, abrasion of the rim, flat bulbs, flaking angle comprised between 50° and 70°, frequent presence of a leap.

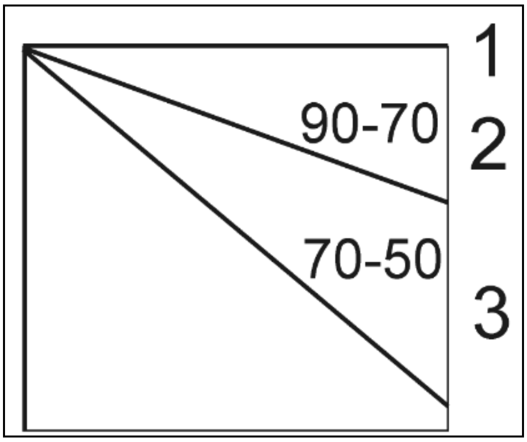


Fig. 1.3: Flaking angle classes

1.5.3. Morpho-technical features of the laminar products

Regularity: it is the only qualitative parameter taken into consideration, to a little extent subject to the personal judgment of the observer. Have been considered regular products all those pieces that can be argued to have achieved the predetermination and standardization intentions: laminar products showing parallel or regularly converging edges, straight or regularly curved profiles, not or slightly hinged or plunged. Other pieces which, while clearly showing a predetermination intention like rim abrasion, prepared butt, triangular or trapezoidal section, are affected by some kind of accidents or aberration like abrupt fracture waves, strong hinging or plunging, not straight or indented edges, very curved profile, have been considered as not regular laminar products.

Morphology: general silhouette of the flaking product, the shape of the distal end and the geometrical relationships between the two edges. The numerous occurrences have been systematized in a limited set of possibilities: entire products or distal fragments with parallel edges and rounded or straight distal end; parallel edges and axial or *déjeté* distal convergence; axial or *déjeté* convergent edges; proximal fragment with parallel edges; proximal fragment with convergent edges; mesial fragment with parallel edges; mesial fragment with convergent edges.

Dorsal scars: the fracture direction of the dorsal scars is indicative of the modality the core was exploited only at the moment the product was detached. It has been recognized they can be unidirectional, bidirectional or crossed. The first two cases occur in the case of respectively unipolar or bipolar modalities of extraction while the latter in the case of crests, neo-crests and *sous-crêtes.*

Ventral profile: laminar products ventral profile have been assigned to specific curvature classes (*Fig. 1.4*), confronting them with a series of four curvature ranges defined *a priori*. The classes are not defined in terms of curvature radius or other measure units, but are only intended to give a more objective and visual significance to terms like very low, low, high and very high curvature. The ventral profile has also been generally described as stratight, slitghly plunged straight, curved, plunged and *torse*.

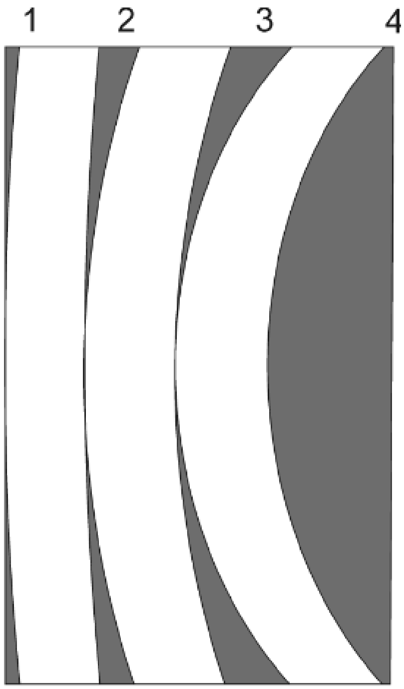


Fig. 1.4: Longitudinal convexity classes

Convexities: the longitudinal and transversal convexities have been evaluated by means of two different procedures. In the case of the longitudinal convexity, the same curvature ranges of the ventral profile evaluation have been employed. In the second one, the angle formed by the more external scars have been compared with a series of six angle ranges (Fig. 1.5), from 0° to 180°, defining in such a way a degree of core *cintrage* at the moment of detachment.

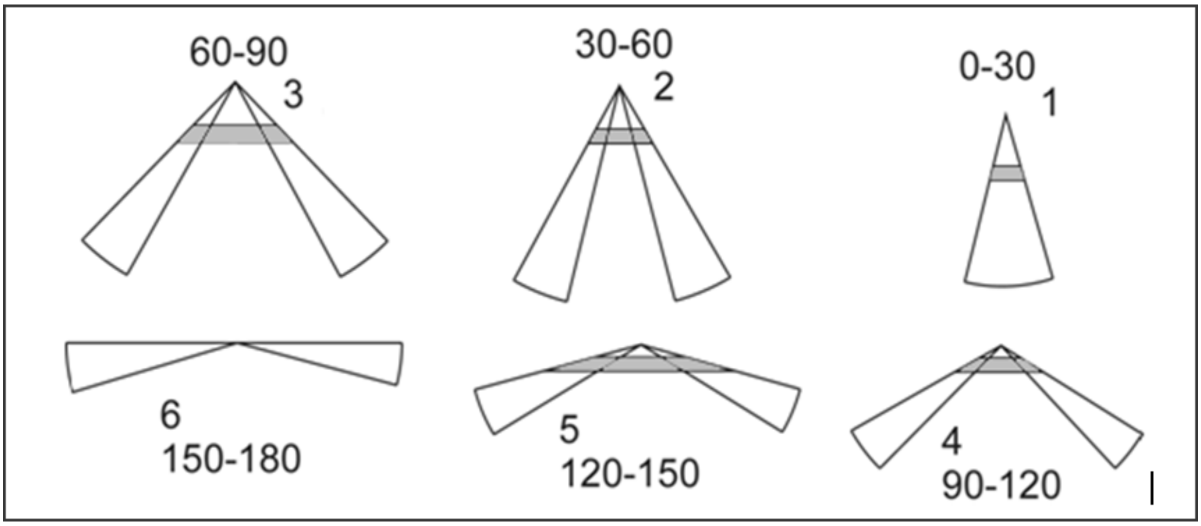


Fig. 1.5 Transversal convexity angular classes

For every laminar piece it has also been registered the means of achievement of the longitudinal convexity. It could have occurred thanks to the natural curvature due to previous detachments, to removals from an opposite pole, to the combination of the two or, finally, to transformation, as in the case of crests and neo-crests.

Section: The section has been assigned to one of six possible occurrences: isosceles or right-angled triangular, trapezoidal or polygonal. The distinction in right-angled or not is to keep separated the central from the lateral products, evidently issued from different areas of the extraction surface and from different flaking intentions.

Accidents: the flaking accidents considered are hinging and the more rare "*Siret* accident". Plunging is also considered among the accidents even if, in some cases, it could have had a precise technological role in the maintaining of the longitudinal convexity. This occurrence is not easy to recognize and for this reason there can be the possibility of misinterpretation of certain plunged products.

1.5.4. Morpho-technical features of cores and pre-cores

Raw blanks: when possible, the nature of the cores and pre-cores raw blanks has been recorded: nodules, slabs, pebbles, gelifracts, blades, flakes. The means of determination is once again based on the morphology of the natural residual surfaces, in the first four cases, and on the presence of a recognizable ventral surface of the blank, blade or flake, subsequently exploited as core.

Reduction sequences and production objectives: a general classification of the reduction sequences the cores underwent has been made according to the nature of the extracted blanks, whose scars are visible on the extraction surfaces. These can be subdivided in blades, bladelets, laminar flakes, flakes and other mixed variants like blades to bladelets etc. Once identified the last readable laminar negatives on the core extraction surfaces, a closer estimate of the laminar blanks calibers has been made taking measures of both width and length.

Convexities: the longitudinal and transversal convexity evaluation has been carried out by comparing them with two different series of four curves each (*Fig. 1.4*, *Fig. 1.6*), defined *a priori*, that, as for laminar products, are intended to give a general visual significance to the classes very straight, straight, curved, very curved. In addition, as for laminar products, the angle formed by the more external residual faces of the last single readable negatives has been measured and classified in one of the six angular classes above defined (*Fig. 1.5*).

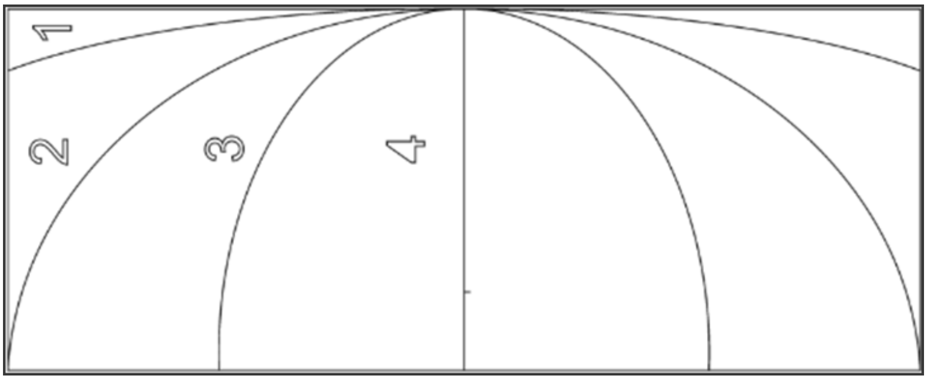


Fig. 1.6: Transversal convexity classes (cores)

When identifiable, the means of achievement and the presence of the two convexities has been recorded, signaling if them occur thanks to the curvature due to previous detachments, to removals from an opposite pole, to the combination of the two or, finally, to transformation, as in the case of crests and neocrests.

Morpho-technique features: even if rarely recognizable, the means of inizialization has been described. This can occur after the detachment of a crest, a natural convexity or dihedral or, finally, in the case of secondary production, removing the edge of a blank (burin spalls).

The recognized extraction progress modalitites are *tournante*, *semi-tournante*, *frontale* and *faciale*, while the number of striking platforms (poles), extraction surfaces and their reciprocal relationships have been conceptualized as follows: one pole and one surface; one pole and two independent surfaces; two opposite poles and one surface; two opposite poles and two independent surfaces; two opposite poles and two partially overlapped surfaces; two crosssed poles and one surface; two crossed poles and two independent surfaces; globular (random proliferation of striking platforms).

The striking platforms have been described as cortical, flat, prepared, rejuvenated and absent, while the flaking angles formed by the striking platform and the extraction surface have been classified as close to 90°, from 90° to 70° and from 70° to 50°.

Finally, flanks and back have been described as prepared or not prepared, without any further indication on the their management ways.

Productivity and abandon: number, regularity and position of the last readable scars within the extraction surface led to an estimate of core productivity and probable reasons of abandon. In particular, in addition to the count of regular, hinged and plunged negatives, it has been tried to determine the position of the last scars, namely, crests or natural convexities, *sous-crêtes*, central and lateral products (both semicortical and not cortical) and neo-crests. As above mentioned, the reasons that led to the deactivation of production and core abandon can be due to natural fracture plans, flaking accidents, not managed convexities, impossibility to perform the extraction of specific blanks from the residual volume and, finally, exhaustion of the potentially available volume.

1.6. Some remarks about typological standards

The typological classification of the retouched blanks (Tab. 1.2) is very simplified, neutral and strongly devoid of references to the classical typological lists in use in Western Europe. The aim of typological classification of the retouched artefacts is in fact essentially that to obtain from the tools and armature typology and relative incidences an, at minimum, indirect evidence of activities conducted at each site.

A primary subdivision consists in two groups, the tools and armatures ones, where the first is composed of retouched blades and flakes while the second of bladelets. This subdivision is obviously not only blank-based by the moment it mainly reflects a theoretical separation between processing and extractive (hunting) implements. Within each of the two major groups, a distinction is made in a series of macro-classes, very roughly grouped according to the *types primaries* of Laplace's *typologie analytique* or the types of the "Bordeaux school" typological classification (BIETTI 1976-1977; DE SONNEVILLE-BORDES and PERROT 1953-56; LAPLACE 1964).

The following typological schemes are based on the most common types effectively found among the analyzed assemblages. Some specimens, whose occurrence is very rare or equal to one, will be added and illustrated within each specific chapter. While it seems useless to provide a strict description of each typological class, it's on the other hand worth to give some remarks and clarify some definitions.

<u>Tools:</u> end-scrapers, burins, becs and *pièce esquillées* are defined by the retouch features only, regardless of the blank on which they are made. The other categories are blank-based. Retouched blades and flakes show a continuous retouch on one or both sides, direct or inverse, marginal, simple, flat or scalariform, straight, concave, convexe or sinusoidal. Pointed blades and flakes bear a point formed by all the kinds of retouch above mentioned. Notched blades and flakes show one or more retouched notches randomly organized while denticulated ones show series of at least three retouched

notches regularly arranged. Backed blades and truncated blades and flakes complete the inventory of tools classification.

<u>Armatures:</u> as for tools, only a few remarks will be given about some armature classes. The "fragment of backed armature" class, generally the most common, groups all the backed fragments which doesn't bear any distinctive feature useful to classify them in another specific class. In all the other cases, an attribution has been anyway given, even if in presence of fragmented pieces.

Furthermore, are considered "shouldered armatures" all the entire pointed armatures or proximal fragments with a retouch clearly forming a *cràn*. The technical shouldered pieces are not counted within this class. "Backed points" group all the types of such an implement, as, in example, the *microgravettes* or the partially backed points. "Pointed bladelets" are all the bladelets showing a point realized by means of a non-abrupt retouch. For the retouched, notched and denticulated bladelets, it's valid what above mentioned about tools.

TOOLS	ARMATURES
End-scraper	Fragment of backed armature
Burin	Shouldered armature
Bec	Backed truncated bladelet
Retouched blade	Truncated bladelet
Pointed blade	Backed bladelet
Notched blade	Backed point
Denticulated blade	Pointed bladelet
Truncated blade	Retouched bladelet
Backed blade	Notched bladelet
Retouched flake	Denticulated bladelet
Pointed flake	-
Notched flake	-
Denticulated flake	-
Truncated flake	-
Pièce esquillée	-

Tab. 1.2: Typological classification of the retouched blanks

2. MADONNA DELL'OSPEDALE

2.1. Presentation of the site[3]

2.1.1. Localization

The epigravettian site of Madonna dell'Ospedale lies at 376 m a.s.l. on a terrace of the Rudielle stream (*Fig. 2.1*, *Fig. 2.2*), which originates at the confluence of Rio Làcque and Fosso di Magliana among the Carcatora (771 m.), Civitella (651 m.) and Acuto (820 m.) mounts. These reliefs belong to the Cingoli ridge, a mountain chain (750-800 m.a.s.l.) characterized by wide plateaus among the reliefs, cut by deep streaming valleys oriented SW-NE pointing the Musone and Potenza river basins. The Rudielle cut is V shaped in the inner part of the ridge while is wider in the outer one, where there are wide fluvial terraces on both the hydrographic right and left, gently sloping towards Piano le Sterpare (SILVESTRINI, et al. 2008).

[3] The present chapter is based on analyses carried out by the author during his Ph.D course of study and subsequently published with Mara Silvestrini and Marco Peresani (SILVESTRINI et al. 2008). Most of the text, graphs and tables presented here, except special indication, is drawn and adapted from the personal contribution of the author to the above mentioned paper. Pictures and drawings without source reference are unpublished contributions to the present work.

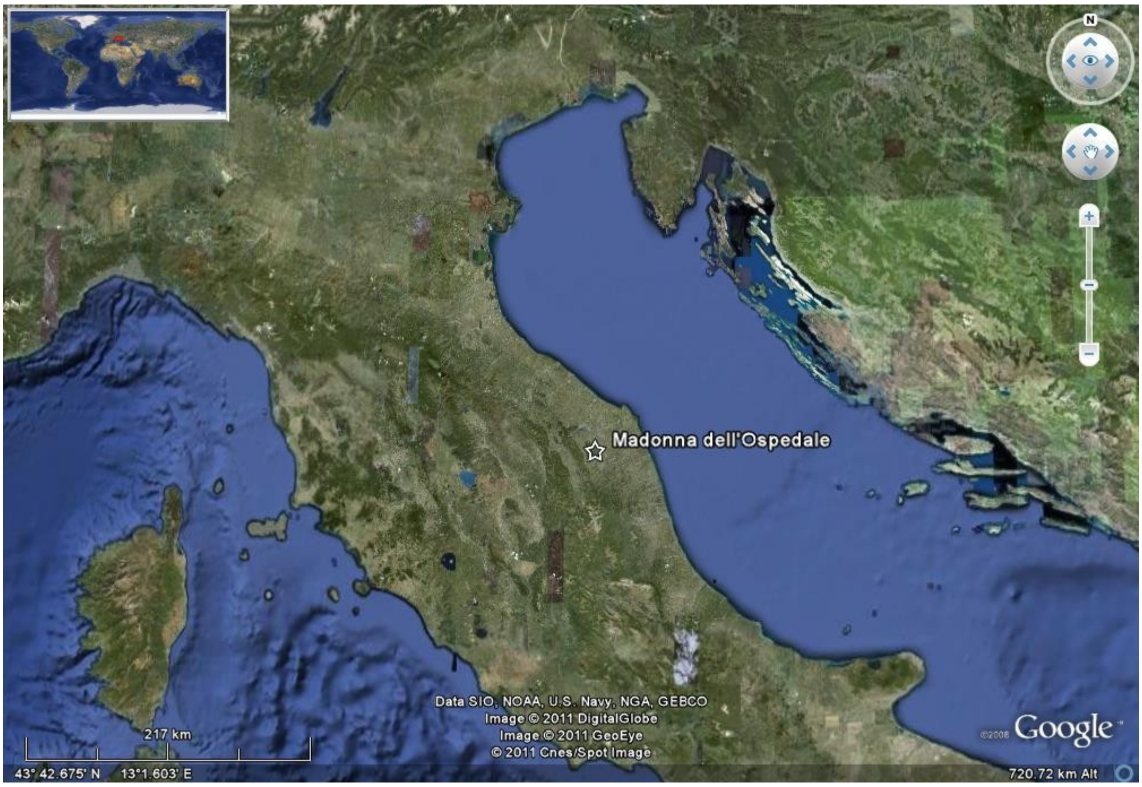


Fig. 2.1: Madonna dell'Ospedale, localization of the site

Fig. 2.2: Madonna dell'Ospedale, localization of the site

Fig. 2.3: Madonna dell'Ospedale, general area

(Courtesy of the Stuperintendence for Archaeological Heritage of the Marche region)

2.1.2. The excavations

Quarry activities carried out in the left terrace, close to the locality called Madonna dell'Ospedale (*Fig. 2.3*) exposed Paleolithic layers attributed to the early Epigravettian because of the presence of shouldered points (SILVESTRINI and PIGNOCCHI 1998). In 1984 a limited test excavation in an undisturbed area of the quarry has been carried out by the Superintendence for Archaeological Heritage of the Marche region, under the direction of Dr. Mara Silvestrini, in order to verify the stratigraphic context and the homogeneity of the findings (SILVESTRINI 1984).

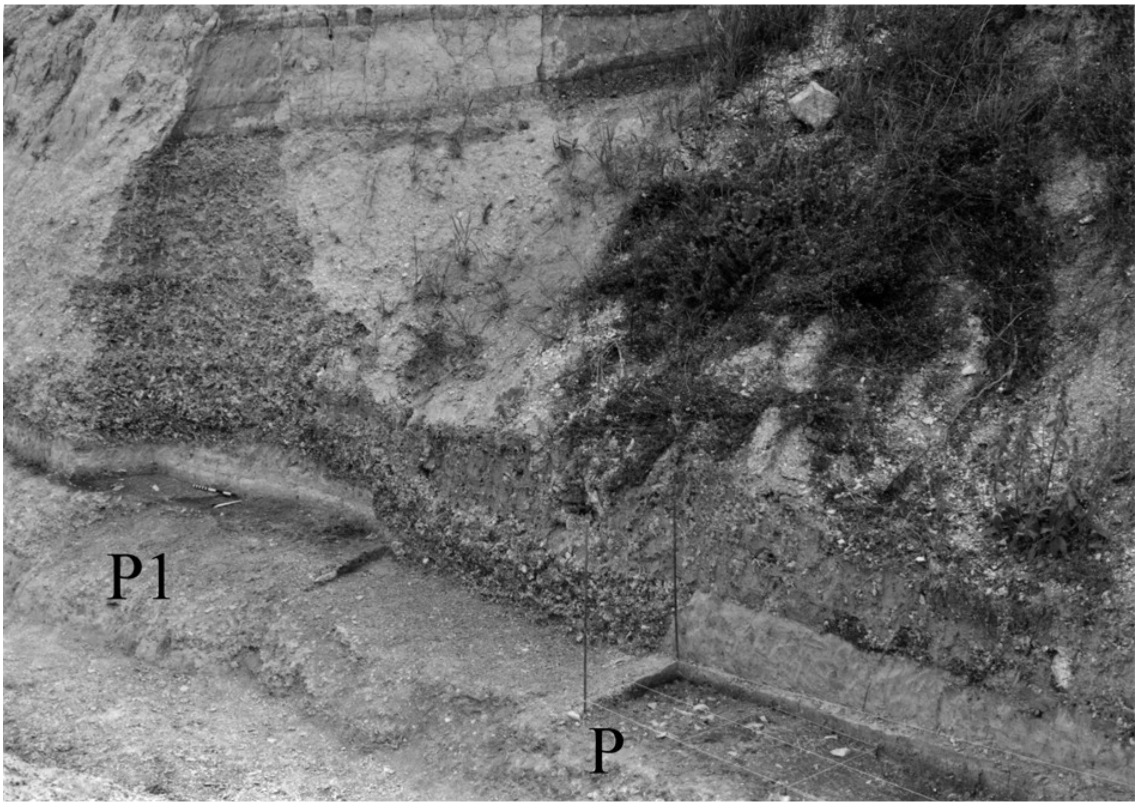


Fig. 2.4: Soundings P and P1, 1984

(Courtesy of the Superintendence for Archaeological Heritage of the Marche region)

The soundings, called P and P1 (

Fig. 2.4), directly set on the quarry face, exposed silty-sandy levels intercalated with massive alluvial gravel deposits.

Sounding P1 returned about twenty artefacts while sounding P, even if of very limited extension (2,5 x 0,5m), returned about 200 artefacts (layers 3 and 4) (*Fig. 2.5*), comprising flaking products, cores, unretouched and retouched blanks. Faunal remains are, conversely, extremely rare and fragmented. Rare charcoals has also been found in layer 4. The spatial distribution pattern, along with the fresh aspect of the surfaces and the recovery of numerous refittings, suggest that the lithic assemblage lied in primary deposition and is homogeneous.

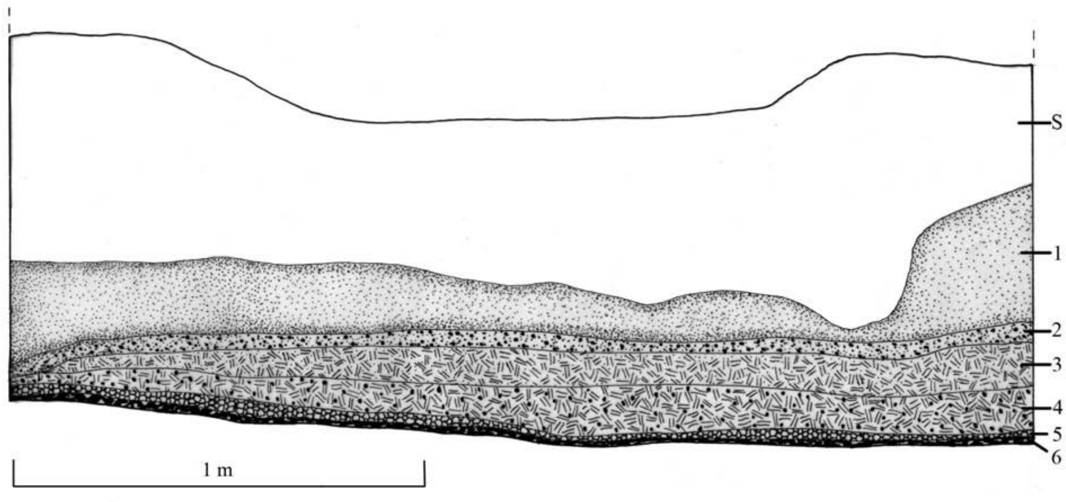


Fig. 2.5: Stratigraphic sequence (SILVESTRINI et al, 2008)

The object of the present work is represented by the analysis of the assemblages coming from both the disturbed and the excavated areas. The aspects relative to raw materials characterization, as their subdivision in Units of Lithic Raw Material, is not evaluated. It can however be mentioned that alluvial deposits and slope debris of the whole area contain abundant selciferous clasts of considerable size and flaking attitude.

2.2. Lithic production: the assemblage recovered out of stratigraphic context

2.2.1. General composition

The assemblage is made of 1.880 artefacts (

Tab. 2.1). Undeterminable artefacts and undifferentiated flakes smaller than 25 mm (n=462) are excluded from the analysis.

2.2.2. Acquisition

The acquisition phase is testified by a single flint block, about 10 cm in size, characterized by sharp edged natural fracture surfaces, collected within loose deposits. It shows a single scar and is interpreted as a flaking suitability test.

2.2.3. Shaping

Shaping phase is represented by two distinct classes of artefacts: undifferentiated flakes and preformed blocks. Preformed blocks, showing series of scars organized to provide them with a suitable shape, are strictly morphologically close to cores. In particular, what is recognizable are crest shaping scars along the major dimension of the blocks, long and wide lateral scars from the supposedly future striking platform and, at least in one case, an incipient conformation of the back. Among the preformed blocks there are some initialized specimens among which any production sequence didn't follow the crest detachment. The morphological features of some of these artefacts suggest a selection of thin flat elongated shapes.

Flakes are mainly semicortical and not cortical. Few *entames* are also present. Cortex macroscopic features reveal the raw blocks to have been collected for about 87% within loose debris deposits while the remaining from alluvial deposits.

Phase	Sub-phase	%	Diagnostic artefacts	N	%
Acquisition (0,1%)	Acquisition	**0,1**	Tested blocks	1	**0,1**
Shaping (30,9%)	Blocks shaping	**30,4**	Totally cortical flakes	24	**1,3**
			Semicortical flakes	158	**8,4**
			Not cortical flakes	389	**20,7**
	Provisioning of shaped blocks for delayed use	**0,5**	Pre-cores	6	**0,3**
			Initialized pre-cores	4	**0,2**
Laminar production (54,4%)	Initialization	**2,0**	Crests	10	**0,5**
			Crests on natural dihedral	20	**1,1**
			Natural dihedrals	7	**0,4**
			Natural convexities	1	**0,1**
	Full production	**46,6**	*Sous-crêtes*	25	**1,3**
			Central, semicrtical	59	**3,1**
			Central, not cortical	792	**42,1**
	Cintrage maintenance	**5,7**	Lateral semicortical laminar products	17	**0,9**
			Lateral, not cortical	91	**4,8**
Management (7,2%)	Convexities and accidents recovery (laminar products)	**2,3**	Neo-crests	30	**1,6**
			Reparation products	14	**0,7**
	Flaking platform management	**2,7**	*Partial* tablettes	25	**1,3**
			Total *tablette*	26	**1,4**
	Change of flaking orientation	**0,1**	Rim products	1	**0,1**
	Flanks, back and extraction surface management	**2,1**	Surface management from striking platform	20	**1,1**
			Surface management from opposite pole	2	**0,1**
			Surface management from the flank	6	**0,3**
			Flank management from the extracion surface	11	**0,6**
Transformation (5,2%)	Tranformation	**5,2**	Retouched blanks	98	**5,2**
Deactivation of production (2,3%)	Deactivation	**2,2**	Cores	42	**2,2**
	Recycle	**0,1**	Reconfigured cores	1	**0,1**
TOT		**100,0**	TOT	1880	**100,0**
Hammerstones	4				
Small flakes and *debris* <25 mm	462				

Tab. 2.1: Technological classes and related reduction phases (assemblage out of stratigraphic context)

2.2.4. Production

Specific laminar classes define the follow production sub-phases: initialization, full production, transversal convexity maintaining.

The production starts with bilateral crests (*Fig. 2.6*, *Fig. 2.8* n. 1-2), natural convexities and single side crests set on natural surfaces. Traces of initialization by means of crest extraction are also sometimes observable on core extraction surfaces.

Fig. 2.6: Crested blade

Full production and maintaining laminar products which follow the initialization show a certain variability, testifying of somewhat complete reduction sequences: *sous-crête*s, semicortical and not cortical lateral products (*Fig. 2.7*, Fig. *2.8*, nn. 3-9). The very most represented class is made of not cortical full production laminar blanks (42,1 % of the total, 792 entire and fragmented specimens), within which some laminar flakes are recognizable (n=20). The latter ones doesn't seem to represent an independent production objective, also for the absence of similar scars on the cores surfaces.

A different series of laminar products testifies how the maintaining of the transversal convexity (centering) was carried out by means of lateral products extractions, both semicortical and not cortical (5,7%).

A sample of 670 unretouched laminar products has been selected for morpho-metric and morpho-technical analyses. These artefacts, which are thought to be highly informative about the main production objectives, have been isolated according to the following parameters: absence of cortex, constant thickness, two sharp edges, parallel or regularly converging sides.

All those artefacts which, even if bearing the same predetermination *criteria*, show some kind of irregularity, are excluded from the analysis, as are plunged and hinged blanks. Width frequencies (Graph 2.1) suggest the existence of at least five dimensional classes, which can be subdivided as shown in (Tab. 2.2). Some difficulties emerge mostly with bladelets, which have a wide variability *spectrum*.

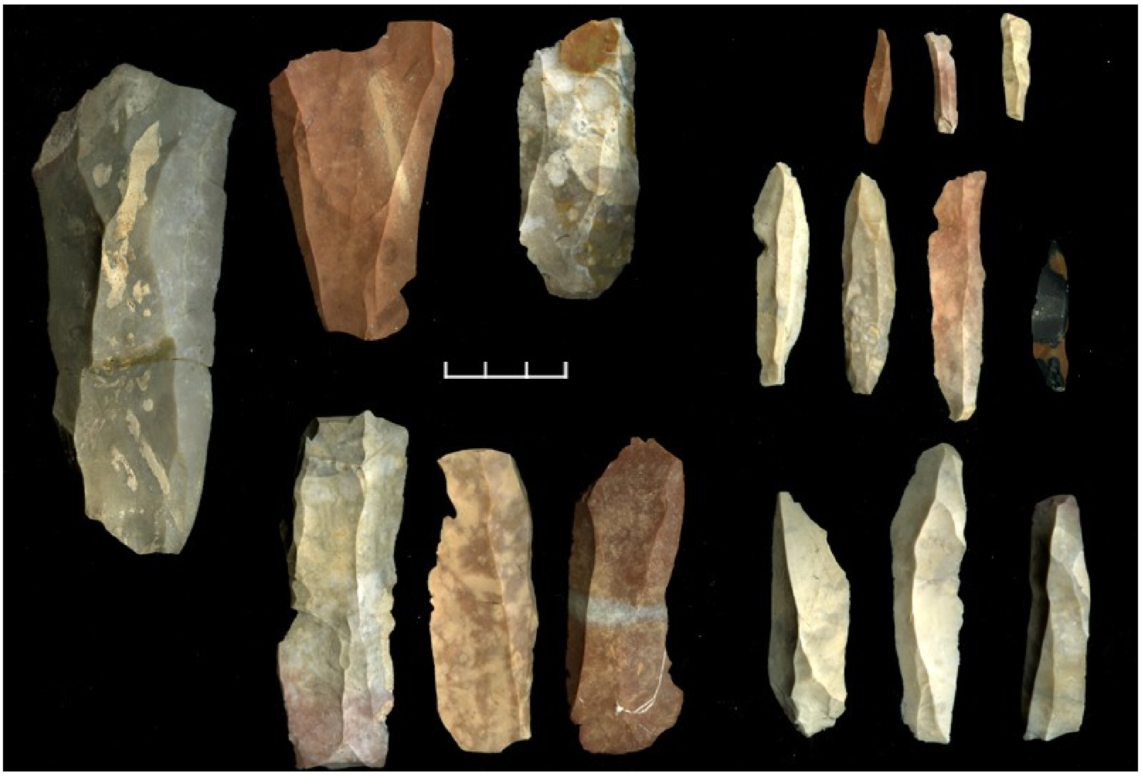
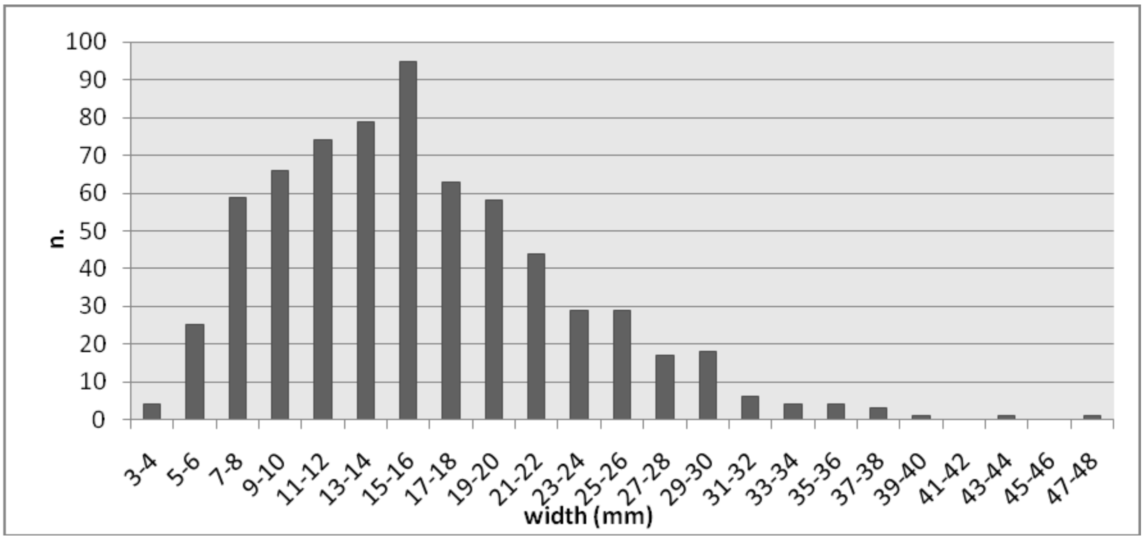


Fig. 2.7: Assemblage out of stratigraphic context, whole spectrum of unretouched central laminar products



Graph 2.1: Width spectrum of central not cortical regular laminar products

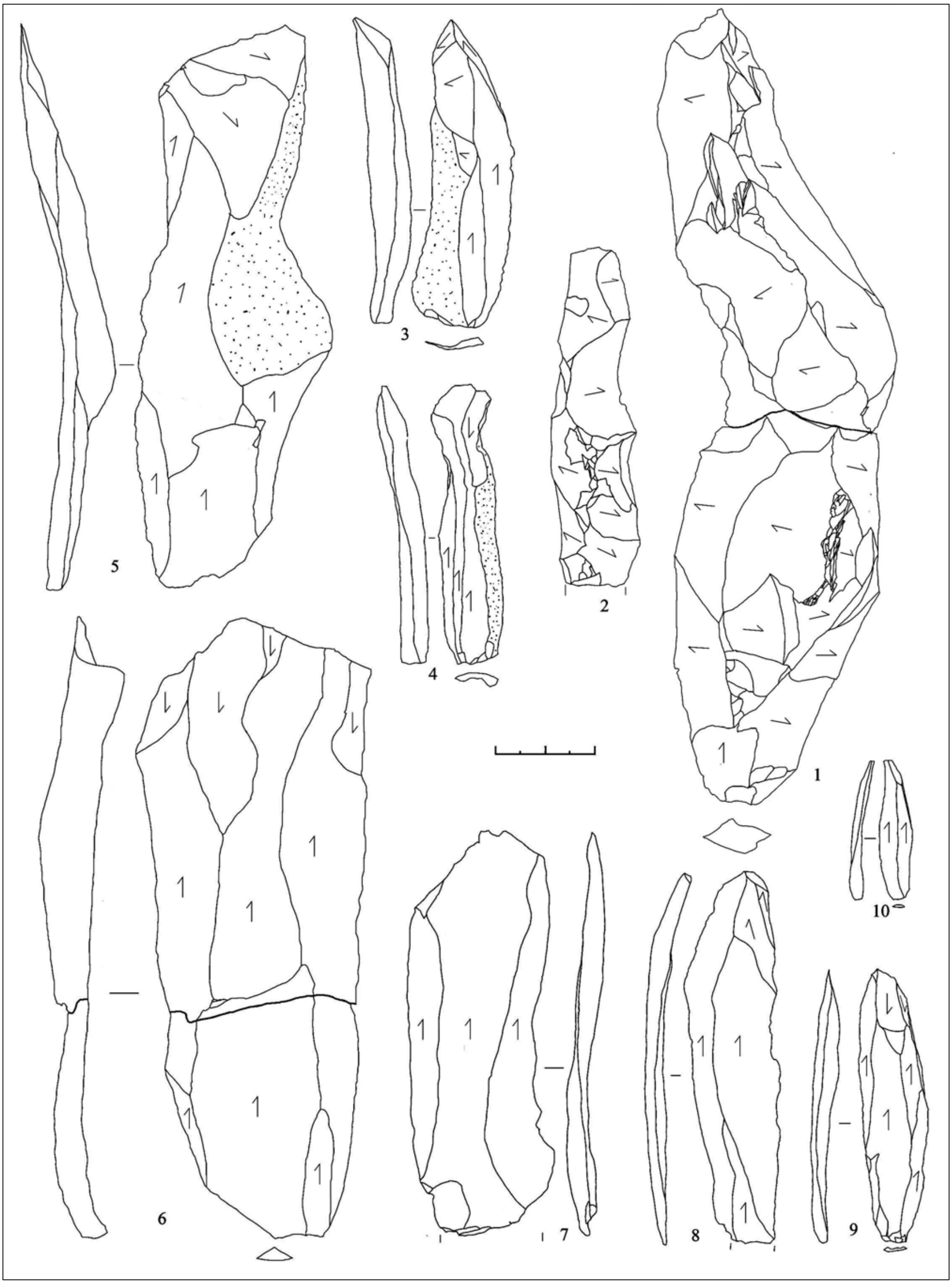
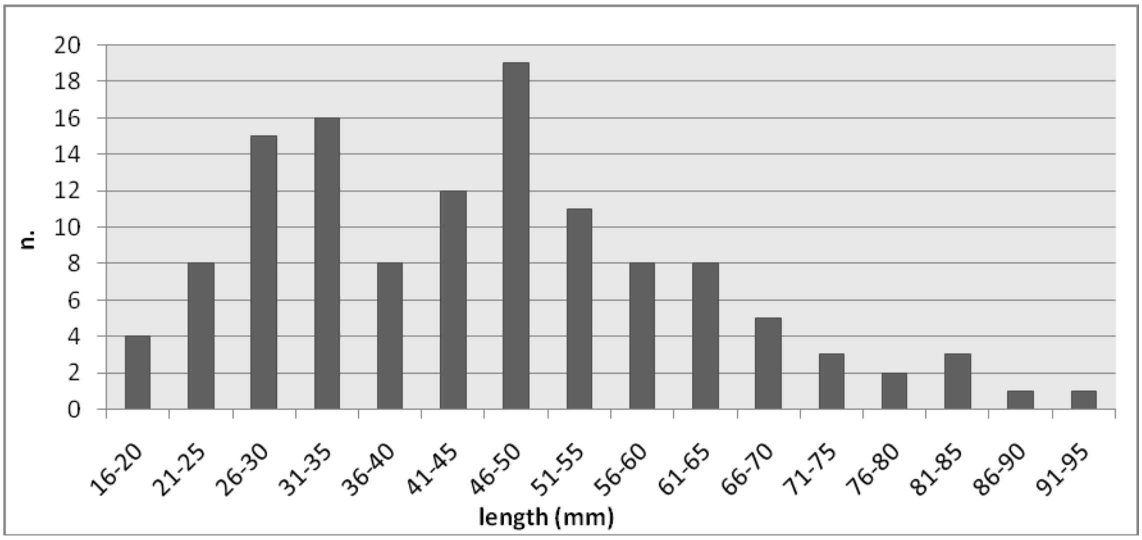


Fig. 2.8: Assemblage out of stratigraphic context: initialization and full production unretouched laminar blanks (SILVESTRINI et al, 2008)

Class	Variability range
A (Microbladelets)	< 7 mm
B (Bladelets and large bladelets)	7 - 16 mm
C (Blades)	17 - 22 mm
D (Large blades)	23 - 30 mm
E (mega blades)	> 30 mm

Tab. 2.2: Laminar products width classes

Length frequencies (Graph 2.2*:*), measured on 124 entire specimens, show the existence of two distinct calibers: the first between 26 and 36 mm; the second between 46 and 50 mm. Maximum length, considering the fragmented specimens also, is 124 mm. Thickness values, principally clustered between 2 and 8 mm, show a slight increase linked to the width increase.

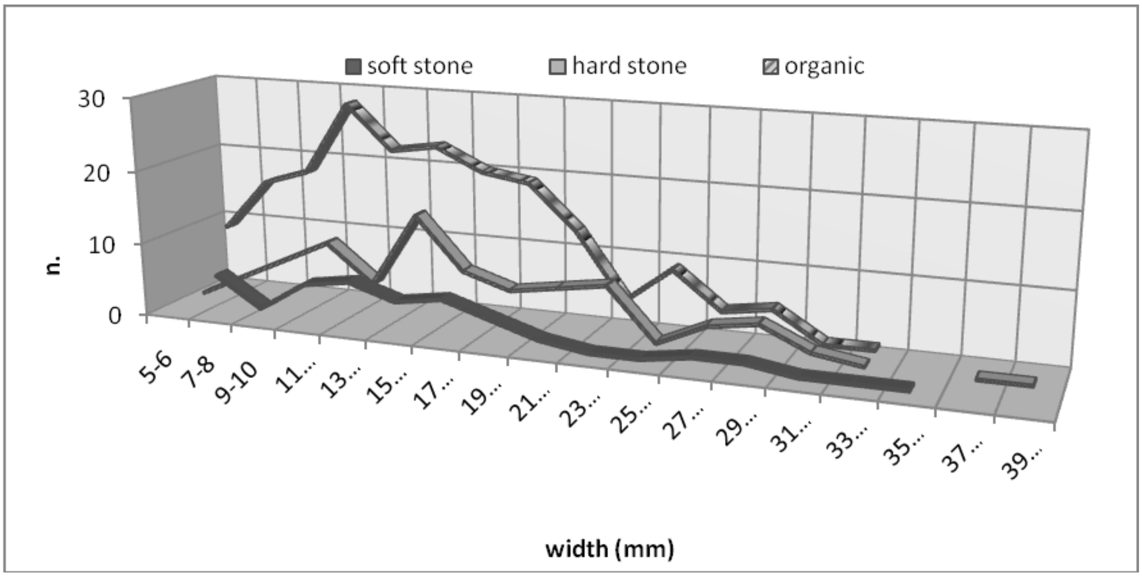


Graph 2.2: Length spectrum of central not cortical regular laminar products

Further, the angle formed by the more external dorsal scars of the blanks have been measured, considering it as an estimate of the transversal convexity present on the core surface prior to the detachment. On the basis of the observations, it is possible to conclude that the most part of the laminar products, showing angles between 60° e 150°, come from quite variable centered surfaces. Comparing products angle and width, it can be however noticed how laminar products larger than 25-26 mm have dorsal angles higher than 90°-100°.

Ventral profiles are generally rectilinear and, in a lesser extent, *torse* or curved. On the basis of the evaluation of the dorsal profile, it can be argued that about half of the specimens come from slightly longitudinally convex cores, while the remaining from rather flat or, on the contrary, highly convex extraction surfaces. Sections are mostly triangular and trapezoidal, in a lesser extent polygonal.

The flaking technique, evaluated on 358 specimens, both entire and proximal fragments, is mostly organic soft hammer direct percussion (*Graph 2.3*). It is signaled by abraded rims, flat bulbs, linear or punctiform platforms, low flaking angles, frequent occurrence of a leap. Hard stone direct percussion, as the soft stone one (PELEGRIN 2000), even if recognizable on a smaller number of specimens, is also used in the process of production of regular predetermined blanks.



Graph 2.3: Flaking technique according to width spectrum of central not cortical regular laminar products

To management interventions can be attributed both laminar products and flakes. Interventions which produced laminar products can be synthesized as follows:

- recovery of the convexity and regularity of the longitudinal profile (*carénage*) by means of the detachment of neo-crests (Fig. 2.9 n. 1). It cannot be excluded that this function could have had accomplished by intentional plunged products.
- Restoration of flaking accidents affecting the extraction surface, both in median position and close to the rim, by means of the removal of steps and other irregularities (Fig. 2.9 n. 5), often by striking a more rear position respect to the rim.

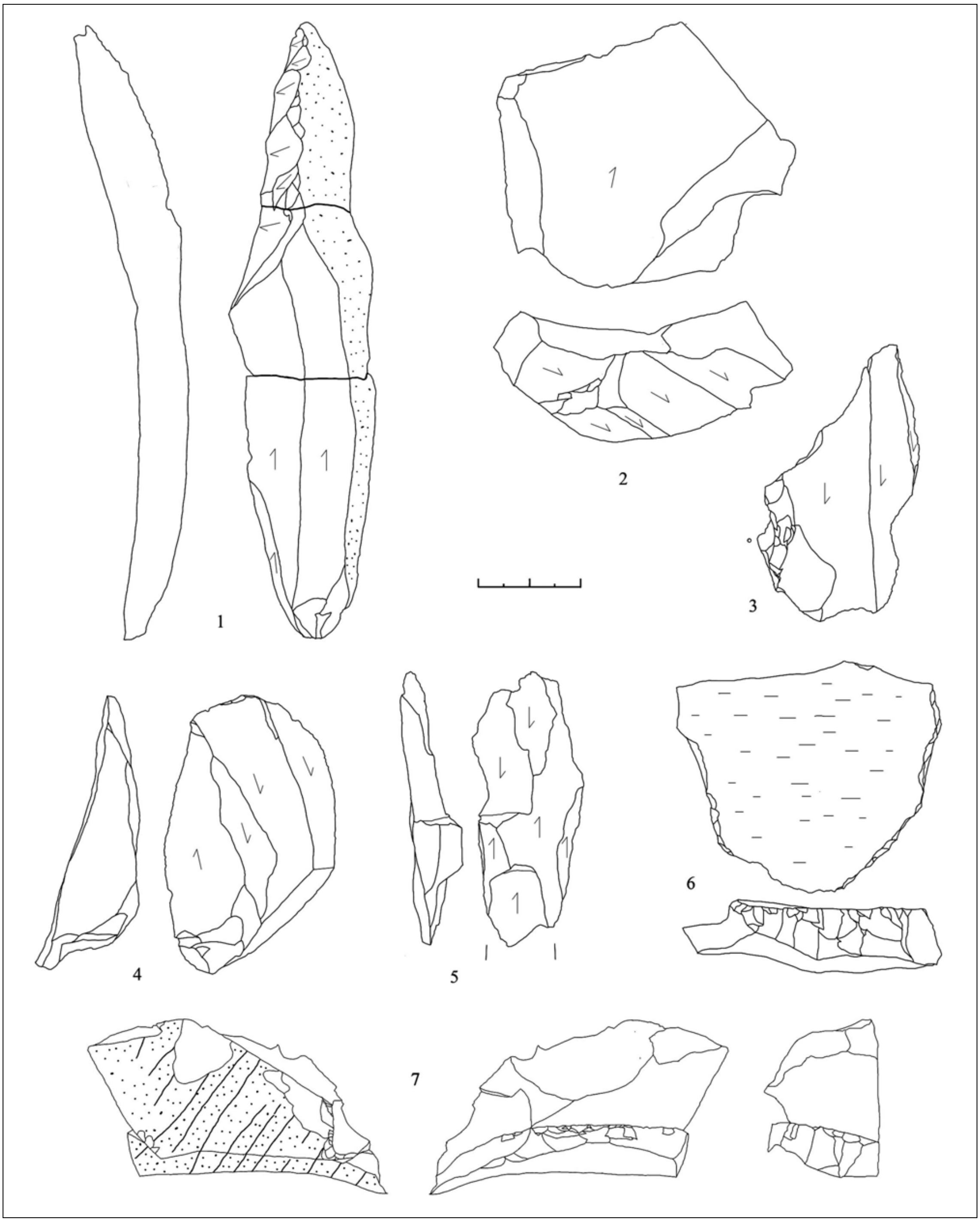


Fig. 2.9: Assemblage out of stratigraphic context, management products (SILVESTRINI et al. 2008)

Flakes deputed to the management and restoration testify of interventions focused on the striking platform, the flanks and the extraction surface by means of the detachment of:

- Partial *tablettes*, issued by localized contingent interventions, finalized to the regularization of a small part of the striking platform
- Total *tablettes*, where the almost total removal of the rim and the striking platform produces lateral debording flakes and, in the case of more radical interventions, latero-distal debording ones, from both the extraction surface and the back (Fig. 2.9n. 6). Among these artefacts it can be signaled a refitting between a flake and a striking platform rejuvenation flake, whose cortical sides bear series of linear engravings, realized prior to the removal of the flakes (Fig. 2.9 n. 7, Fig. *Fig. 2.10*).
- Reparation flakes from the striking platform, aimed to the removal of hinged scars or irregularities form the extraction surface.
- Restoration flakes detached from an opposite accessory pole, finalized to the recovery of the longitudinal convexity (Fig. 2.9. 4);

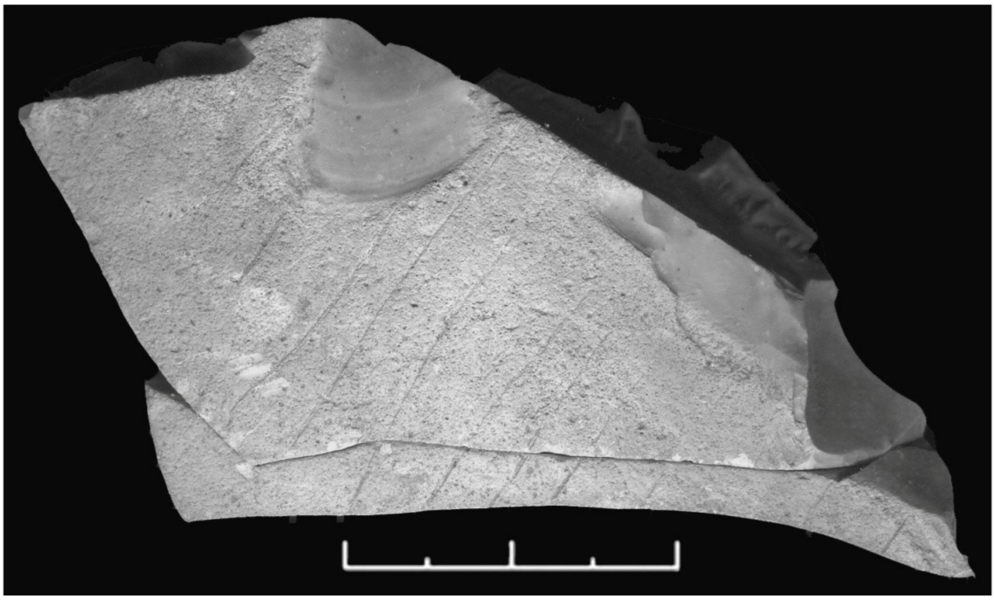


Fig. 2.10: Management flakes showing linear engravings on the cortex

- Flakes from the extraction surface (Fig. 2.9 n. 2) or by the flank/back (Fig. 2.9 n. 3). These flakes, bearing the negatives of one or more laminar scars, respectively on the butt and on the ventral face, perpendicular to the flake extraction direction, are interpreted as the result of interventions of re-shaping of the flanks and of the extraction surface.

2.2.5. Transformation

Type	**N**	**%**
Tools	***67***	***68,37***
Endscrapers	14	14,29
Retouched blades	21	21,43
Truncated blades	5	5,10
Notched blades	8	8,16
Truncated flakes	1	1,02
Bitruncated tools	1	1,02
Becs	1	1,02
Points	2	2,04
Retouched flakes	12	12,24
Notched flakes	2	2,04
Armatures	***31***	***31,63***
Fragments of backed armatures	9	9,18
Truncated bladelets	6	6,12
Retouched bladelets	3	3,06
Notched bladelets	4	4,08
Shouldered armatures	7	7,14
Backed bladelets and *piquant trièdre*	1	1,02
Krukowsky microburins	1	1,02
TOT	**98**	**100,00**

Tab. 2.3: Typological classification of the retouched blanks

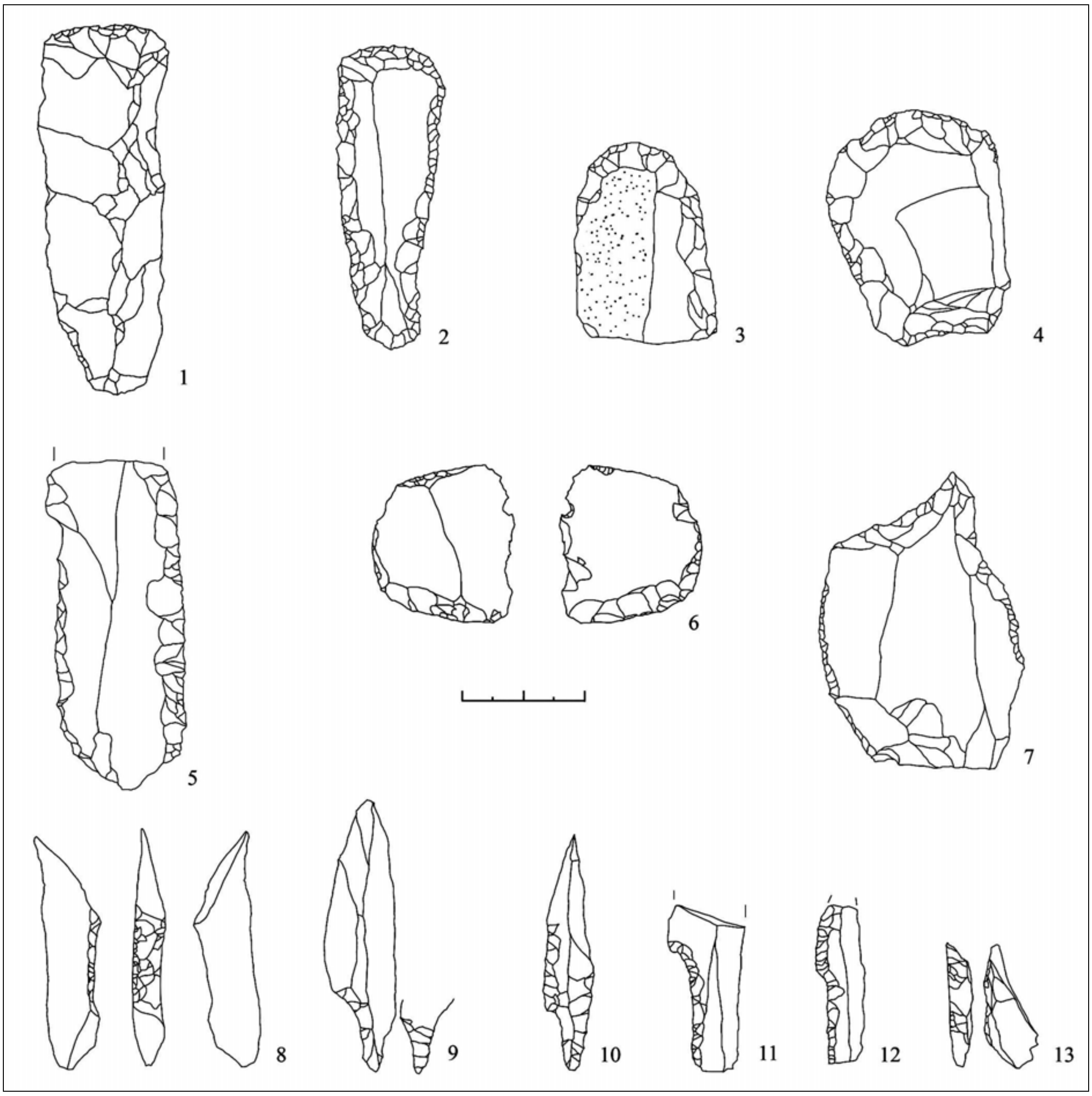


Fig. 2.11: Assemblage out of stratigraphic context, retouched blanks (SILVESTRINI et al. 2008)

2.2.5.1.Blade and flake tools

End-scrapers (Fig. 2.11 n. 1-4), almost all of the frontal type, are mostly on blade rather than on flake. Laminar blanks exploited in the manufacture of such tools are both of full production and initialization.

Retouched blades (*Fig. 2.11* n. 5) show mainly direct simple or scalariform retouch, on one or two sides, often not on the whole length of the blank. Blanks can be both regular or not, sometimes plunged. The specimens with scalariform retouch are, generally, thicker than the others. It is worth notice that in two cases the retouch ends forming a sort of shoulder, but the nature of the blanks prevents to interpret them as armatures in course of manufacture.

Truncations are all on blade except in one case, on flake. They can be oblique or straight. In one case the delineation is concave. It is worth to stress the presence of a bi-truncated specimen, made on a blade, characterized by bifacial invasive retouch on the proximal end and simple direct on the distal one (Fig. 2.11 n. 6).

The only recognized bec (Fig. 2.11 n. 7) is made on a large not cortical blade while the two pointed blanks recovered are on a narrow blade and a flake. The pointed flake is realized by means of convergent retouch while the pointed blade by a partial back on one side only.

A series of notches and scrapers made on undifferentiated and management flakes complete the tools assemblage.

2.2.5.2.<u>Armatures and bladelet artefacts</u>

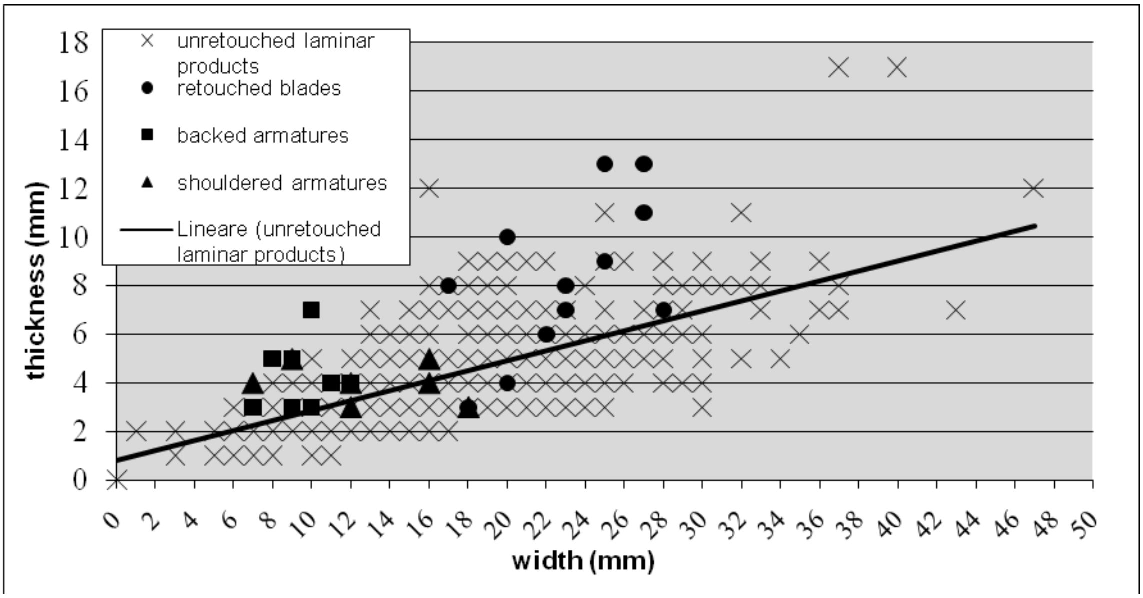
All the armatures are made on regular blanks, not cortical, with straight profile. Among them are firstly present fragmented backed armatures. An entire specimen of backed bladelet shows, at both ends, two *piquant-trièdres*, one of which inverse (Fig. 2.11 n. 8).

While backed truncated bladelets are absent, there are some directly or inversely, mainly obliquely, truncated bladelets. Among the armatures can also be counted some regular bladelets with simple direct retouch.

The only two entire specimens of shouldered points (Fig. 2.11 nn. 9-12, *Fig. 2.12*) show how the points are not shaped by retouch because of naturally pointed blanks. Tangs are extremely narrow and, in one case, show an inverse thinning. As regards the fragmented specimens, in two cases the *cràn* is followed by abrupt retouch on the same side while, in the other two, the sides are unretouched.

Some notched bladelets, interpretable as backed armatures in course of fabrication, and a backed microburin (Krukowsky microburin) (Fig. 2.11 n. 13), complete the armatures and armatures by-products assemblage.

A typometric analysis conducted on three classes of retouched artefacts (retouched blades, backed blades, shouldered armatures) made on regular laminar blanks, show how almost all, even if comprised within the variability *spectrum* of the unretouched blanks, have meaningful distribution patterns (Graph 2.4): shouldered armatures are made on thin bladelets (in one case blade), characterized by high width/thickness ratios (the presence of non-backed specimens make these armatures closely comparable with the unretouched blanks); backed armatures, conversely, are made on thicker blanks. It's worth stressing that the thickness/width ratio is evidently altered by the presence of the back, which affects the original width in substantial way; finally, retouched blades are made on either thin and thick blanks.



Graph 2.4: Distribution of width and thickness values of unretouched laminar products, backed armatures and shouldered armatures

Fig. 2.12: Shouldered armatures

2.2.6. Deactivation of production

The recognition of a deactivation phase, testified by 42 cores, completes the series of observations about the lithic production of the site. The most part of the cores suggests that the abandon occurred for principally independent reasons from reduction degree and processing accidents, because they retain enough material to satisfy the production of further blanks and, as regards accidents, these are generally so limited to be restored by few technical interventions. It results clear, then, how the availability and good quality of flint, easily recoverable in the site surroundings, had a key role in the techno-economic choices of the epigravettian artisans, who, being able to satisfy their productive needing avoiding core iper-exploitation, probably stopped the production once the desired blanks dimensional threshold was reached. Cores are equally distributed between bladelet and blade ones. Evidences of recycling behavior are attested by a blade core which results completely reconfigured and reoriented by means of the creation of two crests in correspondence with the previous poles and, therefore, perpendicular to the laminar scars. This artefact, classifiable as not initialized perform, is set at the end of a reduction sequence and at the beginning of a new one.

Cores are classified (*Fig. 2.13*) first on the basis of the caliber of the laminar scars (blades/bladelets) and, subsequently, of the morpho-technical features (Tab. 2.4). Twenty two blade cores, 19 bladelet cores and 1 globular one have been found. The threshold blades/bladelets is set on 16 mm on the basis of the laminar blanks width. In particular, blade cores of the C type and bladelet cores of the B type outnumber micro-bladelet and large blade cores.

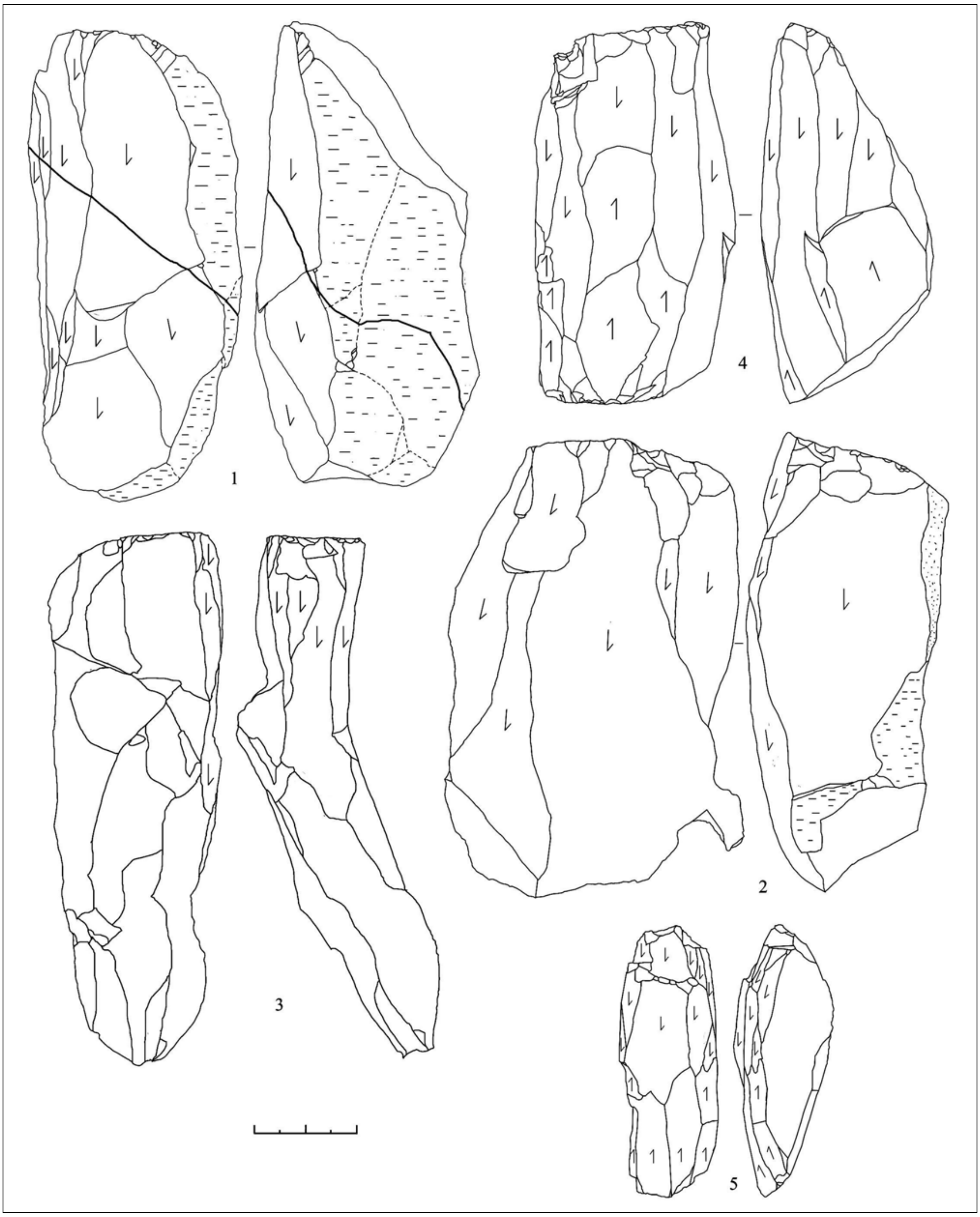


Fig. 2.13: Assemblage out of stratigraphic context: cores (SILVESTRINI et al. 2008)

Laminar scars classes	N. of cores
A+B	1
B	18
C	12
C+B	3
C+D	1
C+D+E	1
D	3
D+E	1
E	1

Tab. 2.4: Laminar scars classes

As far as mixed classes cores are concerned, some clarification are advanced:

- One bladelets/microbladelets core (A+B) shows predetermined central blanks scars of both classes
- In the case of cores with both blades (C) and bladelets (B) scars, in two cases the bladelets scars are in lateral position and in one case have the function of longitudinal convexity maintaining.
- Cores width scars of the classes C+D, C+D+E and D+E, show central laminar negatives only for C and D classes while E classes are only in lateral position.

Globally considered, cores can be distinguisehd in two morphological groups, *a* and *b*, principally defined by the relative width of the front (which is often coincident with core width) respect to the core length. *a* and *b* groups are characterized by a length/width ratio respectively lower and higher than 2.

- *Blade cores of the group a (wide front):* the extraction surface is set on what can be considered the width of the core blank, while the potentially exploitable volume is represented by the thickness. From this derives a certain front wideness and a more or less slight centering. Flanks are rarely rectilinear.

- *Blade cores of the group b (narrow front):* the extraction surface is set on the minor dimension of the core blank and, in this case, the exploited volume is its width. The recurrent feature is represented by a certain regularity of the flanks, which can be parallel or convergent, rather rectilinear.

The morphology of both core groups is generally due to the natural features of the raw blocks, which can be fluviatile pebbles or sharp edged flat blocks. By a technical point of view, there are no exclusive features of one or the other group. Modality can be *frontale* or *semi-tournant*, slightly invasive of the flanks. The transversal convexity management is provided by lateral detachments or by the extraction progress itself. Longitudinal convexity, when present, is due to the opening of an opposite accessory striking platform or to the presence of plunged scars (whose intentionality is hardly evaluable). Back and flanks remain cortical except in few specimens, where they are partially arranged.

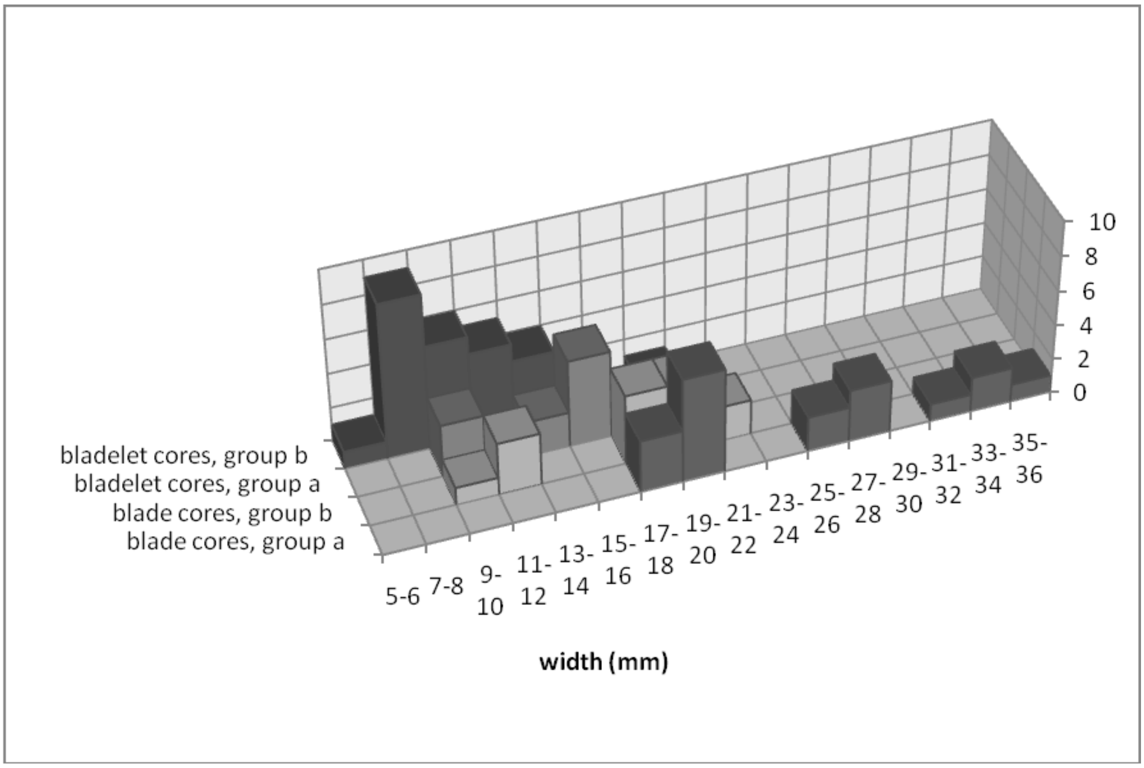
Differently from blade cores, bladelet ones show a high standardization degree.

- *Bladelet cores of the group a (wide front):* rather wide front and extraction surface, paralleled by a somewhat regularity of the flanks, which appear rectilinear and parallel. Specimens bearing part of the cortex signal the nature of nodules or rounded fluviatile pebbles of the raw blocks. One only specimen is out of this pattern, showing wide and lowly centered front and extraction surface set on a wider natural face. Flanks, not regular, doesn't have any role of control on the products morphology. This specimen is, therefore, closer to the blade cores of the group *a*.

- *Bladelet cores of the group b (narrow front):* these cores show the highest standardization degree. Fronts and extraction surfaces are set on the minor dimension of the raw blanks. The specimens conserving part of the cortex testify of their nature of small plates or nodule fragments, narrow and elongated in shape, rather flat, with regular and rectilinear sides. It is worth stressing the presence of a large blade, exploited as core blank, reduced from the distal end exploiting one of the edges as *arête*. This core testifies of possible reduction sequences ramifications.

As for blade cores, it doesn't seem possible to recognize exclusive technical features of one or the other group: the modality is generally little invasive *frontal* or *semi-tournant*; the transversal convexity is managed by lateral detachments or by the extraction progress itself; the longitudinal convexity is generally not so much high, maintained in some instances thanks to the exploitation of a single or two partially overlapped extraction surfaces framed by two opposite striking platforms which, differently from blade cores, seem to have both productive roles (a single specimen has two independent extraction surfaces). The back and the flanks are generally carefully prepared, especially among the cores of the group *b*, except in the cases where these result already suitable due to the natural shape of the raw block.

As regards the caliber of the extracted products (*Graph 2.5*) it can be observed, on the basis of the the readable scars, that, while the blade class C is present on almost only the cores of the group *b*, D and E blade classes are exclusive of cores of the group *a*. Among the negative scars on the bladelet cores it can be noticed a shaded treshold which it is not possible to observe among products. Narrowest bladelets, up to 10-14 mm width, mainly come from cores of the group *b*, while the largest ones, up to 16 mm width (large bladelets), come almost exclusively from cores of the group *a*. As previously signaled, the presence of bladelet scars on blade cores can be referred, in the few observed cases, to control intervention rather than to mixed production.



Graph 2.5: Laminar scars

The depositional conditions, the recovery modalities and the absence, at this level of analysis, of an accurate investigation on the natural litothypes, lead to not going ahead with speculations about reduction sequences and technical systems of production. In any case, some general statements can however be advanced.

While the procurement of the raw blocks of a specific shape could have been occurred in a selective, rather naturally, conditioned way (i.e. a major availability of flat flint blocks), their volumetric management was instead directly oriented by the desired products caliber, generating cores of at least four cathegories:

Blades and large blades cores
Blade cores
Prevalent large bladelets cores
Prevalent bladelets cores

2.2.7. Hammerstones

The hammerstones (4 in total) are all of flint and show the following features:

n. 1- Rounded shape. Rounded edges neo-cortex. The percussion traces are clustered around two areas both formed by the intersection of surfaces forming a sort of dihedral. Detachments in the form of scaled scars. Weight: 107 grams.
n. 2- Rounded shape. Possible core, no longer readable. Calcareous cortex associated to rounded edges neo-cortex. The percussion traces are clustered around an area formed by the intersection of four surfaces. Weight: 114 grams.
n. 3- Polyhedric shape. Sharp edges neo-cortex. Traces are clustered in a small area formed by the intersection of three surfaces. Weight: 180 grams.
n. 4- Large flake, similar to a *pièce machurée* (Fig. 2.14). The percussion traces are clustered in two areas. The first, proximal, shows percussion marks on the ventral face. The second, mesial, on the right side of the flake, shows diffuse edge rounding and scaled bifacial scars. Weight: 149 grams.

The first three hammerstones have probably been used for flaking flint and doesn't bear traces of prolonged use. They are to be considered expedient tools. Their use can be configured as fully contingent with the assemblage under analysis.

As far as the fourth artefact is concerned, after some suggestions about the function of such artefacts (FAGNART and PLISSON 1997), it could have been used in the maintaining of non-opportunistic hammerstones, like the soft stone ones, not recovered.

2.3. Lithic production: the assemblage from the 1984 test excavation

The lithic assemblage recovered during the 1984 test excavation is made of 243 artefacts (except undeterminable items and undifferentiated flakes smaller than 25 mm), coming for the most part from layers 3 and 4 of the sounding P and, in a lesser extent, from the same layers recognized in the sounding P1. The quantitative unconformity between the artefacts amount of the two soundings and the recovery of refitting artefacts from both layers induce to consider the whole *corpus* as a single unit. It is presumable that the activities responsible of the formation of the assemblage and its rapid burying could have occurred in a short time extent.

The general composition shows similarities with the assemblage recovered out of context (Tab. 2.5). Some specific technological classes are missing or represented by few artefacts but, generally, it is possible to follow the production process from the first decortication and shaping phases to the abandon of the cores, through the production and management phases. In this case, too, it is possible to recognize the presence of a large ampunt of regular not cortical laminar blanks.

As regards the morpho-metric and morpho-technical aspects, central not cortical laminar products (63 in total, either entire and fragmented, excluding laminar flakes) show, first of all, a limited *spectrum* of calibers, namely, blades and bladelets of the B and C classes. Large blades count one unique lateral specimen. Profile is generally rectilinear, rarely curved or *torse* and the section is both triangular and polygonal.

The most used flaking technique is the soft organic hammer direct percussion, for both blades and bladelets, and, in a lesser extent, soft and hard stone direct percussion, according to a trend comparable to the assemblage recovered out of context.

Phase	Sub-phase	%	Diagnostic artefacts	P3	P13	P4	P14	TOT	%
Shaping (41,2)	Blocks shaping and arrangement	**40,7**	Totally cortical flakes	4				4	**1,6**
			Partially cortical flakes	34		5		39	**16,0**
			Not cortical flakes	40	3	9	4	56	**23,0**
	Provisioning of shaped blocks for delayed use	**0,4**	Initialized pre-cores	1				1	**0,4**
Laminar production (42,0%)	Initialization	**2,5**	Crests	2				2	**0,8**
			Crests on natural dihedral	2				2	**0,8**
			Natural dihedrals	2				2	**0,8**
	Full production	**33,3**	Central, semicortical	5	1	3	2	11	**4,5**
			Central, not cortical	42	6	18	4	70	**28,8**
	Cintrage maintenance	**6,2**	Lateral semicortical laminar products	2				2	**0,8**
			Lateral, not cortical	9		3	1	13	**5,3**
Management (10,7%)	Convexities and accidents recovery	**4,5**	Neo-crests	8		1		9	**3,7**
			Reparation	2				2	**0,8**
	Flaking platform management	**3,3**	*Partial* tablettes	1				1	**0,4**
			Total *tablette*	7				7	**2,9**
	Change of flaking orientation	**2,1**	Rim products	4		1		5	**2,1**
	Flanks, back and extraction surface management	**0,8**	Surface management from the flank	1		1		2	**0,8**
Transformation (2,9%)	Transformation	**2,9**	Endscrapers	1				1	**0,4**
			Retouched blades	1				1	**0,4**
			Truncated blades	1				1	**0,4**
			Retouched flakes				1	1	**0,4**
			Notched flakes	1				1	**0,4**
			Backed points		1	1		2	**0,8**
Deactivation (3,3%)	Deactivation of production	**2,9**	Cores	6			1	7	**2,9**
	Recycle	**0,4**	Reconfigured cores			1		1	**0,4**
TOT	tot	**100,0**	TOT	176	11	43	13	243	**100,0**

Tab. 2.5: Technological classes and related reduction phases (1984 excavation)

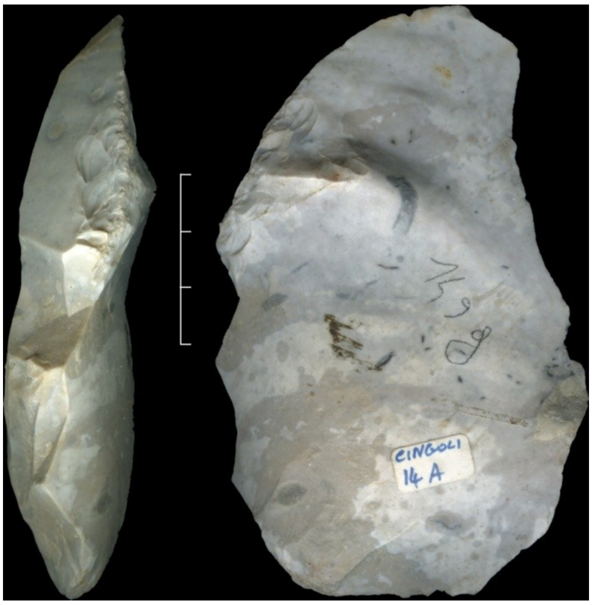


Fig. 2.14: ***Pièce machurée***

Fig. 2.15: Refitting sequence comprising a truncation

Retouched artefacts, seven in total, count one or two specimens for each type. The end-scrapers, one coming from the sounding P (Fig. 2.17 n. 5) and the other being recovered out of context , but just outside the excavated area, (Fig. 2.17 n. 4), as the other tools on blade, are realized on rather regular blanks. Burins are totally absent.

It's worth to describe a refitting testifying of the production and transformation *in situ* of a laminar blank (Fig. 2.17 n. 3). The sequence shows: 1- the detachment of a lateral product and of a plunged neo-crest; the detachment of a semicortical laminar product, subsequently retouched into a truncation; 3- detachment of a large laminar flake aimed to the regularization of the extraction surface.

Armatures, finally (Fig. 2.17 nn. 6-7), represented by two fragmented backed points, doesn't comprise shouldered points.

Cores (n=7) are mostly for bladelets (width class B), discarded at generally not high levels of exploitation and free of particular flaking accidents. Morphologically, they can be classified within the group *b*, being characterized by a relatively narrow front, if compared to length (length/width >2). Flanks are usually rectilinear and regular, frequently because of the conformation of the raw blanks, which are flint nodular of tabular fragments. Modality is for the most part *frontale*. S*emi-tournante* modality results rather invasive of the flanks.

The readable scars present on the extraction surfaces (12 measured scars) show that the most frequent calibers are the bladelet ones, with a frequency pick around 9-10 mm width and, subordinately, the one of the large bladelets, around 13-16 mm. Blade scars, two in total, are around 19-20 mm.

Fig. 2.16: Bladelet core and refitting laminar flake

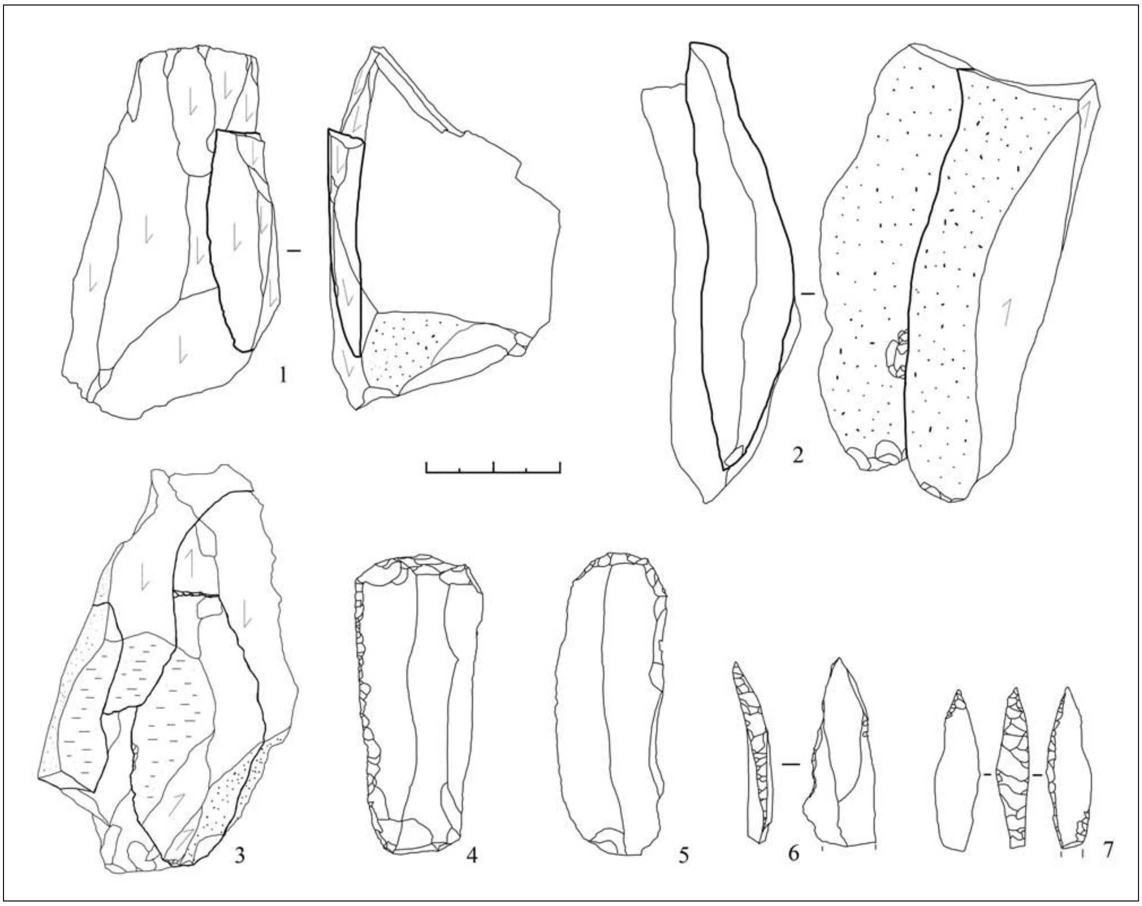


Fig. 2.17: Assemblage from P and P1 soundings (SILVESTRINI et al. 2008)

2.4. Synthesis and discussion

The differences detected between the two assemblages seem to be mainly imputable to the small artefacts amount of the second, which shows few technological and typological classes to be compared. What is worth to underline is that peculiar artefacts that characterize in some extent the assemblage recovered out of context are lacking among the excavated assemblage: large blades, large blades cores and shouldered points. Considering the nature of the analyzed assemblages, it should be stressed that the indications provided are only relative to the techno-economic behavior. The absence of faunal remains, due to post depositional events or to the specific function of the site, doesn't allow to speculate about the season of occupation and about strategies of acquisition and processing of alimentary resources. In any case, on the basis of the features of the lithic assemblage, it is arguable that the acquisition and processing of food resources was not the main motivation of the frequentation.

The production of highly standardized regular blades and bladelets is attested by cores and by the high amount of the products themselves. The production of highly standardized blade and bladelet blanks apparently followed a differential management of the raw blocks, variable in size but relatively similar in global geometrical features. Cores, either blade or bladelet cores, are managed according to the natural morphology of the blocks. The size of blade products is strictly dependent on this. Narrow or large blade and bladelet scars are present respectively on narrow and large extraction surfaces, which are dependent on the position of the block they are set, namely, the narrower or the larger side.

Blades and bladelets produced at the site were also partially consumed as blanks for a series of retouched artefacts, as attested, i.e., by a refitting sequence among a number of artefacts, one of them retouched into a truncation. Retouched blanks are distinguishable in two classes: blade/flake tools (mainly end-scrapers and retouched blades) and armatures on bladelet. Thicker blanks were selected for retouched blades and backed bladelets, while thinner blanks for shouldered points.

On the basis of the previous observations, it can be stated that site function was probably rather specialised, and mostly devoted to blank production. At least a part of the site could have been devoted to the activity of lamino-lamellar production in part finalized to the maintenance of hunting weapons by means of substitution of broken armatures (to be confirmed by traceological analyses) with new ones, suggested by the recovery of a backed microburin (Krukowsky) and of a *piquant-trièdre* on backed bladelet, issues of accidents which occur during the realization of backed implements.

Even taking into account the lack of ^{14}C dates, as well as of information about vegetation and fauna, some considerations can be made about the cultural and, possibly, the chronological attribution of the assemblage. Some quite precise indicators exist: the shouldered points are the 'trade mark' of the Early Epigravettian assemblages, discovered all over the Italian peninsula, between about 20.000 and 15.000 uncal BP. The assemblage from Madonna dell'Ospedale, accordingly, can be bracketed in the chronological sequence of the Marche region, between the final Gravettian/early Epigravettian of Fosso Mergaoni, with a minimum age of 21,400 cal BP (SILVESTRINI, et al. 2005), and the beginning of the Late Epigravettian of Baracche, with a maximum age of 18,000 cal BP (PERESANI, et al. 2005).

3. FOSSO MERGAONI

3.1. Presentation of the site

3.1.1. Localization

The early Epigravettian open air site of Fosso Mergaoni is close to the village of Serra San Quirico in the province of Ancona, Marche region (*Fig. 3.1Fig. 3.2*) just outside the borders of the Frasassi and Rossa Gorges Natural Park (Parco Naturale Gola della Rossa e Frasassi) in the upper Esino river basin, an area which attracted human groups at different periods in the Paleolithic. The Epigravettian evidence is dense and more complete than in earlier periods (BROGLIO, et al. 2005; ESU, et al. 2006; GALDENZI and MENICHETTI 1990; GURIOLI 2005; LOLLINI 1964, 1966; LOLLINI and GUERRESCHI 1979; PERESANI and SILVESTRINI 2007; SILVESTRINI, et al. 2005; SILVESTRINI and LAVAGNOLI 1985-86; SILVESTRINI and PIGNOCCHI 1987; ZIGGIOTTI 2007). In particular, the site lies at the end of the Gola della Rossa, a narrow gorge cut by the Esino river into the calcareous formations of the district (which holds the famous impressive Frasassi karstic complex) and is set on the hydrographical right of the Esino river, just few hundred meters from it, at an altitude of 179 m.a.s.l.. Towards W and S it is framed by reliefs reaching 900 m.a.s.l. (M. Murano, M. Revellone), with rocky crests and abrupt slopes facing the below river embedded in the Rossa gorge, while the N and E landscape is smoother because of the presence of lower reliefs and the beginning of the hilly belt and alluvial plain which extends towards the sea from the Apennine foothills.

Fig. 3.1: Fosso Mergaoni, localization of the site

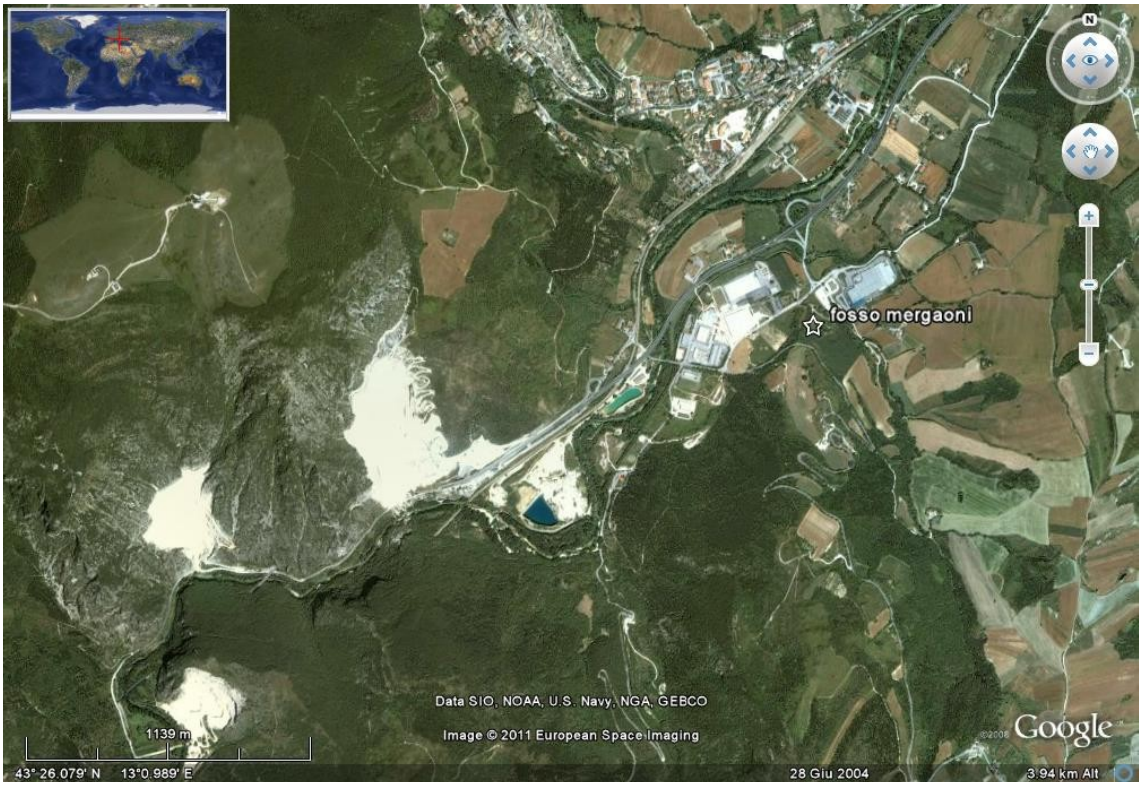


Fig. 3.2: Fosso Mergaoni, localization of the site

3.1.2. The excavations

In the area of Fosso Mergaoni, a number of gravel quarries exposed some upper Pleistocene depositional sequences belonging to a system of alluvial terraces and slope deposits (*Fig. 3.3*) (SILVESTRINI, et al. 2005). The site has been discovered in the early 80's by Prof. Mauro Coltorti after its partial destruction operated by the quarry activities (SILVESTRINI and PIGNOCCHI 1987).

Fig. 3.3: The quarry area of Fosso Mergaoni

After the Superintendence for Archaeological Heritage was informed, in 1982 a first excavation campaign, directed by Dr. Mara Silvestrini, was carried out in order to sound the actual archaeological potential and to delimitate the area that required to be preserved for further investigations. The soundings, made in proximity of the maximum depth of the deposit, reached the archaeological layers signaled by lithic industries lying within a series of sandy and silty deposits of alluvial origin. By eight test trenches (A, B, B1, C, D, E, F, G) measuring 1x2 meters each, an area of approximately 100 m^2 have been tested, recovering about 660 lithic artefacts (>25 mm), the very most part of them coming from soundings B, B1 and E (*Fig. 3.4*), in the two main anthropic layers recognized, 4 and 4a. In that occasion, the collection of the archaeological remains has been carried out without map plotting or drawing.

Fig. 3.4: Sounding E, 1982 excavation

In 1985, the reprise of the investigations focused on the same area explored in 1982. An about 50 m² wide surface, subdivided in 1x1m sectors and 0,5x0,5 m sub-sectors, was extensively explored (*Fig. 3.5*, *Fig. 3.6*, *Fig. 3.9*). The collection of the findings was in this case preceded by the drawing of the most part of them upon 1:2 scale maps representing the fourth part of each sector. The smaller findings, not present on the maps, have been collected anyway according to the sub-squares of provenance, contributing to preserve a quite high resolution of the topographic data. About 1670 findings (>25 mm) were recovered during the 1985 excavation, from the same layers (4, 4a) already recognized during the previous campaign. Observations about the significantly arrangement of the lithic industries in clusters, the light or no patinas and fresh edges, the finding of some refittings, lead to consider the deposition of the archaeological remains as primary (SILVESTRINI and PIGNOCCHI 1987), probably thanks to a rapid alluvial burying.

Fig. 3.5: General view of the 1985 excavation

Fig. 3.6: General view of the 1985 excavation

3.1.3. Stratigraphy and chronology

The LGM correlated sediments outcrop in the northern part of the quarry where the site has been found. They consist in a series of gravel layers produced for gelifraction within a local conoid, whose setting can be imputable to diffuse streaming episodes. In this sedimentary body are present dark soils, enriched in organic matter, indicating some climatic amelioration. The existence, at the top of the organic horizons, of a typical bluish clayey horizon, suggests hydromorphic conditions with the formation of a Gley horizon in presence of seasonal groundwater. Intercalated to these sediments are locally present sandy and silty layers of alluvial origin, due to overflowing processes, containing the industries of the early Epigravettian (SILVESTRINI, et al. 2005).

The excavated area, which roughly develops NNW-SSE, shows a light decreasing inclination from South to North, while it is relatively horizontal from East to West. The vertical distribution of the findings, when plotted on the x-z and y-z axes (N-S and E-W), is perfectly consistent with the distinction made during the excavation between the two anthropic layers (4 and 4a), and clearly show two linear clusters of findings (*Fig. 3.7*) which follow the natural inclination of the surface and are parallel each other.

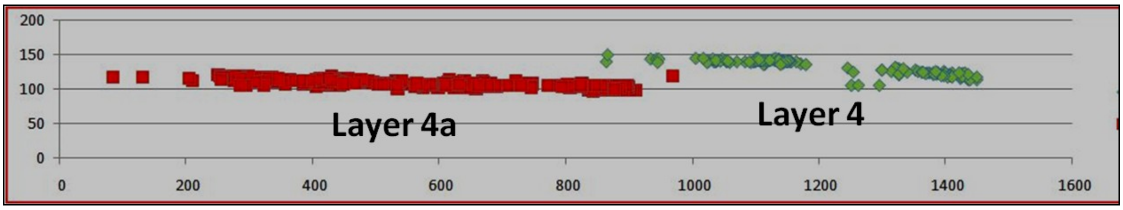


Fig. 3.7: S-N artefacts vertical distribution (scale in cm)

Apparently, any superimposition between the two clusters curiously lacks. The layer 4a is anyway stratigraphically earlier than the layer 4 (*Fig. 3.8*). Furthermore, the six concentrations, which are also horizontally well recognizable, are clearly visible within the two vertical distribution clusters. Contrary to previous studies and publications, where the whole excavated surface has been treated as a single occupation floor, in the present work the distinction between the two layers will be taken into consideration. It introduces new and meaningful elements for the historical and behavioral interpretation of the findings, suggesting that the place was known and object of reiterated frequentation.

A small amount of charcoal recovered on a lithic implement (layer 4a, square P21, sub-square c, finding N° 2) returned an uncalibrated date of 18.160±240 BP (UtC-11551) (SILVESTRINI, et al. 2005), corresponding to a calibrated date of 21.853 ± 406 calBP (CalCurve: CalPal_2007_HULU, http://www.calpal-online.de/). Faunal remains are totally absent.

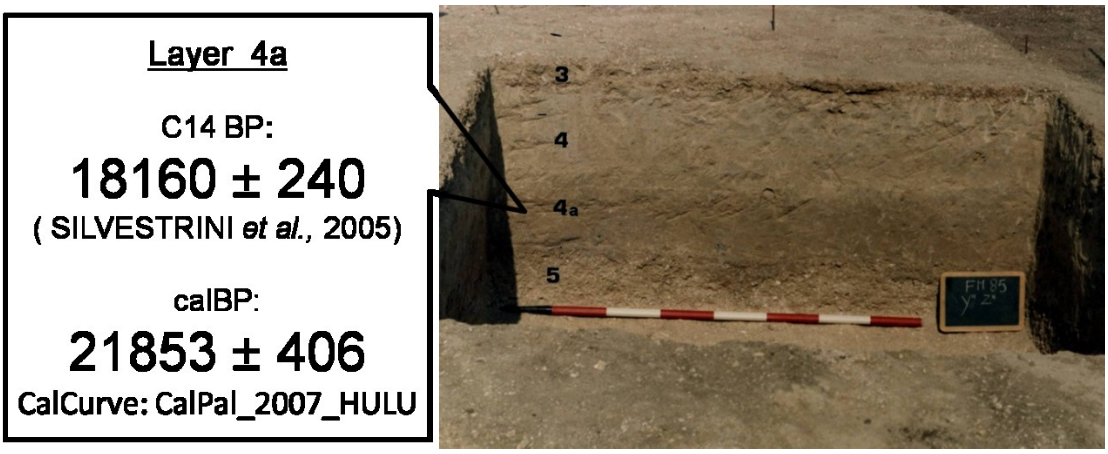


Fig. 3.8: Stratigraphy (1985 excavation)

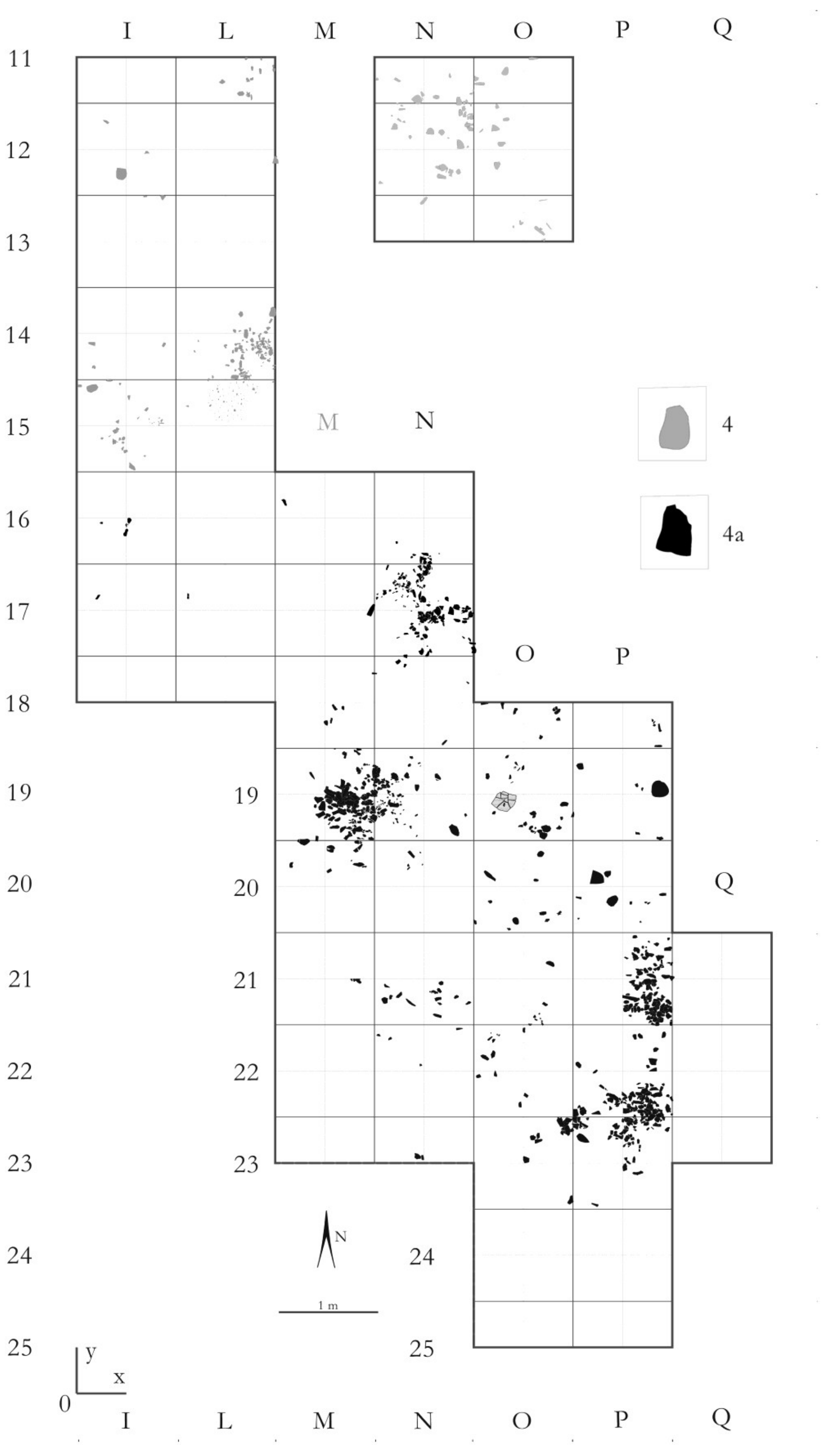


Fig. 3.9: General map of 1985 excavation, digitalized on the basis of the original drawings

3.2. Flint sources

3.2.1. Introduction

The Umbria-Marche sequence is considered an exceptional geological reference for stratigraphic standards. It's well known and it has been the subject of several geological studies. It's represented by one of the most continuous calcareous successions in the world, which contains several lithological markers, like the "anoxic levels", recognizable at a world scale (*Fig. 3.10*, *Fig. 3.11*).

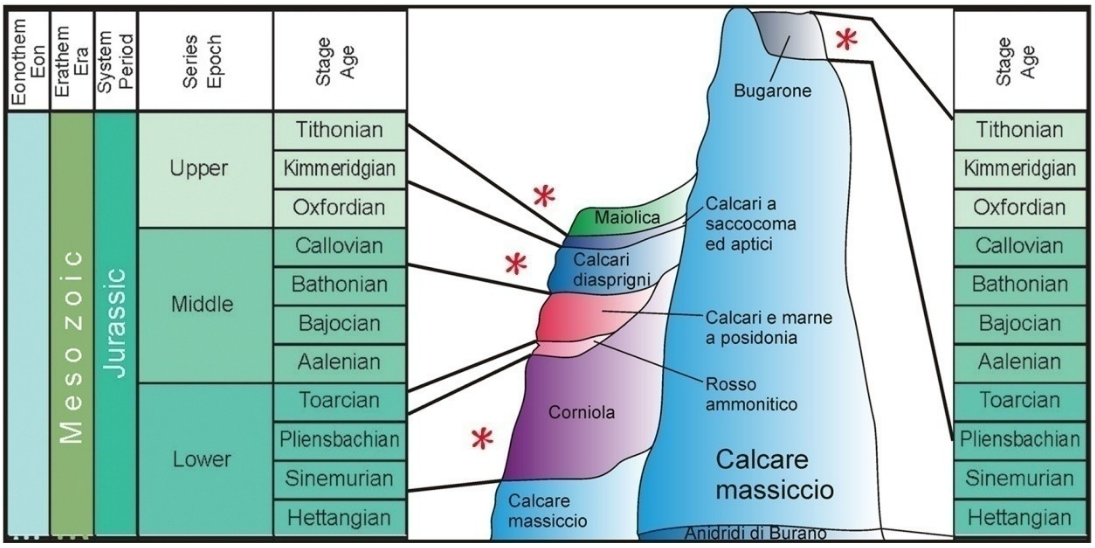


*Fig. 3.10: The Jurassic sequence, * selciferous formations (image based on International Stratigraphic Chart, International Commission on Stratigraphy, 2005, modif.)*

The district of the Rossa and Frasassi gorges is part of the Umbria-Marche sequence. The Jurassic-Paleogene stratigraphy testifies, during the lower Jurassic, of condensed and patchy sedimentation in raised areas ("Bugarone" formation) and most complete successions in lower areas ("Corniola", "Rosso Ammonitico" and "Calcari Diasprigni" formations), caused by drowning and tectonic modifications of the platform. From the upper Jurassic to the Oligocene, the Umbria-Marche Apennine remained in conditions of pelagic sedimentation ("Maiolica", "Marne a Fucoidi" and "Scaglia" formations). (CENTAMORE and MICARELLI 1991; PASSERI 1998). Flint is present in the form of nodules and slabs included in the densely stratified Meso-Cenozoic limestone formations and easily recoverable as pebbles and blocks, within alluvial deposits, slope debris, soils and stream beds.

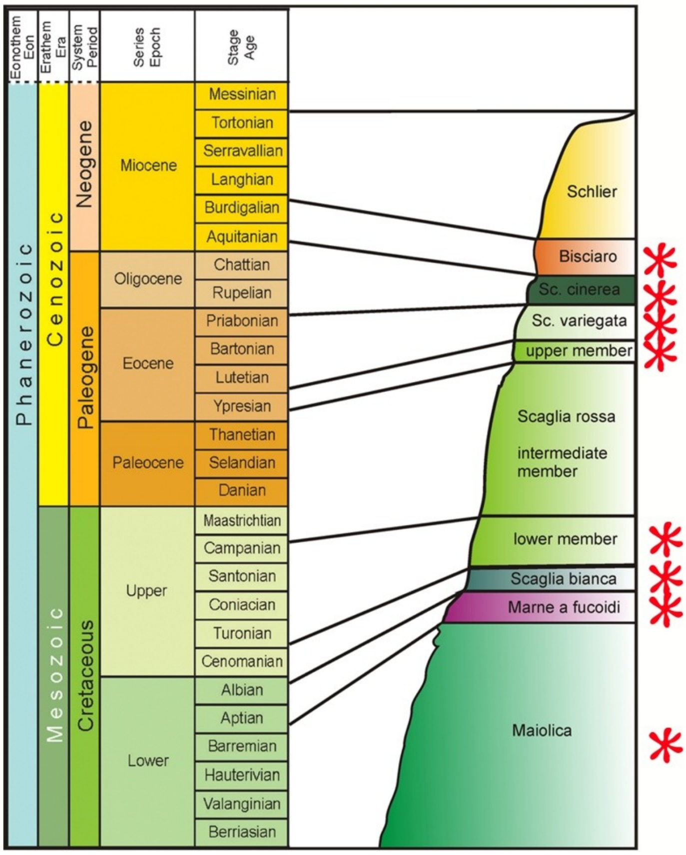


*Fig. 3.11: The Cretaceous-Neogene sequence. * selciferous formations (image based on International Stratigraphic Chart, International Commission on Stratigraphy, 2005, modif.)*

In order to better understand the actual potential in flint availability of the district where the site of Fosso Mergaoni is set, a systematic surveys has been carried out (*Fig. 3.12*)(CANCELLIERI, et al. 2009). Flint has been sampled from limestone outcrops and loose deposits, mapped and described according to a set of macro/microscopic variables and to the relative flaking attitude. The main results about the archeologically informative potential, coming from the synthetic analysis of both the intrinsic variables of flint sources and the differential distribution within the landscape, will be presented.

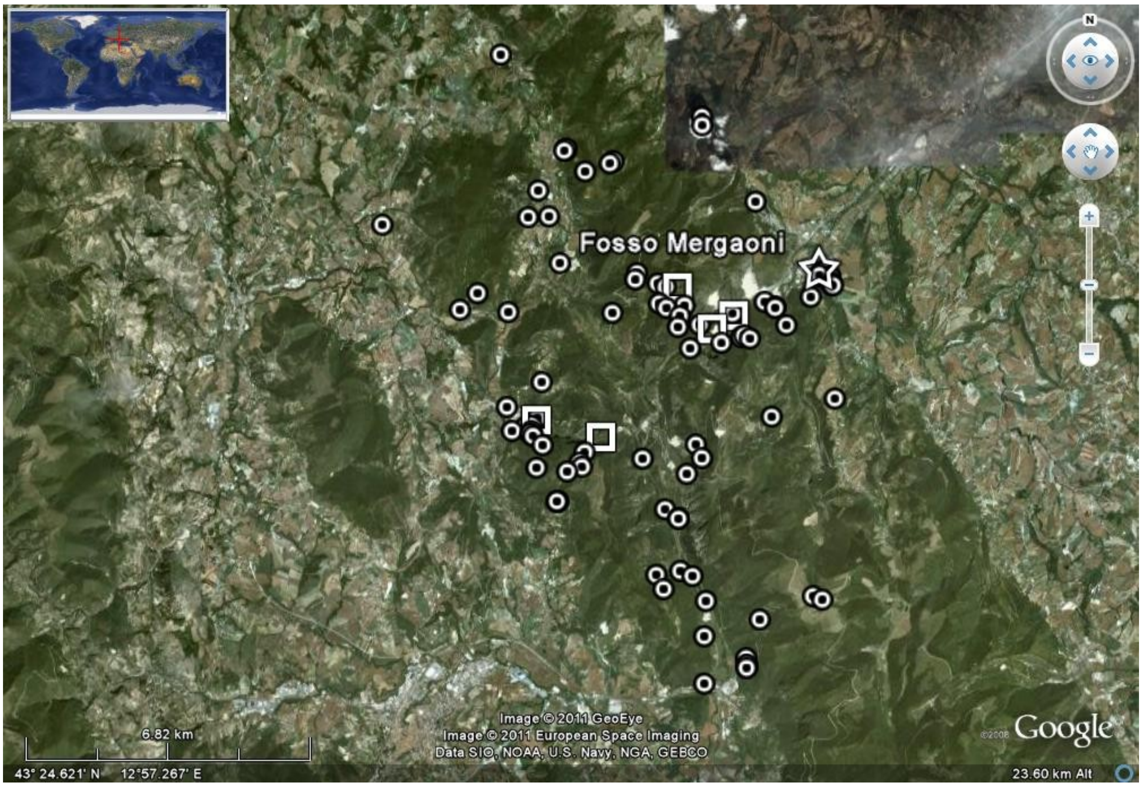


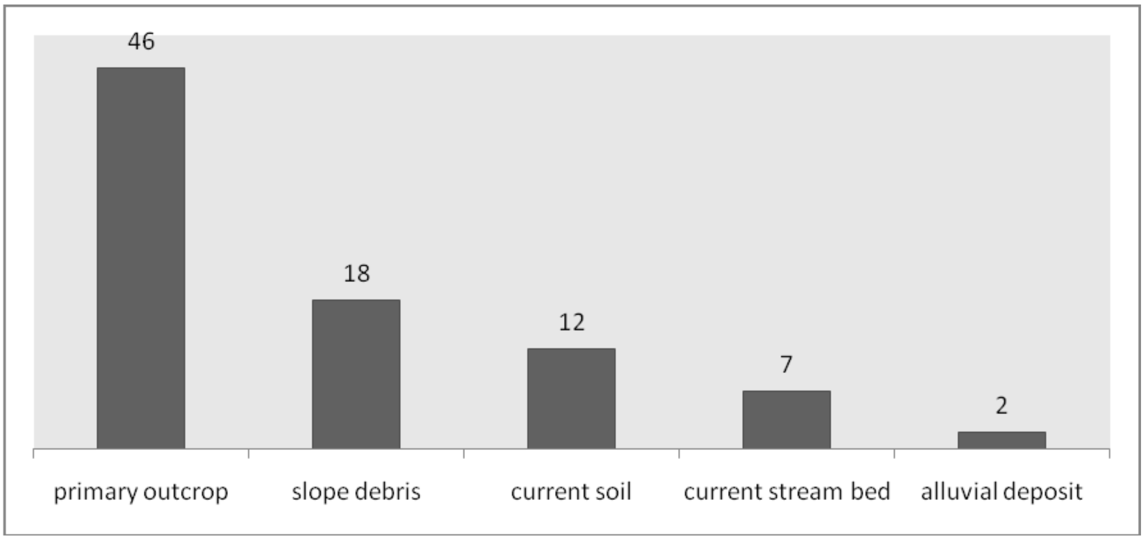
Fig. 3.12: Localization of Fosso Mergaoni (star), of the sampled areas (circles), and of the Late Epigravettian sites of the district (squares).

3.2.2. Field research and sampling strategy

The sampling strategy adopted during the fieldwork focused on both primary limestone outcrops and quaternary deposits (*Graph 3.1*), in the first case to compose a reference archive of the lithotypes of the area and in the second to determine the actual availability of lithic raw materials, assumed that secondary outcrops were the only emergences exploited by the epigravettian hunters, for whom no mining activity is documented, up to now, in the region.

In the case of primary outcrops, after the selection, on the basis of the available geological cartography, of a number of selciferous formations exposed in artificial profiles such as roads or quarries, the actual flint content has been verified and some samples of both the limestone and the embedded flint has been taken. As regards secondary outcrops, the surveys focused on current stream beds and soils, slope debris and alluvial deposits. After the selection of the test areas, all the flint pebbles present within an area of two square meters have been taken, taking it as a sample measure of the flint availability of the very close surroundings (considering a tentative area of no more than 10 meters radius).

The topographic position of each sampling has been acquired by a GPS device and pictures has also been taken.



Graph 3.1: Number and nature of the sampled areas

Fig. 3.13: Main macroscopic characterization features

3.2.3. Flint outcrops characterization and classification

A preliminary characterization (*Fig. 3.13*) of the flint samples coming for both primary and secondary outcrops, was undertaken by describing some major macroscopic features, like color, morphology (rounded nodules or flat slabs), thickness of the flint bed, thickness and nature of the cortex (primary-calcareous, rounded or sharp-edges neo-cortex), overall homogeneity (presence of carbonate inclusions, vacuums, discontinuities) and overall integrity (presence of diaclases and fracture degree).

A limited series of micropaleontological analyses (*Fig. 3.14*) have been carried out on the flint of the "Maiolica", "Scaglia Rossa (upper member)" and "Scaglia Variegata" formations, the most widespread and suitable flint-bearing rocks of the area (thanks to the incomparable support of Prof. Valeria Luciani, University of Ferrara).
Beside radiolarians, planktonic foraminiferal assemblages are better preserved in particular in the flint of the "Scaglia Rossa (upper member)" and "Scaglia Variegata" formations.

The estimate of the flaking attitude, or suitability, represents a methodological interface used to relate environmental and archeological variables, by putting on the same problematic framework the flint features variability (formation of provenance, size, nature of the cortical surfaces, internal quality) by the creation of a metric-qualitative index, the flaking attitude, by which to account for these variables contemporaneously. Flaking attitude estimates have to be framed within the regional archeological reference cases, and, in particular, should take into account the production objectives recognized after the techno-economic analyses.

The general aim has been to classify each flint outcrop according to the flaking attitude of its selciferous bodies and, ultimately, to subdivide the district into areas of differential raw material potentiality. For a better understanding of the spatial dimension of the flint sources over the study area (ca. 9.000 ha), the sample-points data (characterized by the outcrop nature and the flaking attitude) has been plotted over the

3D Regional Cartography by means of a GIS application (*Fig. 3.16*)(thanks to the kind collaboration of Dr. Giansimone Poggi, University of Reading, UK).

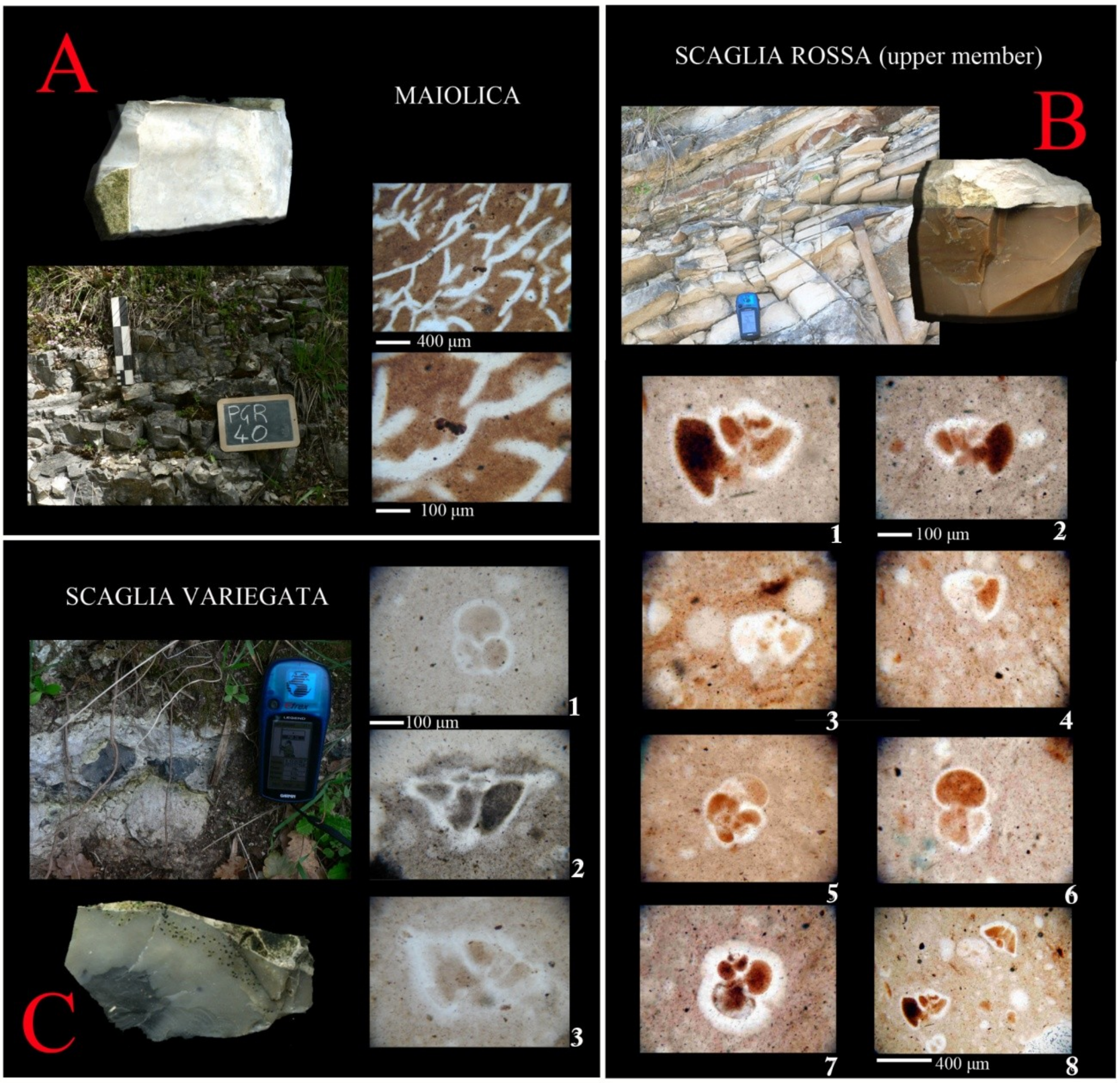
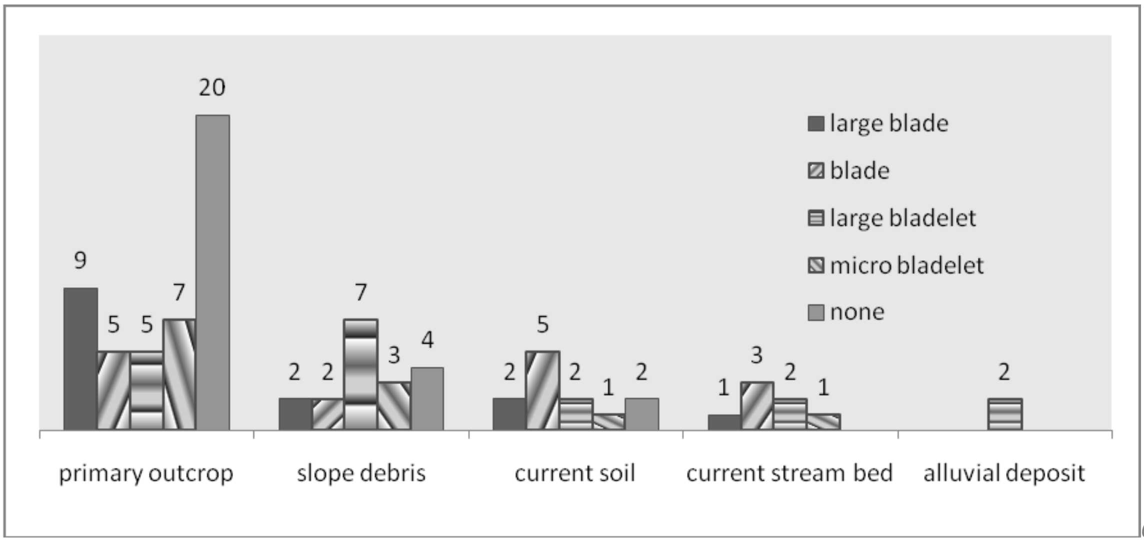


Fig. 3.14: Micropaleontological content of selected outcrops of Maiolica, Scaglia Rossa and Scaglia Variegata flints. A) MAIOLICA: lower Cretaceous, Microfacies showing pelagic bivalvia and one small specimen of Hedbergella sp.. B) SCAGLIA ROSSA (upper member): middle Eocene, 1-2: Acarinina topilensis, 3: Acarinina rohri, 4: Acarinina bullbrooki, 5: Guembelitrioides nuttallii, 6: Subbotina sp., 7: Globigerinatheka kugleri, 8: radiolarians, Acarinina topilensis and Acarinina bullbrooki. C) SCAGLIA VARIEGATA: middle Eocene, 1: Subbotina sp.; 2: Morozovella sp.; 3: Acarinina sp.

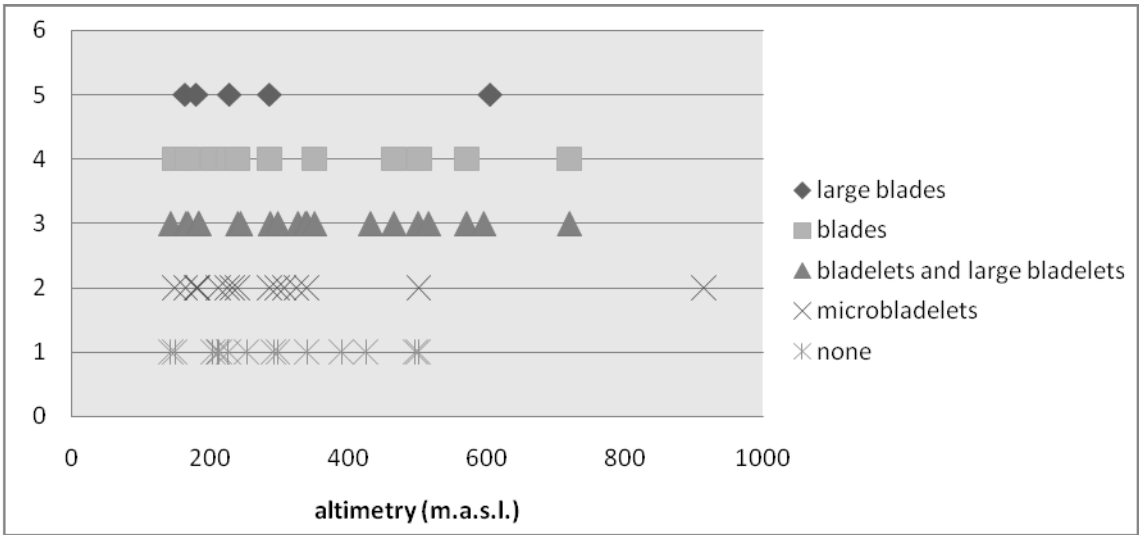
Flaking attitude estimates have been focused on blade technology, in both a morpho-technical and morpho-metric point of view, and each sampled outcrop has been classified according to the largest laminar blank potentially achievable. Almost all the samples have been tested by means of experimental knapping performed by hard hammer direct percussion, and classified according to a rank of five classes, each one corresponding to the largest laminar blank achievable (*Fig. 3.15*) (included the crested or natural ridged blades), with a length/width ratio at least equal to 2 (as regards the secondary outcrops, the flaking attitude is expressed by percentages for each class): 1) no flaking attitude; 2) microbladelets (7mm width); 3) large bladelets (16 mm width); 4) blades (22 mm width); 5) large blades (30 mm width) (Classes derived from analyses carried out on epigravettian assemblages of the region (ESU, et al. 2006; SILVESTRINI, et al. 2005; SILVESTRINI, et al. 2008).

Fig. 3.15: Experimental laminar blanks extracted from the flints samples of the district



Grap h 3.2: Flaking attitude of the sampled outcrops

The district under study shows great variability and availability in flint sources, with areas where the raw material is completely unsuitable to others where large homogeneous blocks and nodules should have surely satisfied the Paleolithic hunters needs. The analysis of the distribution shows , quite clearly, a certain variability in both availability and flaking attitude among the secondary outcrops, depending on the nature of the deposits and consequently determining a series of a sort of flint micro-provinces across the landscape, arranged and classed according to the altimetry (*Fig. 3.12*, *Graph 3.3*) .



Graph 3.3: Distribution of the samples flaking attitude according to altimetry

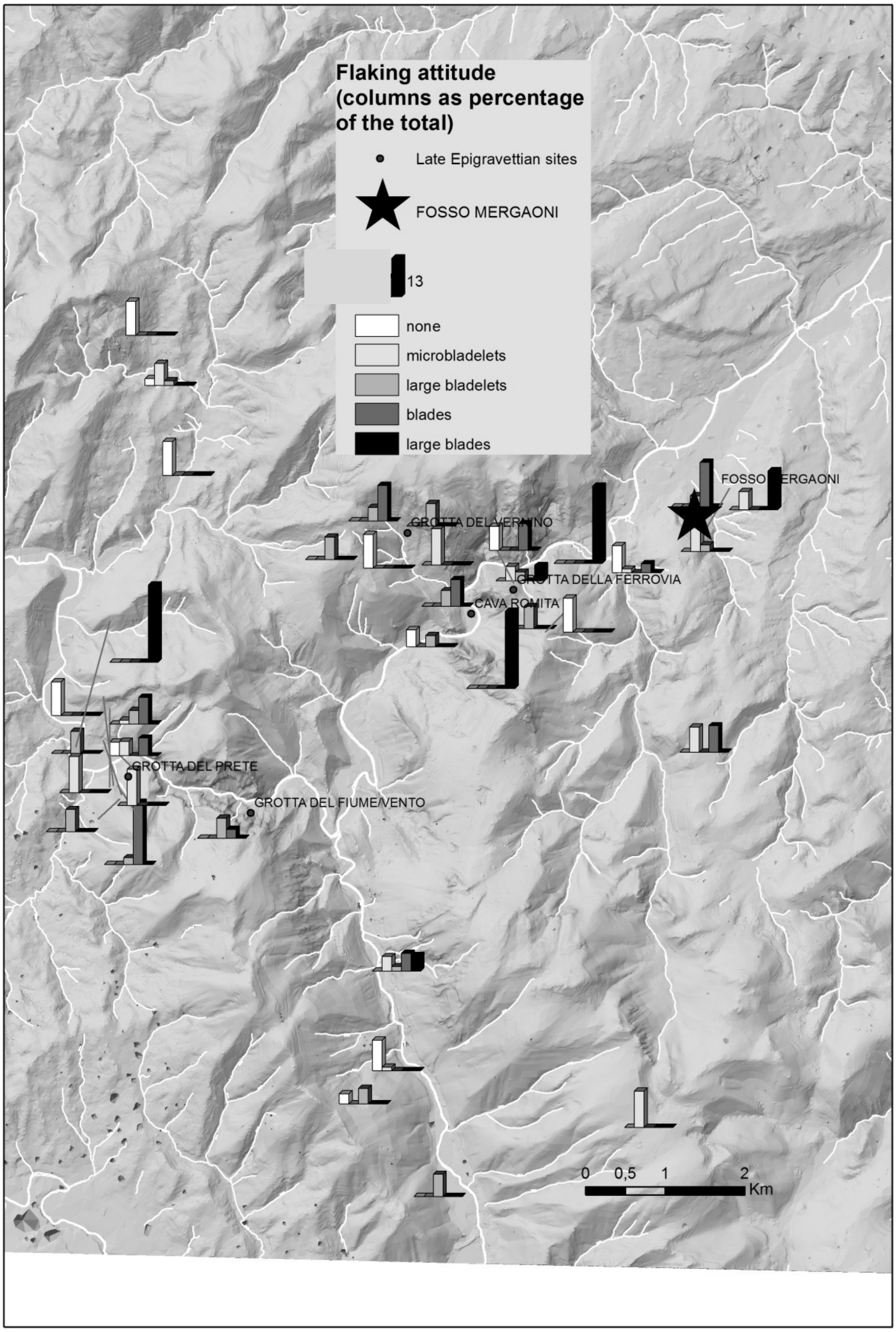


Fig. 3.16: Localization of Fosso Mergaoni and the Late Epigravettian sites of the district. Columns represent the flaking attitude of each sampled secondary deposit, in terms of percentage of the total

3.3. Lithic production

3.3.1. General composition

The following tables (Tab. 3.1, Tab. 3.2,Tab. 3.3) present the amount of lithic artefacts (>25 mm) recovered during the 1982 and 1985 excavation campaigns at Fosso Mergaoni taken into consideration in the present work. Thanks to the courtesy of Dr. Mara Silvestrini of the Superintendence for Archaeological Heritage of the Marche Region, it has been possible to analyze the most part of the material at the Dept. of Biology and Evolution of the University of Ferrara, where it has been temporary moved. Further, a lot of material is exposed at the National Archaeological Museum of Ancona, principally cores and retouched blanks. The author had the opportunity to analyze it directly at the Museum thanks, once again, to the courtesy of the Superintendence, which issued a permission to take the pieces temporary out from their show cases. Finally, the small amount of lithic artefacts currently exhibited at the "Museo Speleo Paleontologico e Archeologico di Genga" (S. Vittore alle Chiuse, Genga, Ancona), hasn't been taken into consideration, as hasn't the artefacts recovered out of stratigraphic context in the area of Fosso Mergaoni.

Excavation campaign	N. Of artefacts
Fm 1982	**664**
Fm 1985	1668
Tot	**2332**

Tab. 3.1: Quantitative composition (>25mm)

Fm 1982			
Sounding	Layer 4	Layer 4a	Tot
A	7	4	11
B	144	44	188
B1	153	60	213
C	21	2	23
E	12	208	220
G	9		9
Tot	346	318	664

Tab. 3.2: Quantitative composition of the assemblage recovered during 1982 excavation (>25 mm)

Fm 1985		
Layer 4	Layer 4a	Tot
325	1343	1668

Tab. 3.3: Quantitative composition of the assemblage recovered during 1985 excavation (>25 mm)

3.3.2. Raw materials

Before moving ahead with any consideration about raw materials, it's worth to give some remarks about the basic analytical units most of the conclusions about provisioning and economy are based on. Lithic raw materials introduced and processed at the site have been tentatively subdivided into ULRM (Unit(s) of Lithic Raw Material) according to a protocol elsewhere defined and successfully adopted (ARZARELLO, et al. 2011; DUCHES and PERESANI in press; PERESANI, et al. 2005; SILVESTRINI, et al. 2005). The basic guiding principle of the partition into ULRM is the recognition and isolation of all the artefacts supposed to have belonged to the same raw blocks. Not always easy to carry out, especially in the case of large series, this approach leads to a better understanding of the lithic assemblages providing finer insights into the ways lithic raw materials were procured, managed, moved and discarded within the technological and settlement systems. According to progressive levels of analysis, starting from the subdivision in terms of geological attribution, various clusters have been created according to the macroscopic features similarities. Natural surfaces, textural and chromatic features, general technological and metric congruence, refittings and conjoins, spatial patterning: all these variables have been taken into account in order to create groups of artefacts as much as possible consistent with their attribution to unique blocks of raw material. Even if it has been tried to attribute the most part of the material to specific different ULRM, it has not nevertheless been possible for every considered item.

The lithic artefacts recovered at Fosso Mergaoni are made on flints of the Maiolica, Scaglia Rossa and Scaglia Variegata, Jurassic-Tertiary local formations belonging to the Umbria-Marche succession. The attribution to the specific formations has been made, as mentioned in ch. 1, on a macroscopic basis only. In many cases, strong similarities in color, texture and cortex features made it difficult to provide an unambiguous diagnosis, and some misinterpretations can surely have occurred. In particular, without micropaleontological analyses for every ULRM, it has not been always possible to distinguish very similar flints actually belonging to different geological formations.

The major problems in this direction have been encountered for red and black homogeneous flints. For the first ones, while the attribution to the Scaglia Rossa formation results quite easy, is on the other hand very hard to distinguish their upper Cretaceous or Tertiary (lower Eocene) age. Black flints, instead, are locally present in at least two tertiary formations, the Scaglia Variegata (middle/upper Eocene) and Scaglia Cinerea (Oligocene/lower Miocene) ones. Flints coming from the Scaglia Variegata formation are, generally, slightly more translucent and fine grained, and this was the only discriminating factor by which it has been tentatively possible to distinguish black homogeneous flints. A better understanding and correct attribution of all the artefacts, useless to say, will only be possible with wide micropaleontological analyses. The other flint types are rather easily attributable to the formations of Maiolica (grey to white flints) and Scaglia Variegata (blue, red-blue, red-green and red-black flints).

All the flint primary formations recognized among the flaked implements recovered at Fosso Mergaoni currently outcrop within a distance of less than 2 Km around it (*Fig. 3.17*) . Cretaceous grey and red flints as well as black Tertiary ones are visible along road and quarry cuts few tens of meters above the site along the road to S. Elia village or along the right side of the Esino river, slightly upstream respect to the site, close to a location called C. Ferri. Large outcrops of Tertiary black flints are further present moving some 3-4 kilometers NW, along the road from Serra S. Quirico to Avacelli, on the opposite valley side.

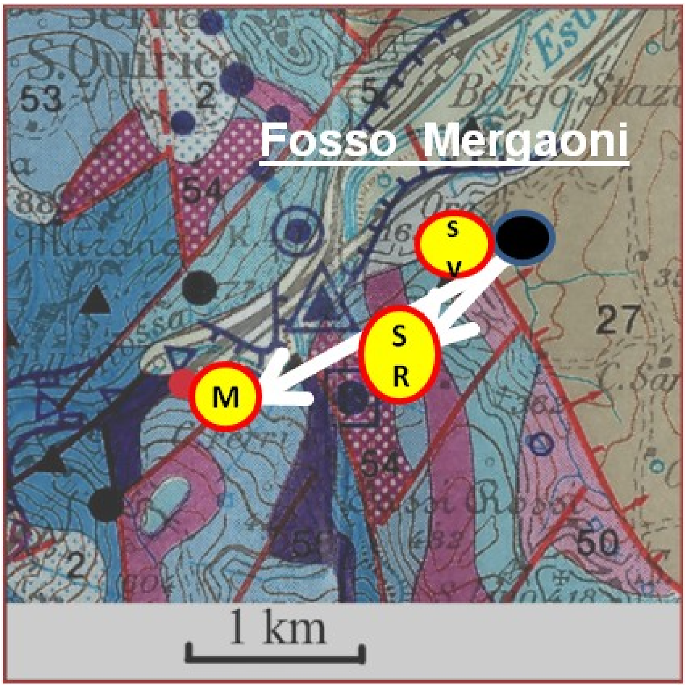


Fig. 3.17: Closest primary outcrops. SV: Scaglia Variegata; SR: Scaglia Rossa; M: Maiolica. (Image: Carta Geologica d'Italia, 1:100.000, Jesi ,modif.)

The whole assemblage of Fosso Mergaoni is composed of 67 ULRM (see tables below), 62 of which representing actual clusters of flaked elements supposedly coming from as many different units of raw material. Two further ULRM are composed by two limestone non-flaked pebble implements: a fragmented (refitted) hammerstone and a retoucher, respectively named "Hammerstone" and "Retoucher". Finally, three ULRM are not truly coherent groups because of the following reasons: one of these, named "Other", puts together all the findings impossible to attribute to a specific group because of their size, texture, color or, finally, because belonging to a physically separate lot of material not compared to the rest of the assemblage (namely, most of the findings analyzed at the National Museum of Ancona); another ULRM, named "Burnt elements", groups all the findings, showing thermal shocks, whose original features cannot be recognized; finally, the "Limestone flaked elements" ULRM assembles all the limestone flaked artefacts, mostly cortex portions, which cannot be attributed to any specific ULRM.

Tab. 3.4 presents the synthetic distribution of the ULRM according to the layer while Tab. 3.5 presents the quantitative composition, in terms of number of findings per ULRM, layer and year of excavation, of the whole assemblage.

Layer 4	Layer 4a
24 ULMR + "other"	38 ULMR + "other" + "burnt elements"
Limestone hammerstone fragments	Limestone retoucher
	Limestone flaked elements

Tab. 3.4: N. of ULRM per layer

ULMR	Layer 4		Tot	Layer 4a		Tot	Tot
	'82	'85	L. 4	'82	'85	L. 4a	
1					74	**74**	**74**
2					19	**19**	**19**
3					5	**5**	**5**
4					40	**40**	**40**
5					1	**1**	**1**
7					54	**54**	**54**
8					26	**26**	**26**
9					190	**190**	**190**
10				104	63	**167**	**167**
11					50	**50**	**50**
12		6	**6**				**6**
13		13	**13**				**13**
14					98	**98**	**98**
15					5	**5**	**5**
16					3	**3**	**3**
17					2	**2**	**2**
18				61	181	**242**	**242**
19				9	28	**37**	**37**
20					70	**70**	**70**
21					11	**11**	**11**
22					2	**2**	**2**
23					28	**28**	**28**
24					2	**2**	**2**
25					1	**1**	**1**
26					39	**39**	**39**
27					80	**80**	**80**
28					1	**1**	**1**
29					14	**14**	**14**
30					93	**93**	**93**
31	142	36	**178**				**178**
32					1	**1**	**1**
33		2	**2**				**2**

34		10	**10**				**10**
35		7	**7**				**7**
36		15	**15**				**15**
37					3	**3**	**3**
38					5	**5**	**5**
39		40	**40**				**40**
40					3	**3**	**3**
41					3	**3**	**3**
42		8	**8**				**8**
43					3	**3**	**3**
44				1		**1**	**1**
44				50		**50**	**50**
45	97	3	**100**				**100**
46	32		**32**				**32**
47		1	**1**				**1**
48		1	**1**				**1**
49	7	1	**8**				**8**
50	1	1	**2**				**2**
51		3	**3**				**3**
52				7		**7**	**7**
55		1	**1**				**1**
56		1	**1**				**1**
57		3	**3**				**3**
58	3	2	**5**				**5**
59				6		**6**	**6**
60				34	90	**124**	**124**
61	3	1	**4**				**4**
63		1	**1**				**1**
64		1	**1**				**1**
70	4	154	**158**				**158**
Other	57	7	**64**	46	19	**65**	**129**
Limestone					25	**25**	**25**
Burned					10	**10**	**10**
Hammerstone (frg.)		7	**7**				**7**
Retoucher					1	**1**	**1**
Tot	**346**	**325**	**671**	**318**	**1343**	**1661**	**2332**

Tab. 3.5: Number of findings per ULRM, layer and year of excavation

ULMR	Color	Munsell
15	Gray	1 gley 5/n
16	Light greenish gray	1 gley 7/10y
17	Light greenish gray	1 gley 7/10y
24	Light gray	1 gley 7/n
25	Gray	2.5 y 6/1
29	Light yellowish brown	2.5 y 7/3
30	White	2.5 y 8/1
31	Light gray	2.5 y 7/1
51	Light gray	2.5 y 7.2
63	Greenish gray	2 gley 5/5bg
70	White	2.5 y 8/1

Tab. 3.6: Munsell color of the findings on Maiolica flint

ULMR	Color	Munsell
3	Dark red	2.5 yr 4/6
20	Dusky red	2.5 yr 4/4
22	Pale red	10 r 6/2
23	Yellowish red	5 yr 4/6
26	Dark red	2.5 yr 4/6
28	Strong brown	7.5 yr 4/6
32	Yellowish red	5 yr 5/6
38	Pinkish gray	5 yr 7/2
39	Dark red	2.5 yr 4/6
40	Dark red	2.5 yr 4/6
41	Yellowish red	5 yr 5/6
43	Pale red	2.5 yr 7/3
47	Yellowish red	5 yr 4/6
48	Dark red	2.5 yr 4/6
50	Yellowish red	5 yr 5/6
55	Yellowish red	5 yr 4/6
56	Yellowish brown	10 yr 6/5
57	Yellowish red	5 yr 4/6
60	Dark red	2.5 yr 4/6

Tab. 3.7: Munsell color of the findings on Scaglia Rossa flint

ULMR	Color 1	Munsell	Color 2	Munsell	Color 3	Munsell
1	Dark gray	1 gley 4/n				
2	Dark gray	1 gley 4/n				
4	Dark greenish gray	1 gley 4/10y				
5	Yellowish red	5 yr 5/6	Dark gray	1 gley 4/n		
7	Strong brown	7.5yr 4/1				
8	Dark greenish gray	1 gley 4/10y				
9	Very dark gray	5 y 3/1				
10	Light greenish gray	2 gley 7/5bg	Light brown	7.5 yr 6/4	Dusky red	2.5 yr 4/4
11	Gray	5 y 6/1	Very dark gray	5 y 3/1		
12	Very dark gray	1 gley 3/n				
13	Yellowish red	5 yr 4/4	Light greenish gray	1 gley 7/5g		
14	Dark gray	1 gley 4/n	Dark greeish gray	1 gley 4/10y		
18	Red	2.5 yr 5/6	Light yellowish brown	2. Yr 6/3		
19	Dusky red	2.5 yr 4/4				
21	Olive gray	5 y 4/2				
27	Dusky red	2.5 yr 4/4				
33	Dusky red	2.5 yr 4/3				
34	Dark gray	1 gley 4/n				
35	Yellowish red	5 yr 4/6	Light brownish gray	2.5 y 6/2		
36	Gray	5 y 5/1				
37	Light brownish gray	10 yr 6/2				
42	Yellowish red	5 yr 4/6				
44	Dark gray	2.5 y 4/1				
45	Dusky red	2.5 yr 4/4	Pale olive	5 y 6/3		
46	Black	1 gley 2.5/n				
49	Pale red	2.5 yr 7/3				
52	Gray	2.5 y 5/1				
58	Dark gray	1 gley 4/n	Pale red	2.5 yr 7/2		
59	Dark gray	1 gley 4/n				
61	Dusky red	2.5 yr 4/7	Olive gray	5 y 4/2		
64	Very dark gray	7.5 yr 3/1				

Tab. 3.8: Munsell color of the findings on Scaglia Variegata flint

The incidence and relative proportions of the different raw materials has been assessed on the basis of both ULRM and number of findings. The examination of the same problematic from a twofold point of view lead to observations, mainly of a methodological significance, worth to be stressed. When evaluating raw materials composition in terms of ULRM, both represented by one or groups of artefacts, we deal with as many individual episodes of introduction/processing/use of single units of raw material into the specific area under analysis. Every ULMR testifies, therefore, of a deliberated choice, operated within the natural environment, linked to the specific technological needing of the group, conveyed by both natural and cultural constrains. The quality and dimensional standards of the flints of the area are generally high, so the observable differences in the represented formations incidences have to be traced in other natural factors such as visibility, proximity and granulometry of the outcrops.

Generally, tertiary flints are the most represented and account for about 51% of the ULRM, about 63% of the number of findings, but show important differences if considering layer 4 and 4a separately, and comparing the number of ULMR (NU) and the number of findings (NF) per formation (Tab. 3.9, Tab. 3.10). Despite of a quite slight increase of tertiary ULRM (15 to 17) from layer 4a to 4, a striking difference is instead evident if considering the NF (1156 to 211). Jurassic/Cretaceous flints show, conversely, a specular pattern, with substantially similar abrupt differences in terms of NU compared to NF. Finally, Cretaceous/Tertiary flints show a decrease, from layer 4a to 4, observable in both the NU and the NF.

Formation	Layer 4		Layer 4a		Tot	
Maiolica (Jurassic/Cretaceous)	4	14,3 %	7	20,6 %	11	17,7 %
Scaglia rossa (Cretaceous/Tertiary)	7	25,0 %	12	35,3 %	19	30,6 %
Scaglia variegata (Tertiary)	17	60,7 %	15	44,1 %	32	51,6 %
Tot	28	100,0 %	34	100,0 %	62	100,0 %
(Except ULRM: "other", "burnt", "limestone", "hammerstone", "retoucher"						

Tab. 3.9: Number of ULMR per formation

Formation	Layer 4		Layer 4a		Tot	
Maiolica (jurassic/cretaceous)	340	56,7 %	120	7,7 %	460	21,3 %
Scaglia rossa (cretaceous/tertiary)	49	8,2 %	284	18,2 %	333	15,4 %
Scaglia variegata (tertiary)	211	35,2 %	1156	74,1 %	1367	63,3 %
Tot	600	100 %	1560	100 %	2160	100,0 %
(except ULRM: "other", "burnt", "limestone", "hammerstone", "retoucher")						

Tab. 3.10: Number of findings per formation

The reasons of such data patterning can be several, including a sampling bias (areas partially excavated). Can be nevertheless reasonably argued that raw materials actually underwent different economic choices, which will be further finer assessed. At this basic level of observation some conclusions can however be drawn considering the possible technological meaning of the ratio NF/NU. High values of the NF/NU ratio, corresponding to high numbers of artefacts per ULRM, can theoretically be due to a series of factors like a higher flaking activity and/or a lower degree of introduction of preformed blocks and readymade blanks and tools. Conversely, low ratio values suggest a limited flaking activity due to the introduction of preformed/partially exploited blocks and readymade blanks and tools.

The NF/NU values of 45,9 for layer 4a and 21,4 for layer 4, calculated on 62 ULRM and corresponding artefacts, suggest the existence of different strategies of raw material management. In particular, a further articulation is observable when comparing the values of each flint formation (Tab. 3.11). Maiolica flint shows more findings per ULRM in layer 4 than in 4a, while Scaglia Rossa and, mostly, Scaglia Variegata flint, returned opposite data.

Formation	Layer 4	Layer 4a
Maiolica (Jurassic/Cretaceous)	85,0	17,1
Scaglia rossa (Cretaceous/Tertiary)	7,0	23,7
Scaglia variegata (Tertiary)	12,4	77,1

Tab. 3.11: Number of findings / number of ULRM ratio

As introduced in ch.1, the raw materials pedological and depositional environment of collection has been determined by the morphology and degree of elaboration of the natural surfaces, whose morphology is induced by the natural environment where the flint blocks lie after their detachment from the parent rock. The little or not elaborated calcareous cortexes have been associated to collection places close to primary outcrops, calcareous and neocortical surfaces bearing rounded (rolled) edges to stream beds and alluvial deposits, sharp edged neocortical surfaces to debris deposits and, finally, pedo-chemically altered surfaces to soils. A certain number of artefacts, mainly the smallest ones, showing unclear (neo)cortical features, have been classified to undeterminable secondary outcrop. Here again, the incidence of each collection environment has been evaluated on both the NU and the NF (Tab. 3.12, Tab. 3.13). Contrary to what previously observed in the case of flint formations, the comparison between the two means of evaluation seems to highlight minor problems of (mis)interpretation, even if substantial differences anyway occur.

In general, the majority of the flint has been collected within debris deposits most likely close to primary outcrops, because of the high percentages of both ULRM and single findings showing little elaborated calcareous cortical surfaces. This evaluation can be further supported by the presence of 25 limestone flakes (layer 4a), not counted in the tables below, probably coming from the outer portion of thickly corticated nodules and slabs.

Considering the whole assemblage, the other main exploited environment of flint collection is represented by the fluviatile/alluvial deposits. However, when considering the two layers separately, some contrasting feature arises, like what observable, in layer 4, about the shifting percentages of fluviatile and debris deposits. Once again, different economic strategies could have produced, according to NU and NF viewpoints, an apparently contrasting data patterning.

Flint from debris deposits, if compared with the previous, seems to have, anyway, a minor weight, while soil altered flint show negligible incidences. Tab. 3.14 clearly shows how the collecting environment, evaluated for every single flint formation, is consistent with the previously observed trend.

Collecting environment	Layer 4		Layer 4a		Tot	
Close to primary outcrop	15	53,6 %	20	58,8 %	35	56,5 %
Soil			1	2,9 %	1	1,6 %
Stream bed/alluvial deposit	3	10,7 %	5	14,7 %	8	12,9 %
Debris	4	14,3 %			4	6,5 %
Undeterminable secondary	2	7,1 %	4	11,8 %	6	9,7 %
Tot	24	100,0 %	30	100,0 %	54	100,0 %
(Only ULRM with cortical findings; except ULRM: "other", "burnt", "limestone", "hammerstone", "retoucher")						

Tab. 3.12: Number of ULRM per collecting environment

Collecting environment	Layer 4		Layer 4a		Tot	
Close to primary outcrop	91	44,6 %	488	78,3 %	579	70,0 %
Soil			5	0,8 %	5	0,6 %
Stream bed/alluvial deposit	71	34,8 %	118	18,9 %	189	22,9 %
Debris	40	19,6 %			40	4,8 %
Undeterminable secondary	2	1,0 %	12	1,9 %	14	1,7 %
tot	**204**	100,0 %	**623**	100,0 %	**827**	100,0 %
(only cortical findings; except ulrm: "other", "burnt", "limestone", "hammerstone", "retoucher")						

Tab. 3.13: Number of findings per collecting environment

Collecting environment	Maiolica		Scaglia rossa		Scaglia variegata		Tot	
Close to primary outcrop	7	63,6 %	10	52,6 %	18	56,3 %	35	56,5 %
Soil			1	5,3 %			1	1,6 %
Stream bed/alluvial deposit	1	9,1 %	2	10,5 %	5	15,6 %	8	12,9 %
Debris			1	5,3 %	3	9,4 %	4	6,5 %
Undeterminable secondary outcrop	1	9,1 %	2	10,5 %	3	9,4 %	6	9,7 %
Undeterminable (ulrm without cortical elements)	2	18,2 %	3	15,8 %	3	9,4 %	8	12,9 %
Tot	11	100,0 %	19	100,0 %	32	100,0 %	62	100, 0 %
(except ulrm: "other", "burnt", "limestone", "hammerstone", "retoucher")								

Tab. 3.14: Number of ULRM per formation and collecting environment

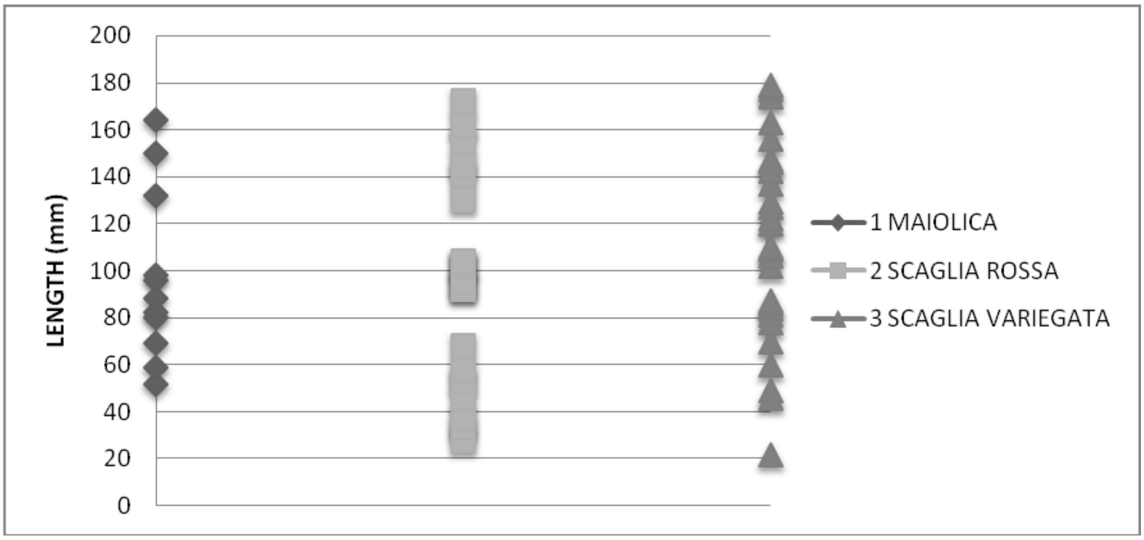
A discretization of blocks morphologies has been tried on the basis of the most complete refittings and largest pieces and a total of 12 ULRM has been classified to one of four general geometric solid shapes, according to their collecting environment: ellipsoid, flat ellipsoid, ellipsoid with a flat, generally neocortical, side, and parallelepipedoid, with at least two flat sides and, consequently, at least one natural arris. Results are shown in Tab. 3.15. Generally, ellipsoidal shapes, both flattened or not, are the most frequent among the determinable ones.

Blocks morphology	Close to primary outcrop	Soil	Stream bed/alluvial deposit	Debris	Tot	
Ellipsoid	2		2		4	33,3 %
Flat ellipsoid	2		1		3	25,0 %
Ellipsoid + Flat side				1	1	8,3 %
Parallelep.	1	1	2		4	33,3 %
Tot	**5**	**1**	**5**	**1**	**12**	100,0 %

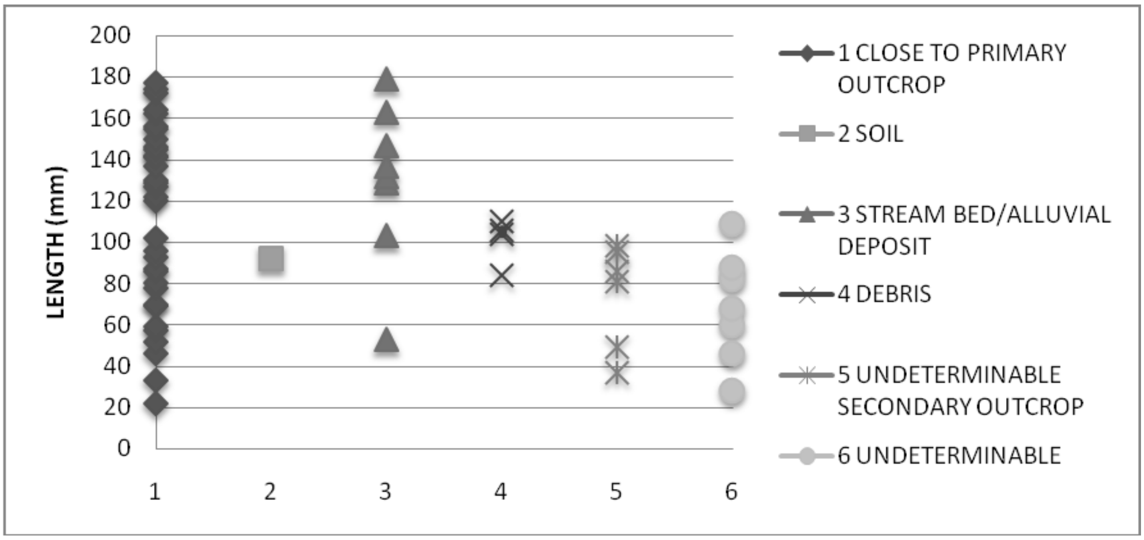
Tab. 3.15: Determinable ULRM morphology

The minimum determinable size of the raw blocks has been estimated by recording the maximum dimension detectable on each ULRM. The measures have been taken on the largest piece or the largest refitting of each ULRM. It has rarely been possible to register the actual maximum sizes of the raw blocks, namely between two opposite cortical sides. Therefore the estimates can be classified as to "minimum maximum sizes". Only the highest values of the graphs below should be regarded as actual indicators on which to speculate. Estimates on the minimum sizes are, possibly, even more difficult to provide.

Raw blocks maximum size values are around 160-180 mm, and, if plotted according to flint formation, doesn't return substantially different patterns from each other (Graph 3.4). Meaningful information comes, conversely, by plotting them according to the corresponding collecting environments (Graph). It results in this way that the largest units of raw material have been collected within secondary outcrops, both close to primary ones or of fluviatile/alluvial character, which are, as above mentioned, also the most exploited.



Graph 3.4: Minimum determinable size of the raw blocks per formation



Graph 3.5: Minimum determinable size of the raw blocks per collecting environment

3.3.3. Reduction sequence, general observations

Tab. 3.16 and Tab. 3.17 present the general composition of the assemblage, whose technological main classes are organized according to the theoretical development of the reduction sequence principal phases. While in general tables it has always been maintained the distinction between layers, many of the results of the subsequent elaborations will be provided without any distinction. While being aware of possible data loss and data misreading in some extent, it has been found useful to not split it in order to deal with greater amounts of observations and to provide an as much as clear interpretation. Further, undifferentiated flakes, fragments and undeterminable items smaller than 25 mm are not considered.

Few unprocessed or tested units of raw material testify of the scarce representation of the acquisition phase, whose incidence is 0,1%-0,2% of the assemblage. They are nonetheless present and should be regarded as an actual segment of the technological life of the site, where at least a small amount of raw material has been introduced in its integrity, without of course any presumable intention of actual storage. Artefacts referable to the shaping phase represent, conversely, an important part. Five pre-cores, which have been attributed to this phase according to the reasons mentioned in ch.1, and almost 800 undifferentiated flakes, account for about 33% of the whole assemblage. To the phase of laminar production have been attributed both initialization and full production artefacts, which respectively account for about 2% and 31-38%. Management interventions, carried out by the extraction of both flakes and laminar products, represent globally about 20% of the assemblage, with a lower incidence in layer 4 (16,3%) rather than in layer 4a (22,3%). The deactivation of production and subsequent core abandon, being present for about 0,3%, seems to be a poorly represented phase, contrasting with the amount of units of raw material recognized. The amount of artefacts referable to this phase is rather poor and mostly consists in cores and, in a lesser extent, reconfigured cores. Finally, the transformation phase, entirely consisting in retouched blanks, both common tools and a few armatures, is represented by 148 artefacts for a global incidence of about 6%. A series of three processing implements complete the assemblage: one hammerstone on a reutilized flint core; one fragmented, almost entirely refitted, limestone pebble used as hammerstone and a limestone pebble used as retoucher.

Phase	**Diagnostic artefacts**	**L. 4**		**L. 4a**		**Tot**	
		N	**%**	**N**	**%**	**N**	**%**
Acquisition	Unprocessed/tested blocks	1	**0,2**	2	**0,1**	3	0,13
Shaping	Undifferentiated flakes	237	**35,7**	535	**32,2**	772	33,23
	Precores	3	**0,5**	2	**0,1**	5	0,22
Production	Initialization laminar products	11	**1,7**	36	**2,2**	47	2,02
	Full production laminar products	253	**38,2**	524	**31,6**	777	33,45
Management	Management laminar products	29	**4,4**	67	**4,0**	96	4,13
	Management flakes	79	**11,9**	303	**18,3**	382	16,44
Deactivation of production	Cores	4	**0,6**	4	**0,2**	8	0,34
	Reconfigured cores	1	**0,2**			1	0,04
Transformation	Retouched blanks	26	**3,9**	122	**7,3**	148	6,37
Undeterminable	Undeterminable	19	**2,9**	65	**3,9**	84	3,62
	Tot	**663**	**100,0**	**1660**	**100,0**	**2323**	100,00
	Hammerstones	1				1	
	Hammerstone fragments	7				7	
	Retouchers			1		1	

Tab. 3.16: Technological classes and related reduction phases

Phase	**L. 4**		**L. 4a**		**Tot**	
	N	%	N	%	N	%
Acquisition	1	0,2	2	0,1	3	0,1
Shaping	240	36,2	537	32,3	777	33,4
Production	264	39,8	560	33,7	824	35,5
Management	108	16,3	370	22,3	478	20,6
Deactivation of production	5	0,8	4	0,2	9	0,4
Transformation	26	3,9	122	7,3	148	6,4
Undeterminable	19	2,9	65	3,9	84	3,6
Tot	663	100,0	1660	100,0	2323	100,0

Tab. 3.17: Reduction sequence main phases

3.3.4. Acquisition

Three unprocessed blocks, consisting in tested units of raw material of the Scaglia Variegata formation, have been collected within stream beds (1) and debris close to primary outcrop (2). According to their size (57x48x13, 110x84x79, 123x113x34), they broadly agree with the general trend above observed, both in terms of absolute values and of corresponding collecting environments.

3.3.5. Shaping

The undifferentiated flakes and pre-cores, broadly attributed to the shaping phase, are analyzed according to a set of variables thought to be informative especially of the ways of entry of the raw materials.

Pre-cores, consisting in shaped units of raw material suggesting a predisposition of the convexities for a delayed use, both initialized or not, are represented by five specimens, four of which on blade (*Fig. 3.18*) and one on flake (Tab. 3.18). No preformed block has been found. The blanks, processed to potentially be used as cores, has to be interpreted as the outcome of parallel production chains which could exploit the flaking products obtained at the site, as in the case of two blade pre-cores of layer 4a, which belong to ULRM with more than one finding each, or introduced as readymade blanks, as for a blade and a flake of layer 4 found to be the only representatives of as many ULRM. The last pre-core belongs to the "other" ULRM. Shape, size and further indications from the initialized pre-cores suggest they have been predisposed for bladelets extraction.

Fig. 3.18: Pre-core on a large plunged blade

	On blade		On flake	Tot = 5
	Layer 4	Layer 4a	Layer 4	
Pre-core	1	1	1	3
Initialized pre-core	1	1		2

Tab. 3.18: Precores blanks

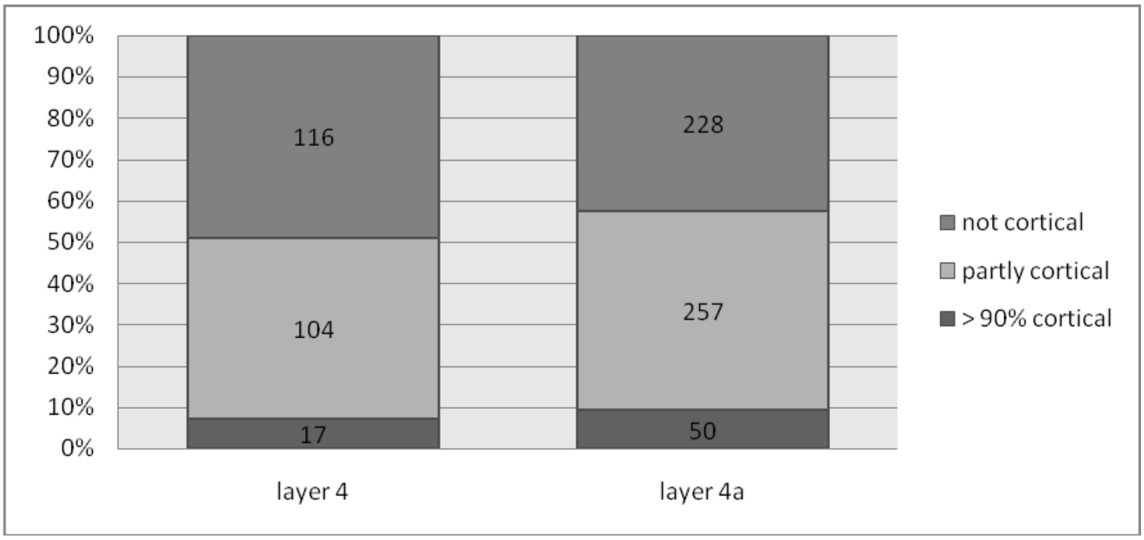
Unretouched undifferentiated flakes are the by-products of raw material shaping, which is assumed to have occurred at the site in a quite large extent. Generally speaking, about 10% of flakes with cortex presence for more than 90% of the dorsal surface and a balanced amount of partially and not cortical flakes suggest continuous shaping processes of almost raw blocks. Actually, the occurrence of a shaping phase has been recognized on 44 out of 62 ULRM (except "other", "limestone", "burnt", "hammerstone" and "retoucher" ULRM), with very varied incidences of cortical, partially and not cortical pieces (Graph 3.6, Graph 3.7.)

By the moment that part of the undifferentiated flakes have been retouched into scrapers and other expedient tools, it has been found useful to compare their distribution, in terms of ULRM and cortex presence, with the data obtained from the unretouched ones, in order to exclude a possible misreading of the pattern caused by the exclusion of part of the record because of its "being retouched". As visible in Graph 3.8, no substantial differences would have occurred adding the data coming from retouched flakes to the unretouched ones.

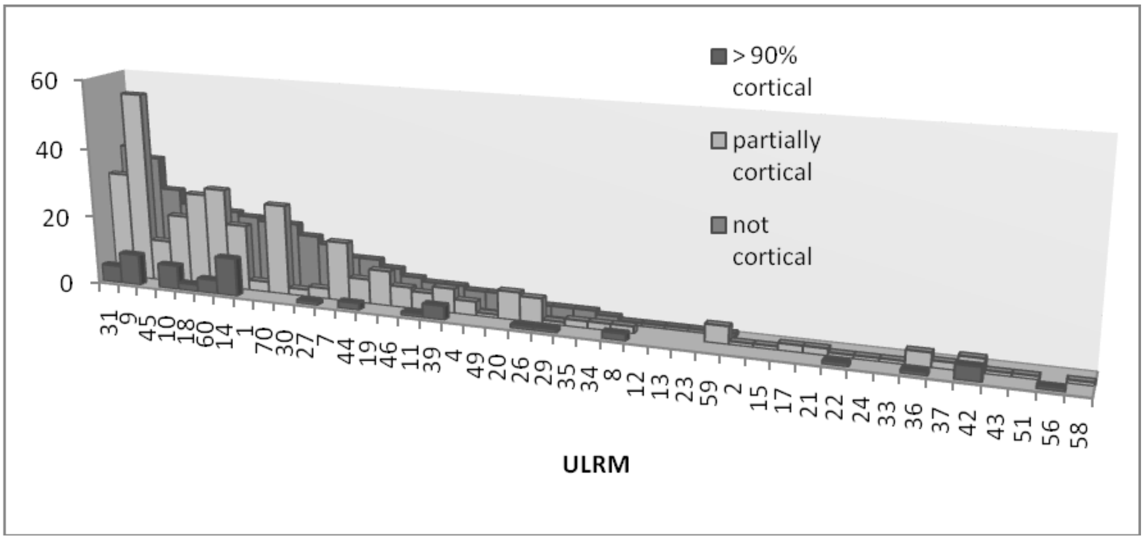
Fig. 3.19: Refitting cortical flakes, one of which subsequently retouched into a large notch

Part of the material (18 ULRM) has been introduced at an advanced stage of processing and hasn't been subject to any shaping episode at the site. Further, 26 ULRM, out of the 44 recognized to have been shaped at the site, doesn't bear any fully cortical flakes, suggesting that more than half of the raw material subject to shaping has been introduced partially preformed. Finally, most part of the tools made on ordinary flakes have been processed at the site (*Fig. 3.19*). Further, it should be nevertheless kept in mind the presence of 25 limestone flakes, mainly portions of cortex which, if could have been attributable to some recognized ULRM, would have probably changed in some extent the above presented pattern.

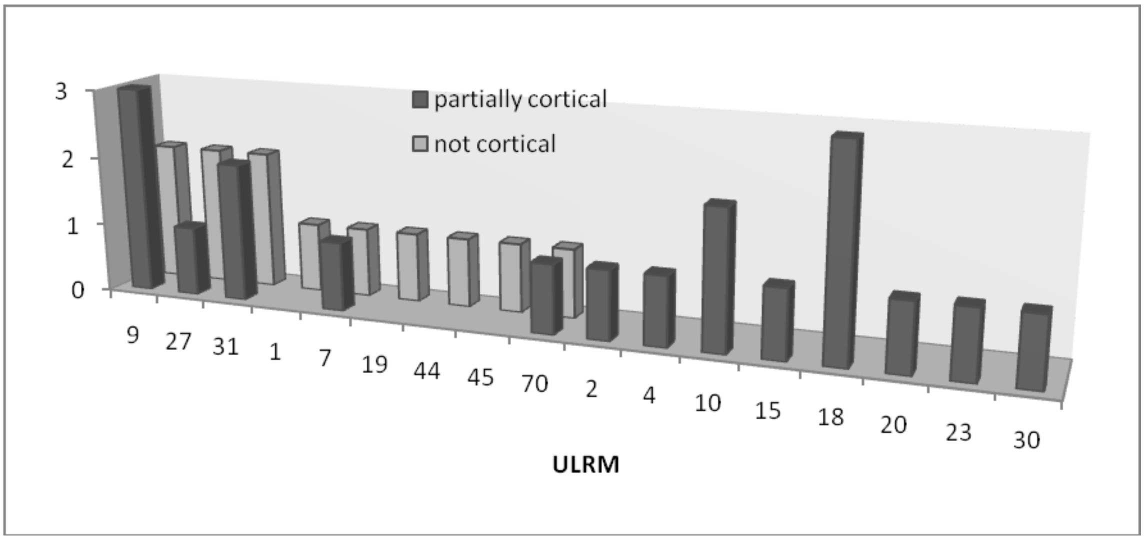
Fully cortical flakes show clear features suggesting the exclusive application of the hard stone direct percussion. Soft stone direct percussion is present in a limited extent only among partially and not cortical specimens (Graph 3.9). Some degree of misinterpretation cannot be anyway excluded due to frequent occurrence of morphological convergence phenomena of the diagnostic characters. Conversely, the quite unambiguous organic soft hammer direct percussion characters identified on a set of flakes induces to think about them as to undifferentiated management products rather than shaping products, probably extracted during laminar production without changing the soft organic flaking implement.



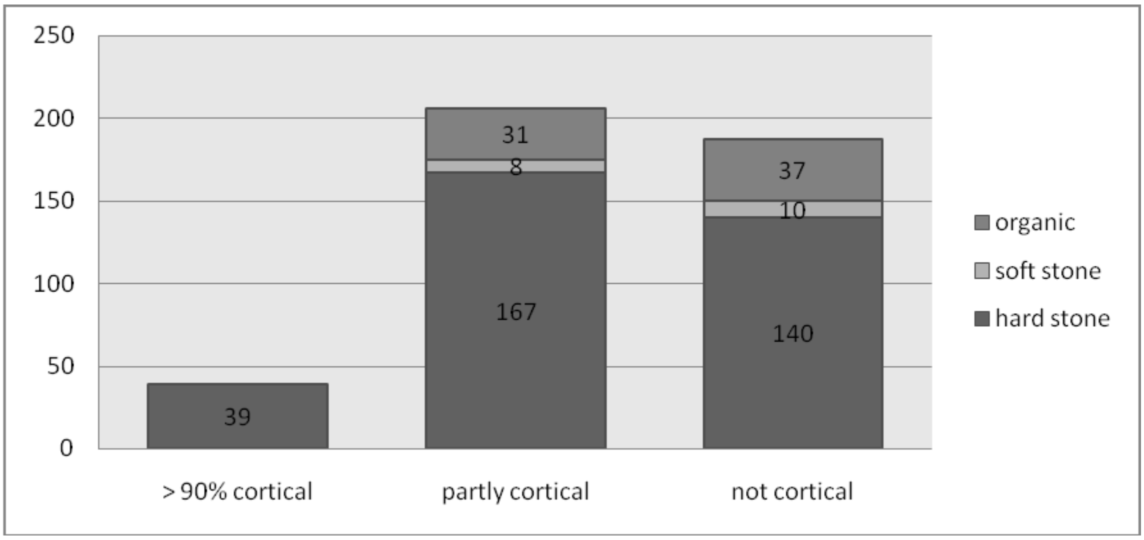
Graph 3.6: Undifferentiated flakes cortex amount



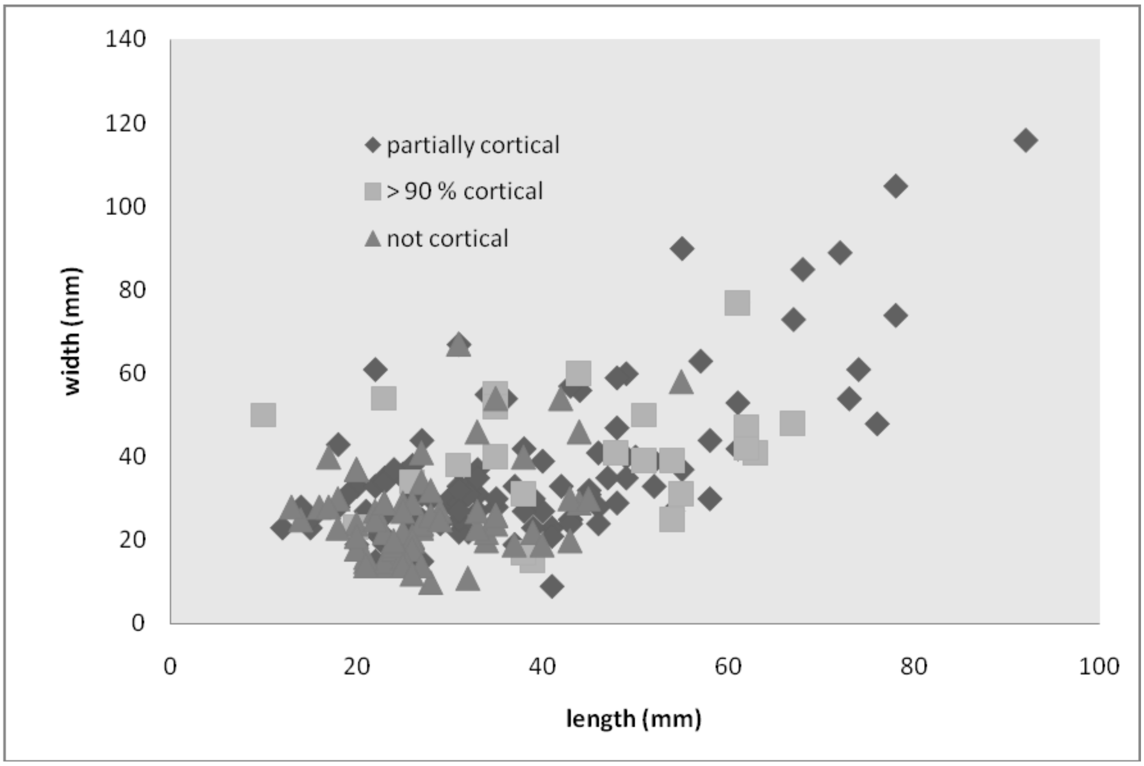
Graph 3.7: Undifferentiated flakes cortex amount per ULRM



Graph 3.8: Retouched flakes cortex amount



Graph 3.9: Flaking technique applied to shaping flakes



Graph 3.10: Undifferentiated flakes size, layers 4 and 4a grouped, 1985 excavation

3.3.6. Laminar production

3.3.6.3. Quantitative characters

Three main lamino-lamellar production sub-phases, from initialization onward, has been considered, recognizable on the basis of a series of artefacts diagnostic features. The analysis of the incidences of each laminar sub-class and their main morphologic, technical and metric features contributed to define the range of production objectives and to refine the interpretation of the assemblage in terms of both functional orientation and economic strategies. The convexities restoration by means of the reshaping of the volume and subsequent extraction of flakes or laminar products, is here considered within the management phase, and will accordingly be presented in a separate section.

Fig. 3.20: Initialization products: natural dihedrals and natural convexities

Fig. 3.21: Shaping out of crested blades

Fig. 3.22: Extraction of crested blades

Fig. 3.23: Semicortical laminar products

Fig. 3.24: Not cortical laminar products

The composition of the unretouched laminar products is consistent with continuous production processes, from initialization to full production and contextual management of the transversal convexity (Tab. 3.19, Tab. 3.20, Tab. 3.20). Laminar initialization (*Fig. 3.20*, *Fig. 3.21*, *Fig. 3.22*) (5,7%) is principally carried out by means of crests extraction, mainly bilateral rather than unilateral on a natural surface, while the exploitation of natural convexities is less represented. Laminar products belonging to initial and advanced phases of full production (82,6 %), characterized by two sharp edges, here referred to as "central blades", comprise *sous-crêtes* and subsequent products, both semicortical or not (*Fig. 3.23*, *Fig. 3.24*). They represent the very most part of the laminar assemblage. Almost 3% of them is composed of laminar flakes, which doesn't seem to represent the objective of distinct reduction sequences but, rather, failed laminar extractions. Four burin spalls have been tentatively classified among the laminar production phase, but their incidence is negligible. Debording blades showing a natural back (11,7 %), cortical or not, here referred to as "lateral blades", are interpreted as the result of the *in fieri* maintenance of the transversal convexity (*cintrage*) and accordingly placed within the production phase.

Laminar product	**N**	**%**
Crested and naturally convex products	47	5,7%
Central products	681	82,6 %
Lateral products	96	11,7 %
Tot	824	100,0 %

Tab. 3.19: Unretouched laminar classes, synthetic classification and quantitative composition

Subphase	**Laminar product class***	**Layer 4**		**Layer 4a**		**N**	**%**
Initialization (5,7 %)	Bilateral crest	6	**2,3 %**	19	**3,4 %**	25	3,0 %
	Unilateral crest on natural surface	1	**0,4 %**	8	**1,4 %**	9	1,1 %
	Natural convexity			5	**0,9 %**	5	0,6 %
	Natural dihedral	4	**1,5 %**	4	**0,7 %**	8	1,0 %
Full production (82,6 %)	*Sous-crête*	11	**4,2 %**	24	**4,3 %**	35	4,2 %
	(LF) *Sous-crête*	2	**0,8 %**	1	**0,2 %**	3	0,4 %
	Central, partially cortical	30	**11,4 %**	111	**19,8 %**	141	17,1 %
	Central, not cortical	183	**69,3 %**	299	**53,4 %**	482	58,5 %
	(LF) Central, not cortical	2	**0,8 %**	9	**1,6 %**	11	1,3 %
	(LF) Central, partially cortical			5	**0,9 %**	5	0,6 %
	Burin spall			4	**0,7 %**	4	0,5 %
Cintrage maintenance (11,7 %)	Lateral, partially cortical	11	**4,2 %**	39	**7,0 %**	50	6,1 %
	Lateral, not cortical	14	**5,3 %**	32	**5,7 %**	46	5,6 %
	TOT *(LF= laminar flake)	**264**	**100,0 %**	**560**	**100,0 %**	**824**	100,0 %

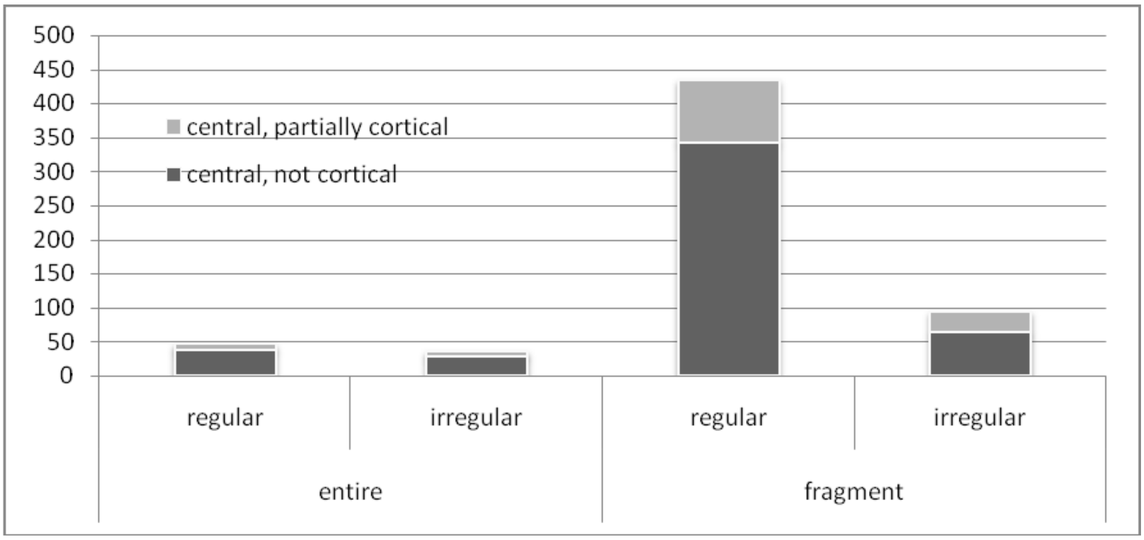
Tab. 3.20: Unretouched laminar products, incidence of the different classes per layer

The incidence of fragmented pieces is quite high (*Tab. 3.21*) reaching almost 85% of the whole laminar assemblage. The lowest frequencies of entire products are recordable for initialization products (12,8%), while central and lateral products show respectively increasing values.

Of some interest can be the higher percentage of entire lateral products respect to central ones, suggesting this can be probably due to their being by-products or 2nd choice products, and therefore more frequently abandoned/discarded at the site. Further indications about this topic come from the qualitative evaluation of blanks regularity. Irregular blanks are considered all those specimens which, while showing clear predetermination features like platform, angles and convexities arrangement, present meanwhile some kind of irregularity in morphology and profile or are affected by flaking accidents. Graph 3.11 presents the distribution of regular and irregular central laminar products according to their integrity. While observing that most part of the laminar assemblage is composed by regular rather than not regular blanks, is nevertheless noticeable the relative difference among the regular/irregular entire blanks and their fragmented correspondents. This pattern would suggest a reason for the discard of a great amount of regular blanks, probably because of their being fragmented. Anyway, a detailed analysis of fractures (not carried out in the present work) could be decisive for the understanding of such a matter.

Integrity rate	Initialization products		Central products		Lateral products		TOT	
Entire	**6**	12,8 %	**97**	14,2 %	**24**	25,3 %	127	15,4 %
Proximal fragment	**9**	19,1 %	**265**	38,8 %	**33**	34,7 %	307	37,3 %
Mesial fragment	**17**	36,2 %	**209**	30,6 %	**17**	17,9 %	243	29,5 %
Distal fragment	**15**	31,9 %	**110**	16,1 %	**22**	23,2 %	147	17,8 %
TOT	47	100,0 %	681	100,0 %	96	100,0 %	824	100, 0%

Tab. 3.21: Unretouched laminar products, integrity rate



Graph 3.11: Distribution of regular and irregular central laminar products according to integrity

The quantitative distribution of the unretouched laminar classes and laminar production phases subdivided according to ULRM is presented in Graph 3.12 and Graph 3.14. For a better readability, they are arranged according to central not cortical blanks, which are supposed to be the final production objectives. Graph 3.13 and Graph 3.15 present the data about retouched laminar blanks of layers 4-4a. The comparison between retouched and unretouched blanks, aimed to detect major differences and avoiding interpretations based on partial data coming from the unretouched blanks only, highlights the presence of two retouched blanks (ULRM 25 and 28) whose ULRM is not shared with any of the unretouched ones. Further, retouched blanks doesn't introduce substantial changing in the general pattern (Tab. 3.23).

If reasoning in terms of pure absence/presence of the main laminar classes per ULRM, an interesting pattern is observable in Tab. 3.24. Central laminar products are ubiquitous and seem to represent an hypothetical point of arrival of differently advanced reduction processes. The general observed pattern could be synthesized as follows (

Tab*. 3.22*):

IF are present	THEN are present too
Initialization products	Lateral products AND Central products
Lateral products	Central products

Tab. 3.22: Synthetic presence/absence pattern of central, initialization and lateral products

Moreover, within each ULRM, to high frequencies of central laminar blanks correspond a higher incidence of initialization and lateral products, suggesting a direct correlation between state of entry of the ULRM and intensity degree of its processing.

<table>
<tr><th colspan="2">ULMR Layer 4a</th><th colspan="2">ULMR Layer 4</th></tr>
<tr><th>unretouched</th><th>retouched</th><th>unretouched</th><th>retouched</th></tr>
<tr><td colspan="2">1</td><td>12</td><td></td></tr>
<tr><td>2</td><td></td><td>13</td><td></td></tr>
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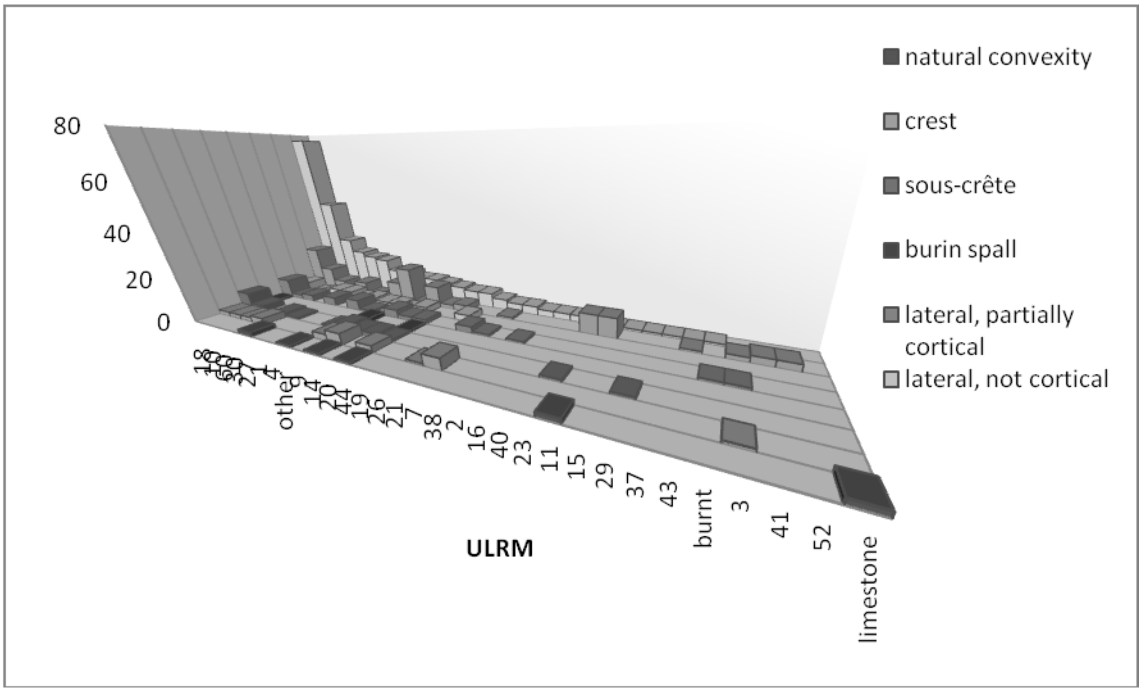
<tr><td colspan="2">60</td><td></td><td></td></tr>
<tr><td colspan="4">SHARED</td></tr>
<tr><td colspan="4">NOT SHARED</td></tr>
</table>

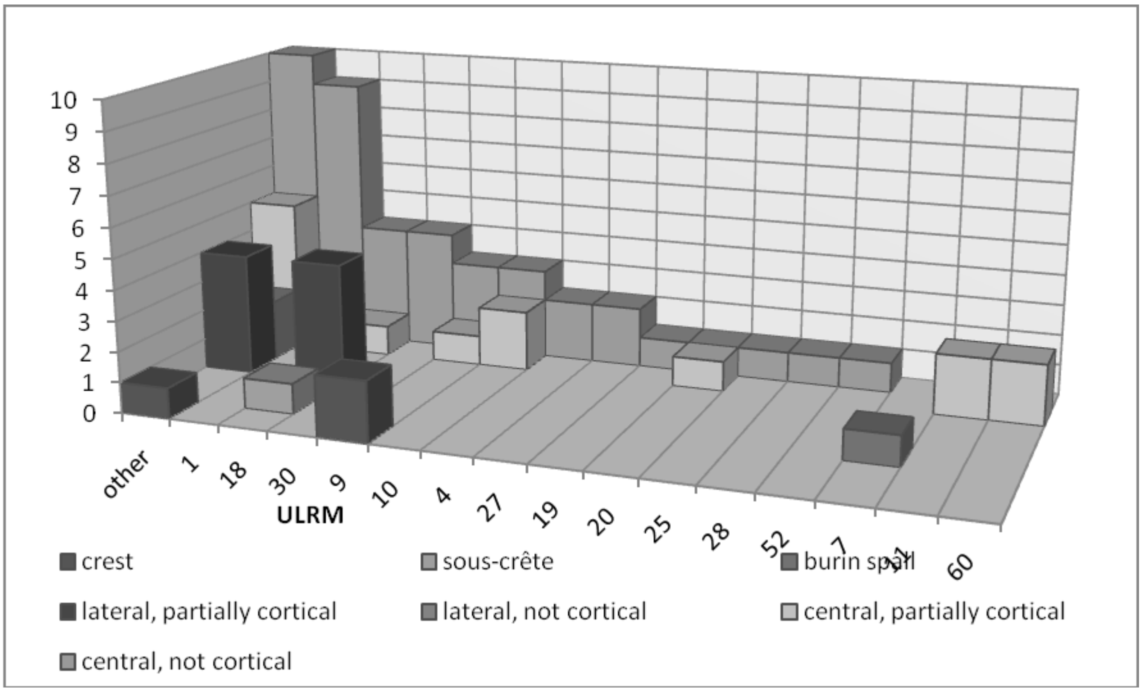
Tab. 3.23: Synthetic distribution of unretouched and retouched blanks among ULRM

Layer 4a				**Layer 4**			
Ulrm	**Initialization Products**	**Lateral Products**	**Central Products**	**Ulrm**	**Initialization Products**	**Lateral Products**	**Central Products**
18	√	√	√	70	√	√	√
10	√	√	√	31	√	√	√
60	√	√	√	45	√	√	√
30	√	√	√	39	√		√
27	√	√	√	34		√	√
9	√	√	√	13		√	√
14	√	√	√	35		√	√
44	√	√	√	12		√	√
21	√	√	√	58		√	√
7	√	√	√	46			√
3	√	√	√	61			√
11	√		√	36			√
1		√	√	51			√
4		√	√	49			√
20		√	√	50			√
2		√	√	57			√
26		√	√	63			√
38			√	64			√
19			√	Other		√	√
16			√				
40			√				
23			√				
15			√				
29			√				
37			√				
43			√				
41			√				
52			√				
Other	√	√	√				
Limeston e	√						
Burnt		√	√				

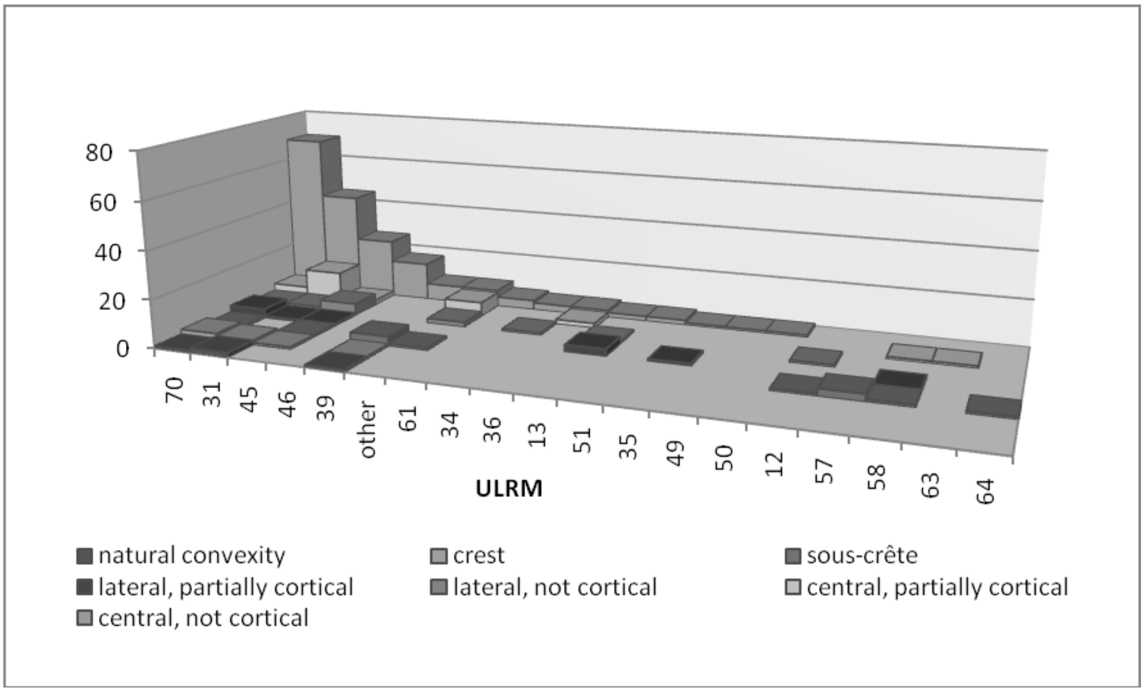
Tab. 3.24: Presence/absence pattern of central, initialization and lateral products



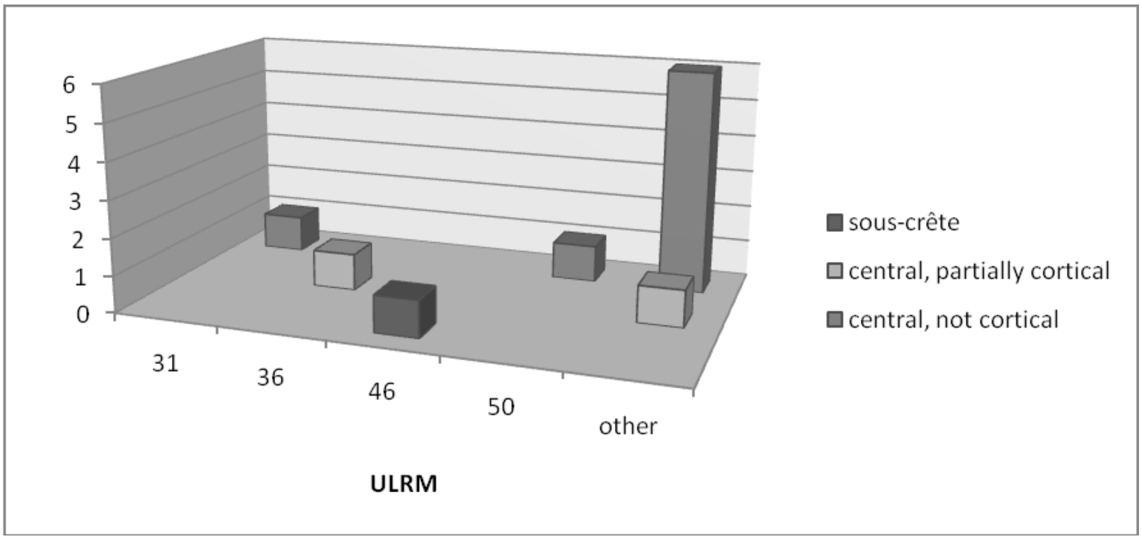
Graph 3.12: Unretouched laminar blanks per ULRM, layer 4a



Graph 3.13: Retouched laminar blanks per ULRM layers 4a



Graph 3.14: Unretouched laminar products per ULRM, layer 4



Graph 3.15: Retouched laminar products per ULRM, layer 4

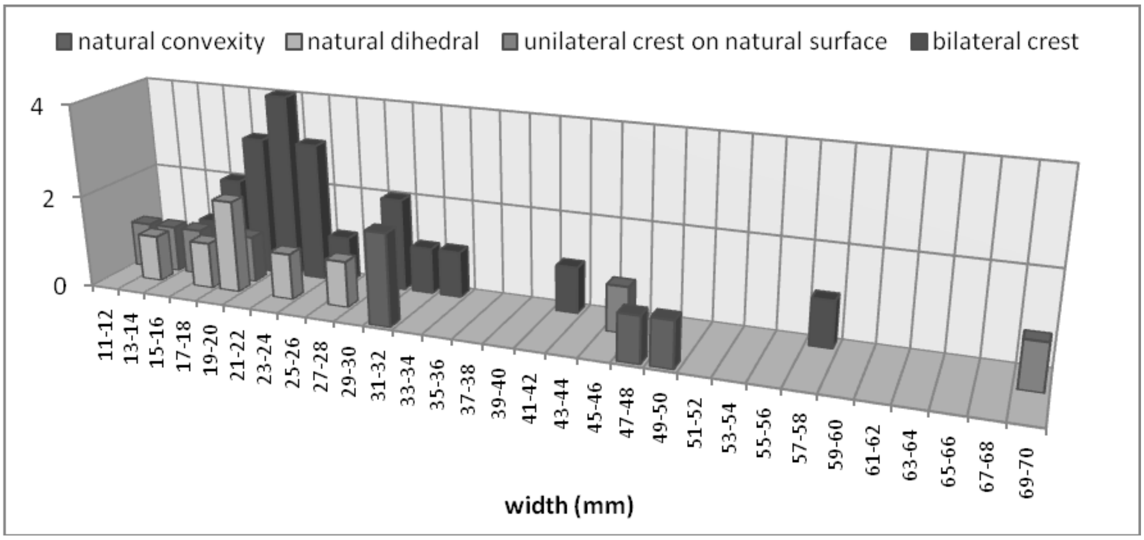
3.3.6.4.Morpho-technical and morpho-metric characters

Initialization products width cover a wide range of calibers, from a minimum of 11-12 mm to a maximum of 69-70 mm, corresponding to the bladelets/mega-blades *spectra*, with of course significant distribution patterns (Graph 3.16). Natural convexities show values around 31-32 mm and 47-52 mm, without any important frequency pick because of their low incidence. Natural dihedrals are conversely a little more eloquent by this point of view, showing a range between 13 and 28 mm with a frequency pick around 19-20 mm. Unilateral crests on natural surface are almost all clustered between 11 and 22 mm, with two occurrences at 45-46 mm and 69-70 mm. Finally, bilateral crests, which are the most represented initialization laminar products, show two clusters respectively between 15 and 26 mm, with a frequency pick around 21-22 mm, and another between 29 and 34 mm. Two further isolated occurrences are 41-42 mm and 57-58 mm.

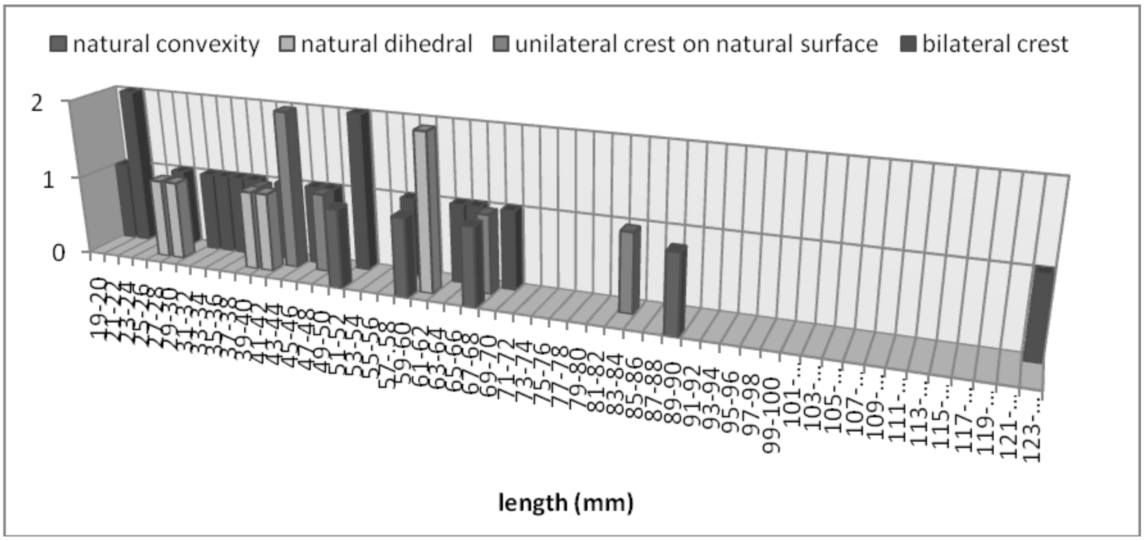
The natural convexities *l.s.*, which are the representatives of a shaping/initialization phase, show two different, not overlapped, distributions probably due to the relation between raw blocks size and production objectives. Natural convexities, extracted from rounded blocks, are represented only within the mega-blades while natural dihedrals, coming from sharp edged blocks, are comprised between bladelets and large blades *spectra.* Crests installed on a natural surface are clustered within the bladelets/blades *spectra*, with two occurrences within the mega-blade *spectrum*, one of which being the largest initialization product recorded. Bilateral crested blades show two clusters and two isolated occurrences. The first cluster is comprised within the large bladelets/blades *spectra* while the second between the higher values for large blades and the lowest for mega-blades. The other two specimens fall within the mega-blades *spectrum*.

Crests, mainly the bilateral ones, are thought to be strictly linked to the subsequent production objectives because of being obtained after a deliberated reduction of the raw volume, and, according to their distribution, suggest that the laminar production sequences mostly started from blade laminar calibers, with important distribution tails towards bladelets, on one side, and large/mega blades, on the other.

As regards length, because of the quite high fragmentation, it has been found useful to consider both entire and fragmented specimens, in order to obtain an at least broad evaluation of the maximum values (Graph 3.17), which are recorded for natural convexities around 89-90 mm, for natural dihedrals around 61-62 mm, for unilateral crests on natural surface around 83-84 mm and for bilateral crests around 123-124 mm.



Graph 3.16: Width spectrum of initialization laminar products, 1985 excavation

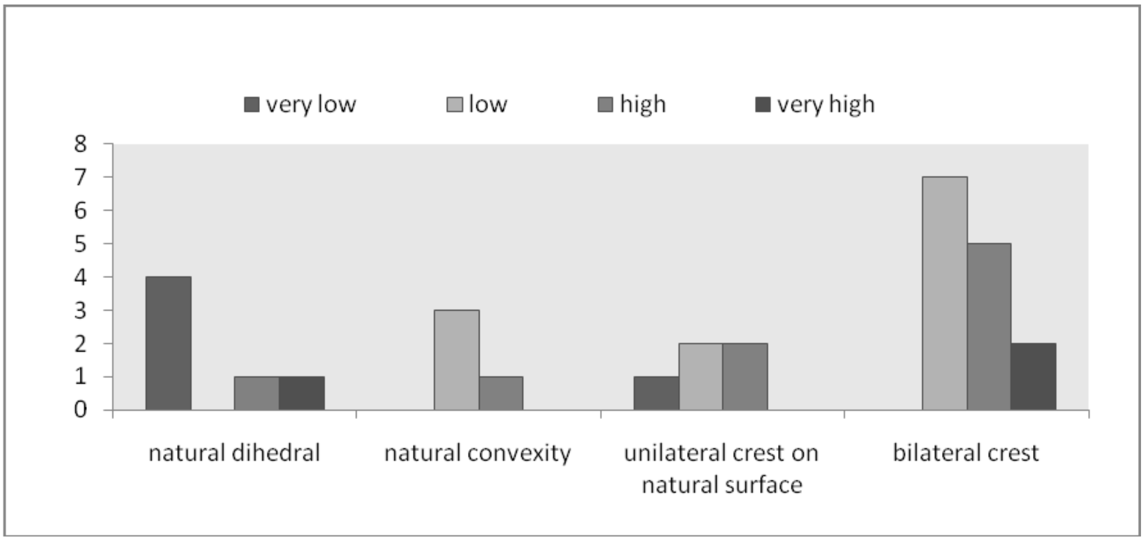


Graph 3.17: Length spectrum of initialization laminar products, (entire and fragmented specimens), layers 4 and 4a grouped, 1985 excavation

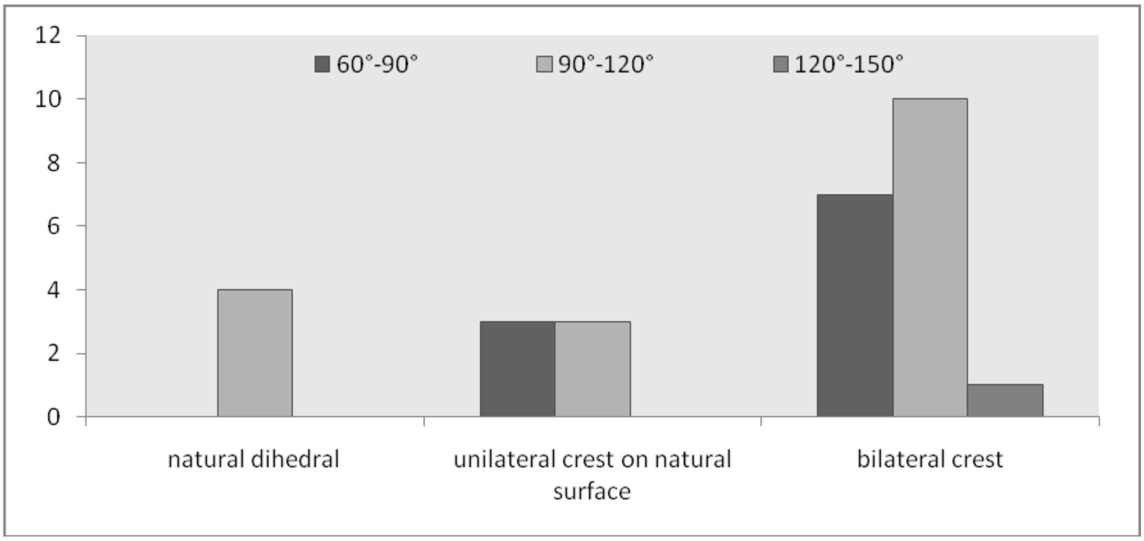
The evaluation of longitudinal and transversal convexities, carried out by means of the standard reference scheme illustrated in chp.1, suggests some indications about the main convexity degrees researched by the handcrafts (Graph 3.18, Graph 3.19).

Bilateral crests, once again, since being deliberated fashioned according to desired parameters, provide the best indications about this topic. The most part of them show low to high longitudinal convexities, with few very high convex specimens and no very low convex ones. The same could be said for unilateral crests, even if reasoning with a smaller number of observations. Natural convexities follow the trend of the retouched crests, exhibiting low to high convexities, while natural dihedrals are mostly very low convex. The evaluation of the dorsal angle taken as measure unit for the estimate of the transversal convexity places the very most part of the bilateral crests and the totality of unilateral ones within the 60°-120° range, while natural dihedrals show a more restricted range, from 90° to 120°.

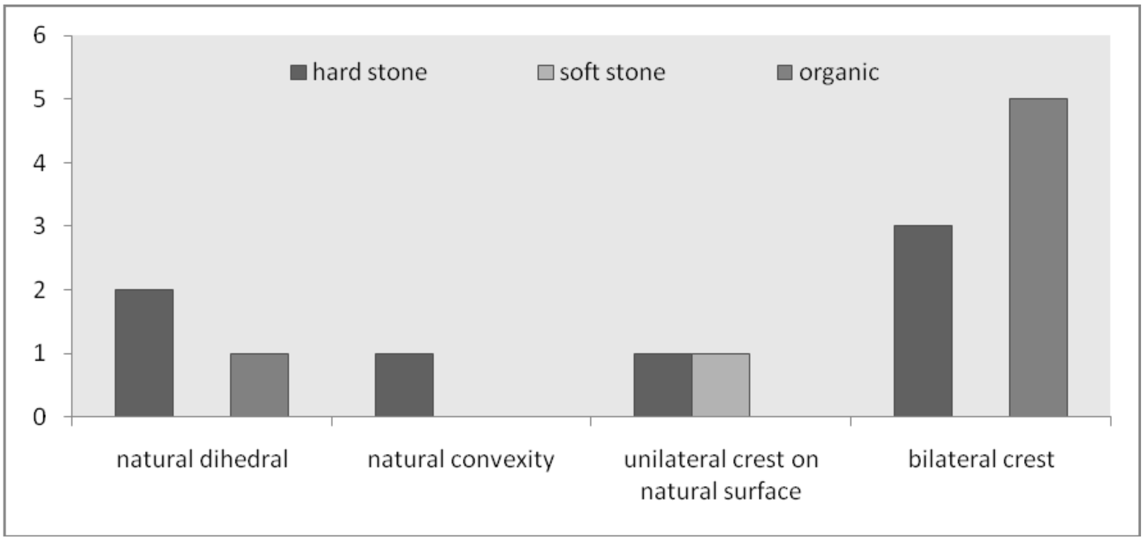
The recognizable flaking technique (Graph 3.20) suggest a differential application according to the products extracted, providing further evidence of the role of shaping/initialization products of the natural convexities *l.s.*, among which hard stone direct percussion is well represented as is in the case of unilateral crests. Bilateral crests, while showing a strong occurrence of the same technique, are nevertheless mainly extracted by means of organic soft hammer direct percussion.



Graph 3.18: Initialization products, longitudinal convexity, layers 4 and 4a grouped, 1985 excavation



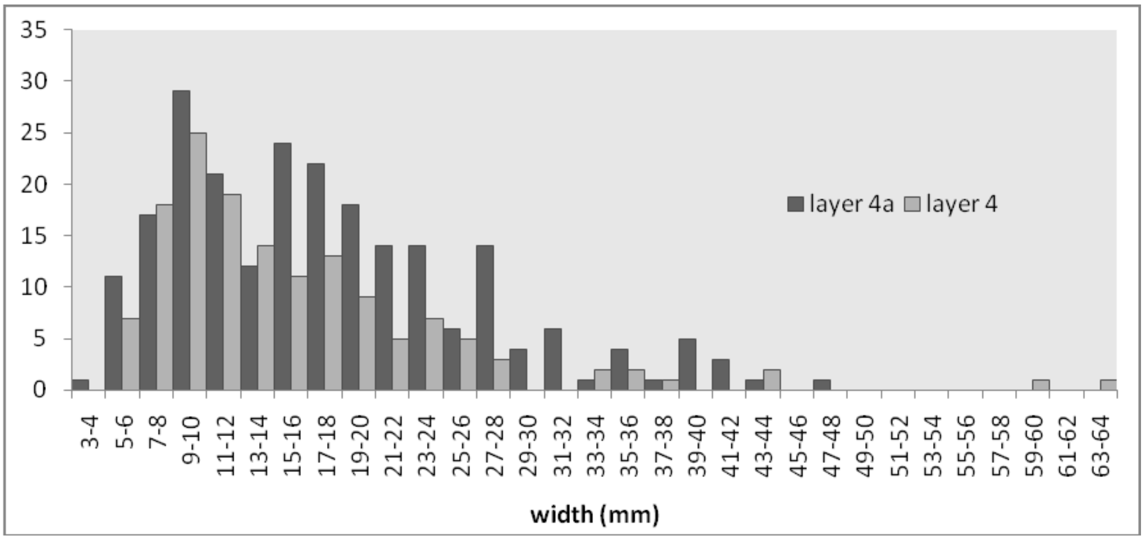
Graph 3.19: Initialization products, transversal convexity, layers 4 and 4a grouped, 1985 excavation



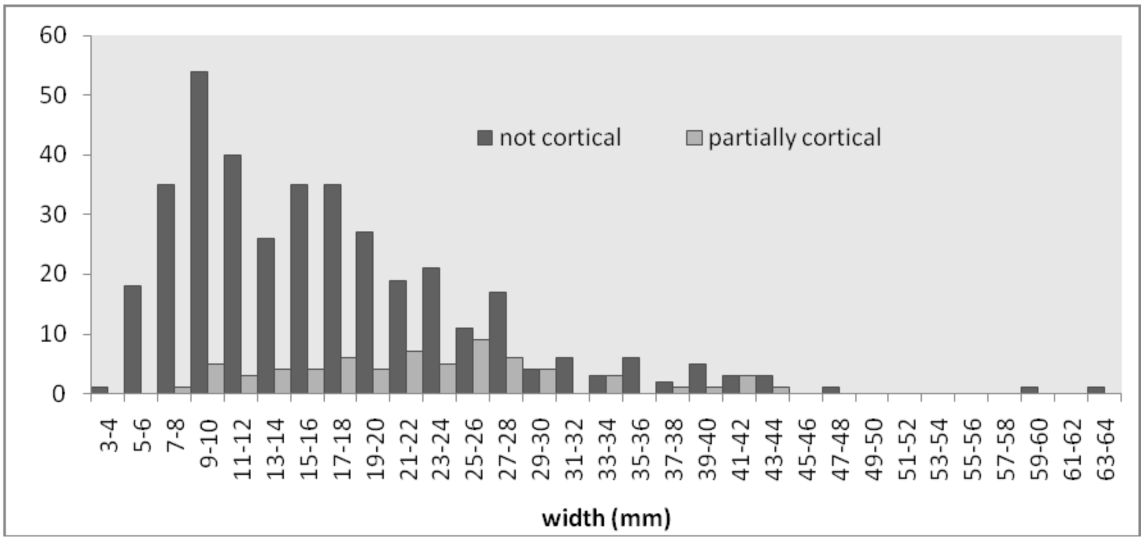
Graph 3.20: Initialization products, technique

Considerations about full production laminar blanks will be mainly based on central not cortical specimens, which are considered to be the best indicators in order to provide an assessment of the production objectives main features.

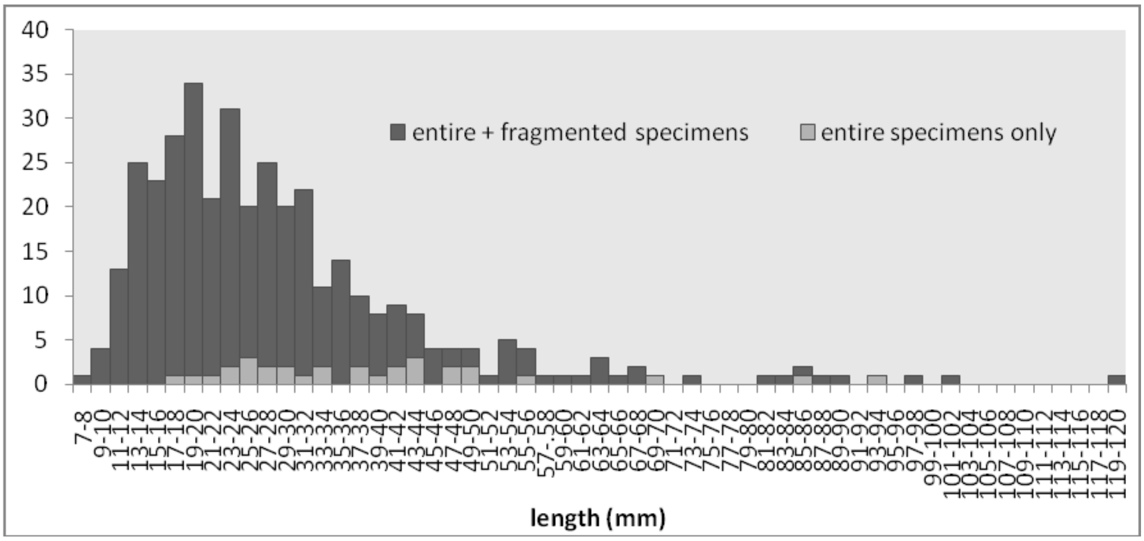
Width distribution suggests the existence of at least four researched calibers (Graph 3.21, Graph 3.22), which seem to fit well with the classification in bladelets, blades, large blades and mega-blades, elsewhere proposed (SILVESTRINI, et al. 2008) and tentatively adopted as a regional comparison scheme. The distribution shows two major frequency picks for the bladelets around 9-10 mm and for the blades around 15-18 mm. Data from larger calibers seems to be more randomly distributed but anyway suggests a major occurrence of large blades around 27-28 mm and of a series of more rare mega-blades, whose largest specimen reaches the considerable width of 64 mm. The assessment of length is more difficult because of the high fragmentation rate (Graph 3.23). Entire blanks, mostly clustered between 11 and 50 mm, record the longest specimen within the class of 93-94 mm, while fragmented ones within 119-120 mm.



Graph 3.21: Width spectrum of central not cortical regular laminar products, 1985 excavation



Graph 3.22: Width spectrum of central not cortical regular laminar products, layers 4 and 4a grouped, 1985 excavation

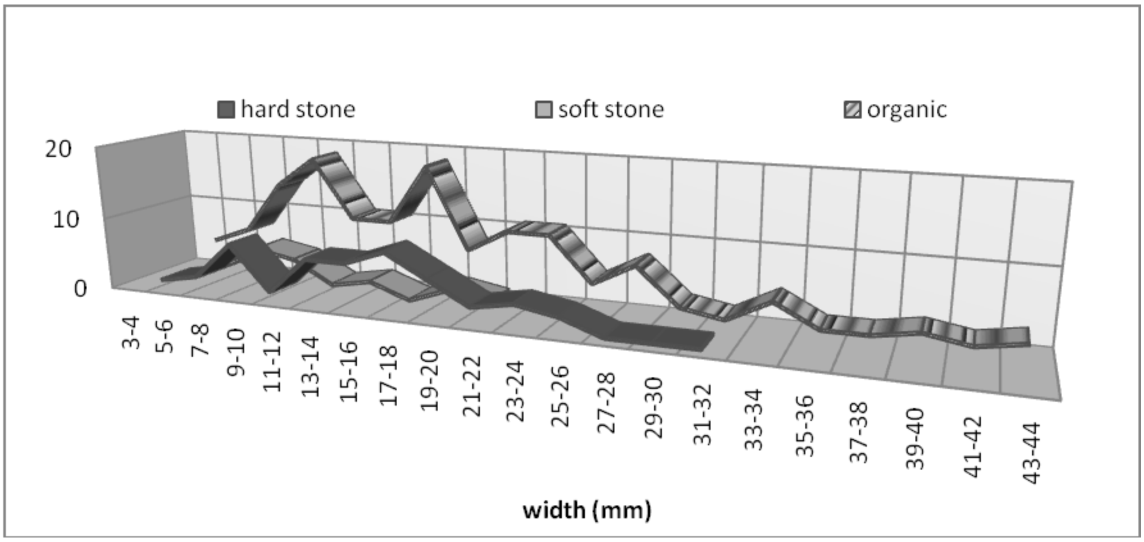


Graph 3.23: Length spectrum of central not cortical regular laminar products, layers 4 and 4a grouped, 1985 excavation

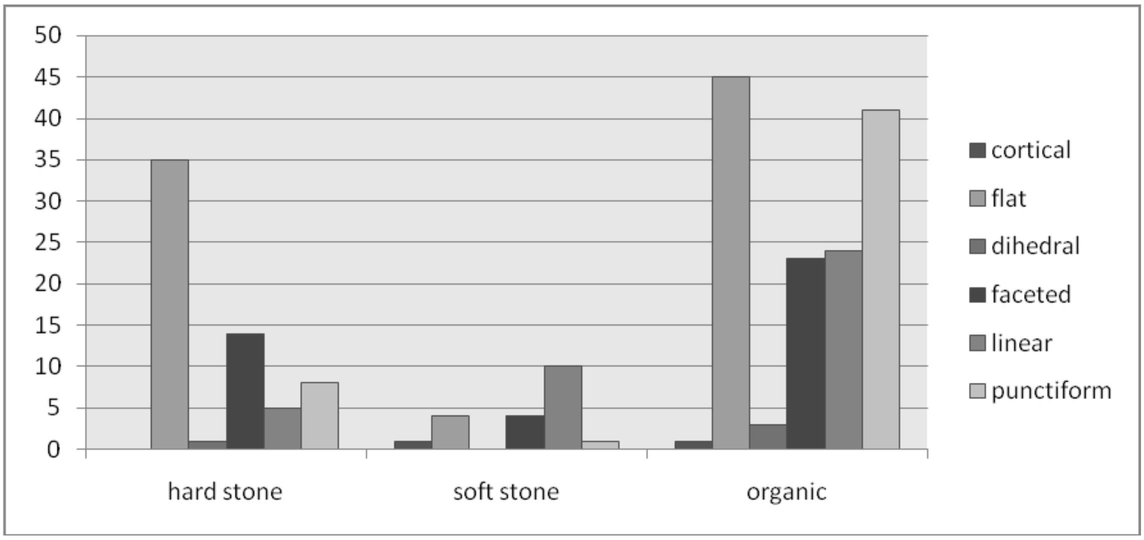
The most employed flaking technique (Tab. 3.25, Graph 3.24, Graph 3.25) is the organic soft hammer direct percussion, observable on 59,4% of the sample, and is recognizable across the whole *spectrum* of laminar calibers. Platforms associated to this technique are punctiform, flat, linear or faceted. Hard stone direct percussion accounts for 28,2% and is recorded within the bladelets/large blades *spectra* only while soft stone direct percussion, which accounts for 12,4%, is not employed over the blades range.

Technique	**N**	**%**
Hard stone	57	28,2 %
Soft stone	25	12,4 %
Organic	120	59,4 %
Tot	**202**	100,0 %

Tab. 3.25: Full production laminar products, technique

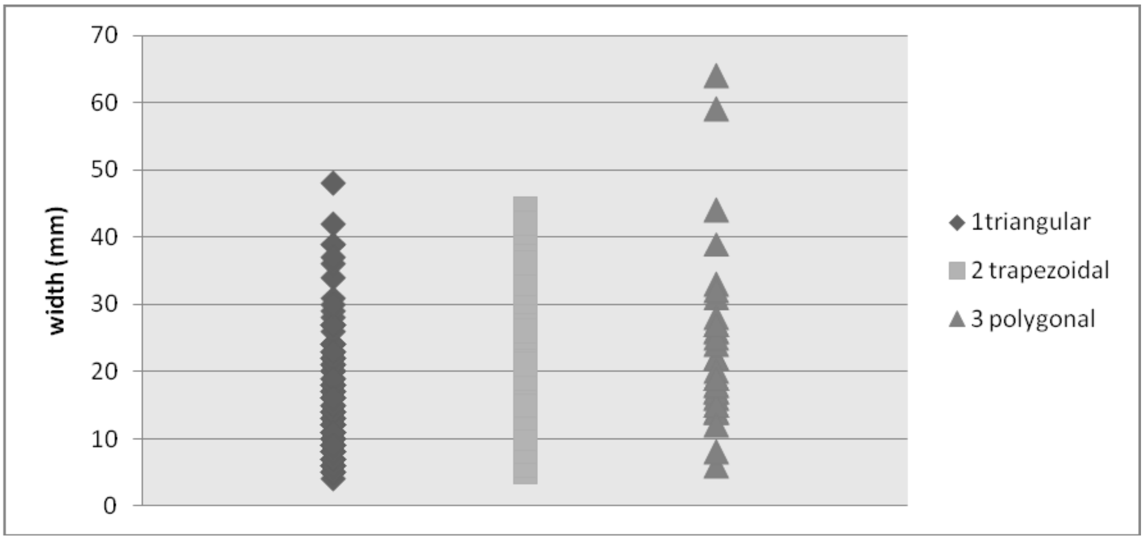


Graph 3.24: Full production laminar products, technique compared to caliber



Graph 3.25: Full production laminar products flaking technique compared to platforms

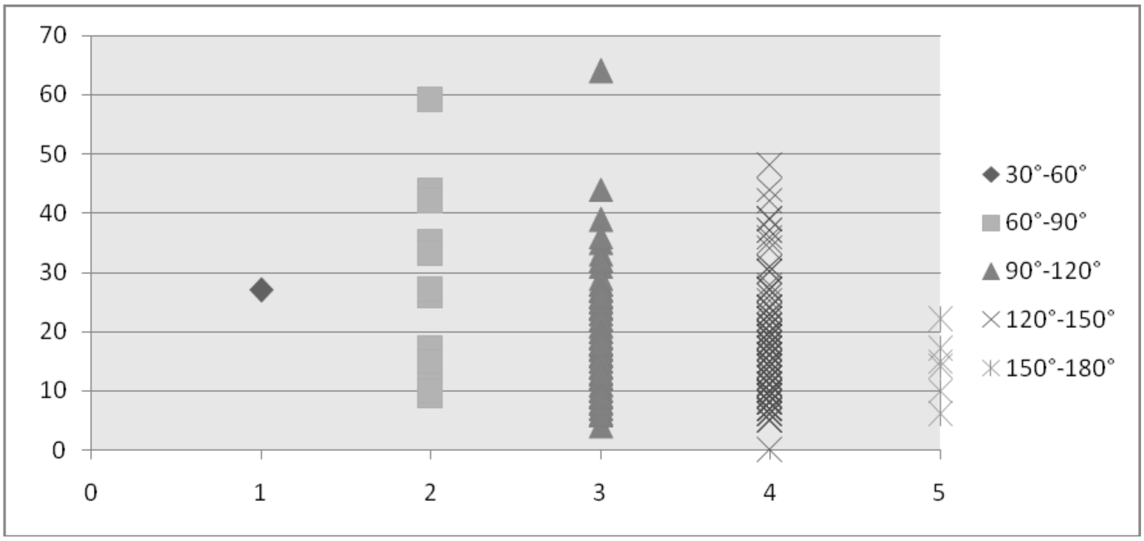
The very most part of the laminar blanks (96,7%) have unidirectional dorsal scars, suggesting the exploitation of mainly unipolar cores. As regards the transversal section of the blanks, triangular, trapezoidal or polygonal, it doesn't seem to be strictly correlated with the blanks width, except in the case of polygonal section blades, which show the highest width values of the sample (Graph 3.26). A more meaningful relation is conversely recorded if considering the transversal convexity, which seems to be, even if not so markedly, inversely proportional to blanks width (Graph 3.27). In other words, the wider the blank, the higher is the *cintrage* of the extraction surface from which it comes.



Graph 3.26: Full production laminar products, central, not cortical, regular, section

Range	Tot	
30°-60°	1	0,3%
60°-90°	15	4,1 %
90°-120°	113	30,7 %
120°-150°	233	63,3 %
150°-180°	6	1,6 %
Tot	**368**	100,0 %

Tab. 3.26: Full production laminar products, transversal convexity

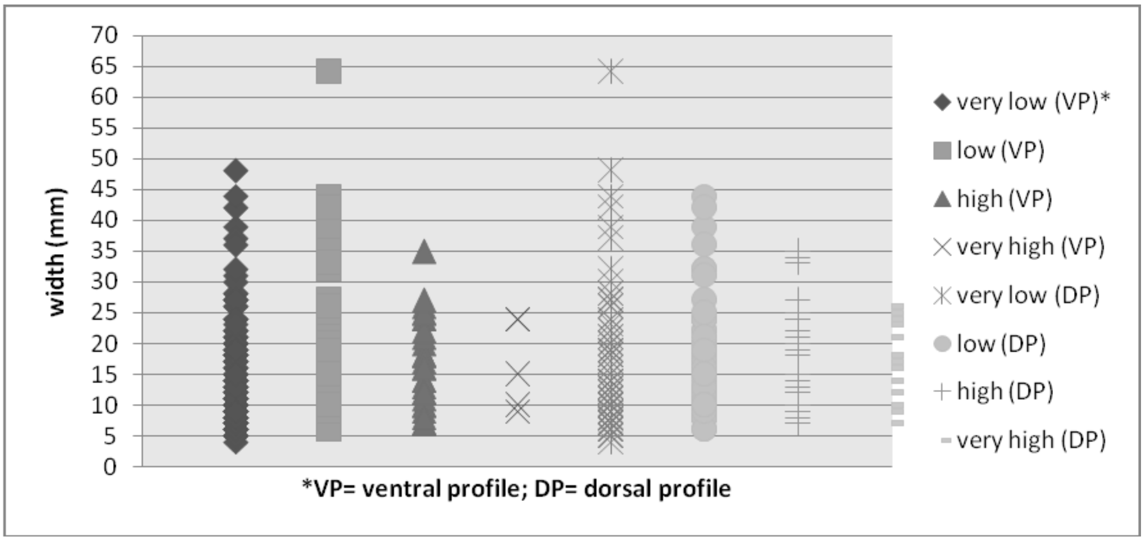


Graph 3.27: Full production laminar products, transversal convexity, width

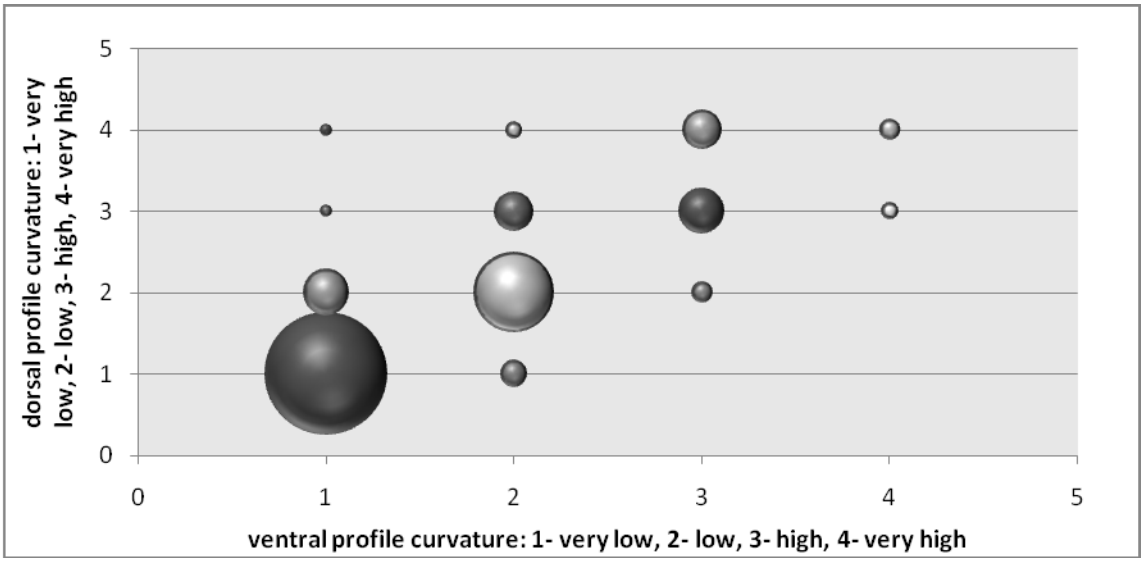
Ventral profiles are mainly straight and secondarily *torse* or curved. The evaluation of both ventral and dorsal longitudinal curvatures led to recognize the trend of large and mega-blades to be progressively less curved with increasing width. In other words, respect to the dorsal convexity, over the large blades *spectrum*, the wider the blank, the lower is the *carénage* of the extraction surface from which it comes. Further, Tab. 3.28 and Graph 3.29 show that a remarkable correlation between dorsal and ventral longitudinal curvatures can be detected, suggesting an active role of the *carénage* degree on the ventral curvature control.

Ventral profile	N	%
Straight	144	63,7
Straight, slightly plunged	7	3,1
Curved	30	13,3
Torse	45	19,9
TOT	**226**	100,0

Tab. 3.27: Full production laminar products, ventral profile



Graph 3.28:Full production laminar products, ventral and dorsal profile, width



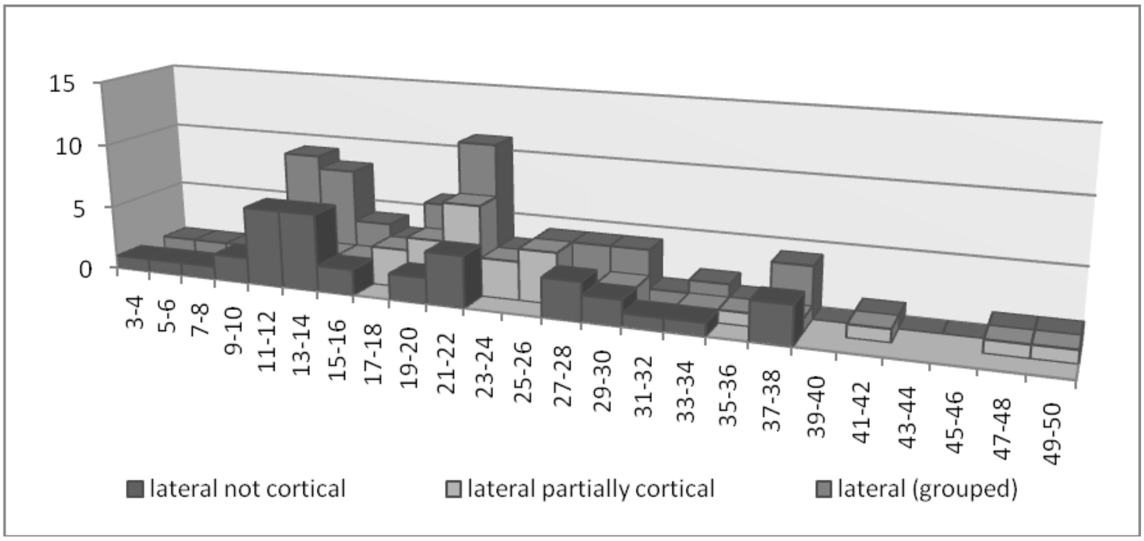
Graph 3.29: Full production laminar products, ventral and dorsal curvature

(Yates) χ^2 =116,918, 99% C.I.		**Ventral profile curvature**	
		Low and Very low	High and Very high
Dorsal profile curvature	Low and very low	174	15
	High and Very high	3	31

Tab. 3.28: *χ^2 test, ventral and dorsal curvature*

Lateral laminar products are widespread along the most part of the central blanks width *spectrum*, except for the very highest values of mega-blades, not represented (Graph 3.30). The width distribution shows two major clusters around the bladelets and the blades calibers and significant occurrences, even if less patterned, within the large and mega-blades ones. If splitting the data into partially cortical and not cortical products, it results that the bladelets frequency pick is almost exclusively composed of not cortical specimens while the blades one is quite specular, being mostly composed of partially cortical products. This could be hypothetically consistent with continuous reduction processes where cortex disappearance is due to volume reduction.

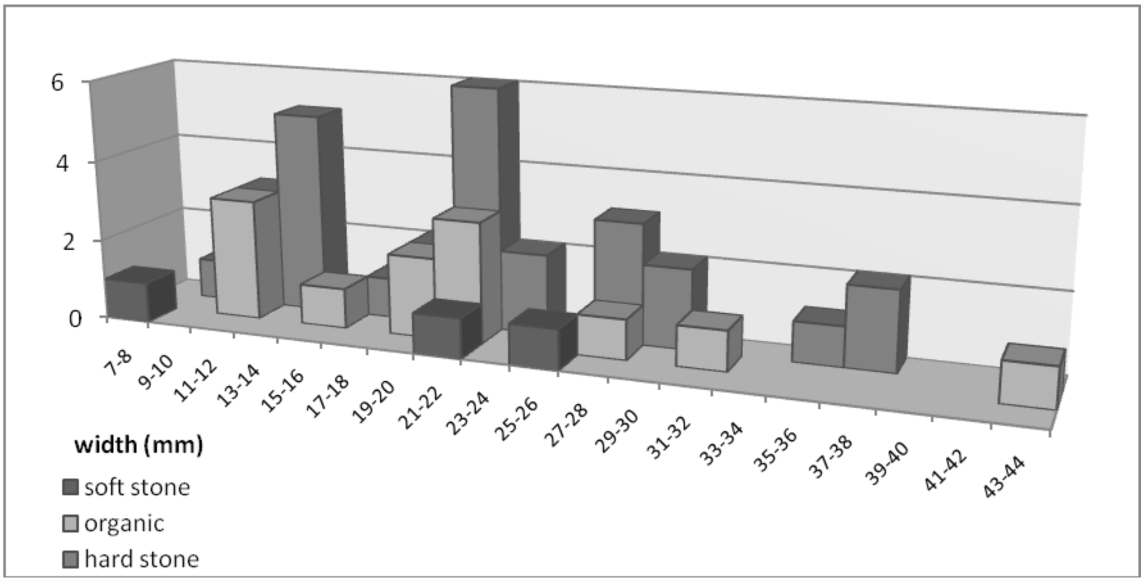
Hard stone direct percussion accounts for about 65% of the flaking techniques recognizable among lateral products, while soft organic hammer direct percussion for almost 28%. The distribution of the different techniques according to the laminar calibers is roughly undifferentiated (Tab. 3.29, Graph 3.31). Hard stone, as well as organic direct percussion, seem to have been applied indifferently to both bladelets and blades. Larger blanks, namely the large blades and the mega-blades, show conversely a much higher incidence of the application of the hard stone direct percussion. These data, symmetrically opposite to those of central products, suggest an actually different role played by lateral blanks within the laminar production process and reinforce their interpretation as actually belonging to managing episodes intercalated to the full laminar production.



Graph 3.30: Width spectrum of lateral laminar products, layers 4 and 4a grouped, 1985 excavation

Technique	N	
Hard stone	28	65,1 %
Soft stone	3	7,0 %
Organic	12	27,9 %
TOT	43	100,0 %

Tab. 3.29: Lateral laminar products, flaking technique



Graph 3.31: Flaking technique according to width spectrum of lateral laminar products, layers 4 and 4a grouped, 1985 excavation

3.3.7. Management

More than half of the products referable to this phase are related to the striking platform restoration (Tab. 3.30) (*Fig. 3.25*, *Fig. 3.26*). The most part of them (36,6%) are aimed to the removal of part of the striking platform, signaled by the rare lateral debording. Often, this kind of flakes are heavily hinged and/or bear on their dorsal face heavily hinged scars, which suggests a deliberated strategy finalized to not to remove a substantial part of the core and contemporary creating a quite acute flaking angle suitable for organic direct percussion.

Fig. 3.25: Striking platform management

Total striking platform management flakes, signaled by frequent latero-distal debording, represent 5,1% of the management products, and were necessary after that a series of partial removals and laminar extractions made the striking platform no longer exploitable.

Fig. 3.26: Striking platform management

Very broadly speaking, taking aside the different meaning of the various technological classes, the interventions focused on the extraction surface account for 38,1%. The most part of them are represented by neo-crests extraction (*Fig. 3.27*), aimed to both restore the transversal and/or longitudinal convexities and to regularize the surface. Further, the other class of laminar products comprised within the management phase, represented by restoration products aimed to the removal of accidents and irregularities clearly visible on their dorsal faces, account for 4,4%. These products often show a very rear point of impact, aimed to the removal of a substantial portion of the volume. Two classes of flake products deal with the extraction surface maintaining by means of removals from the main striking platform, in order to remove accidents and irregularities or to maintain the transversal convexity, and from a secondary opposite pole *Fig. 3.29*), less represented, aimed to maintain the longitudinal convexity or to remove accidents and irregularities. Interventions carried out from the core flank are interpreted as the result of neo-crests fashioning, as are the flakes removing flank portions from the extraction surface (*Fig. 3.29*).

Finally, flakes and laminar blanks removing the core rim are not much represented and their interpretation as the outcome of a 90° rotation of the flaking direction is not supported by cores data.

Fig. 3.27: Management of the surface by means of neo-crests extraction

The frequencies distribution (Graph 3.32), arranged according to the ULRM and organized according to the values of the most represented class of artefacts, highlights and confirms the widespread and prevalent presence of the striking platform management flakes, with the incidence of the other classes very roughly following the overall pattern suggested by them. More precisely, it is not possible to observe cases where to lower values of striking platform rejuvenation flakes correspond higher values of something else. Conversely, very frequent is the case of ULRM whose management products are almost entirely dominated by striking platform management ones. If removing this class of products (Graph 3.33) just to observe the behavior of the other classes, and ordering data according to neo-crests and laminar restoration products, in example, it can be noticed a rough synchrony of the frequency picks of the different classes.

All retouched blanks made on management products share the same ULMR with the unretouched ones, suggesting that they have been fashioned on flaking products issued by activities carried out at the site (Graph 3.34). The main exploited blanks are neo-crests/restoration products and striking platform management flakes.

	Management product	**Layer 4**		**Layer 4a**		**TOT**	
		N	**%**	**N**	**%**	**N**	%
51,5 %	Total striking platform management	5	**4,6**	19	**5,1**	24	5,0
	Partial striking platform management	38	**35**	137	**37**	175	36,6
	Striking platform management (fragment)	9	**8,3**	38	**10**	47	9,8
38,1 %	Neo-crest	19	**18**	56	**15**	75	15,7
	Restoration laminar product	10	**9,3**	11	**3**	21	4,4
	Surface management from striking platform	9	**8,3**	30	**8,1**	39	8,2
	Surface management from opposite pole	3	**2,8**	9	**2,4**	12	2,5
	Surface management from the flank	7	**6,5**	28	**7,6**	35	7,3
8,6 %	Flank management from the extracion surface	8	**7,4**	33	**8,9**	41	8,6
1,9 %	Rim product		**0**	9	**2,4**	9	1,9
100,0 %	**TOT**	**108**	**100**	**370**	**100**	**478**	100,0

Tab. 3.30: Management products, incidence of the different classes per layer

Fig. 3.28: Management of the flanks from the extraction surface (neo-crest preparation)

Fig. 3.29: Recarenage intervention (left) and removal of hinging accidents on the extraction surface and/or neo-crests preparation (right)

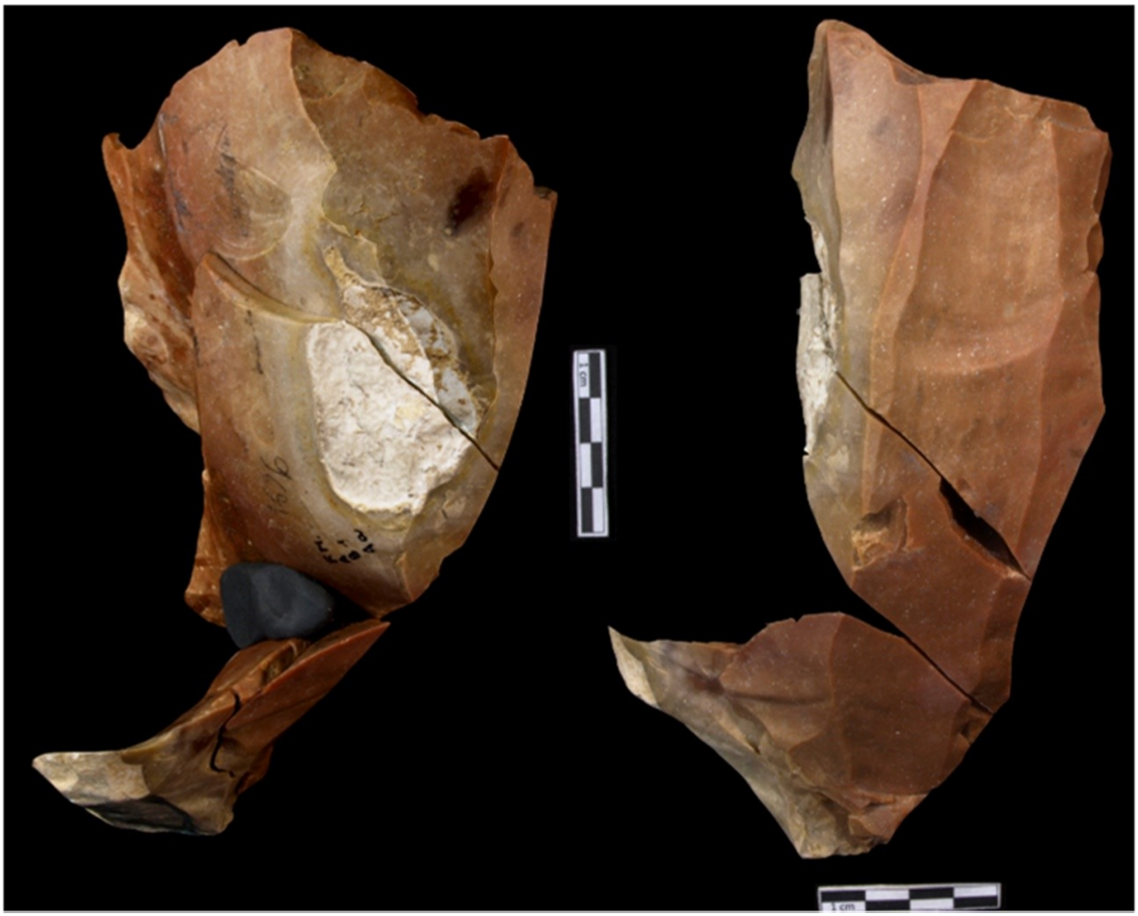
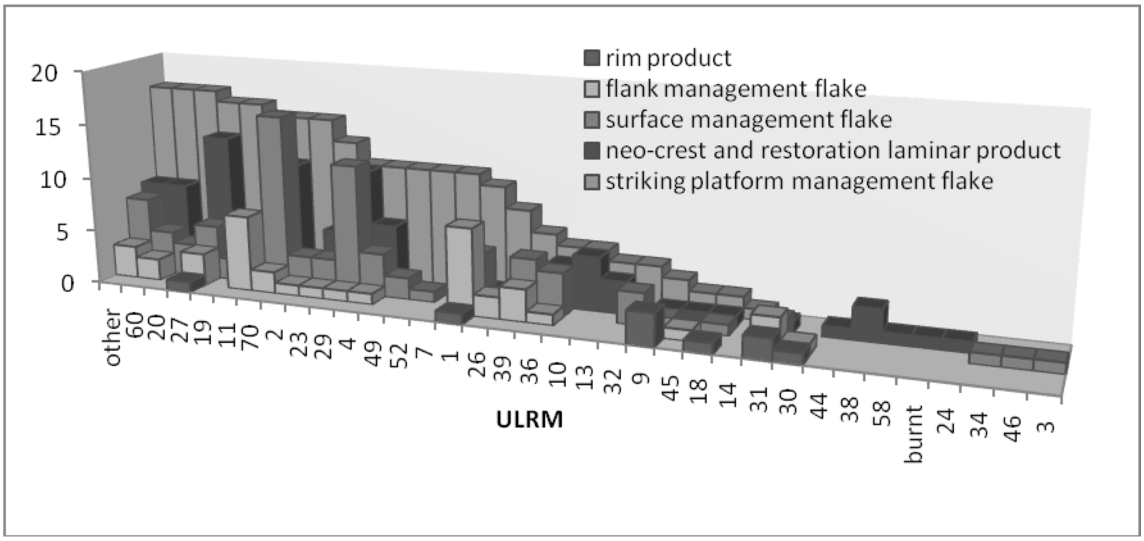
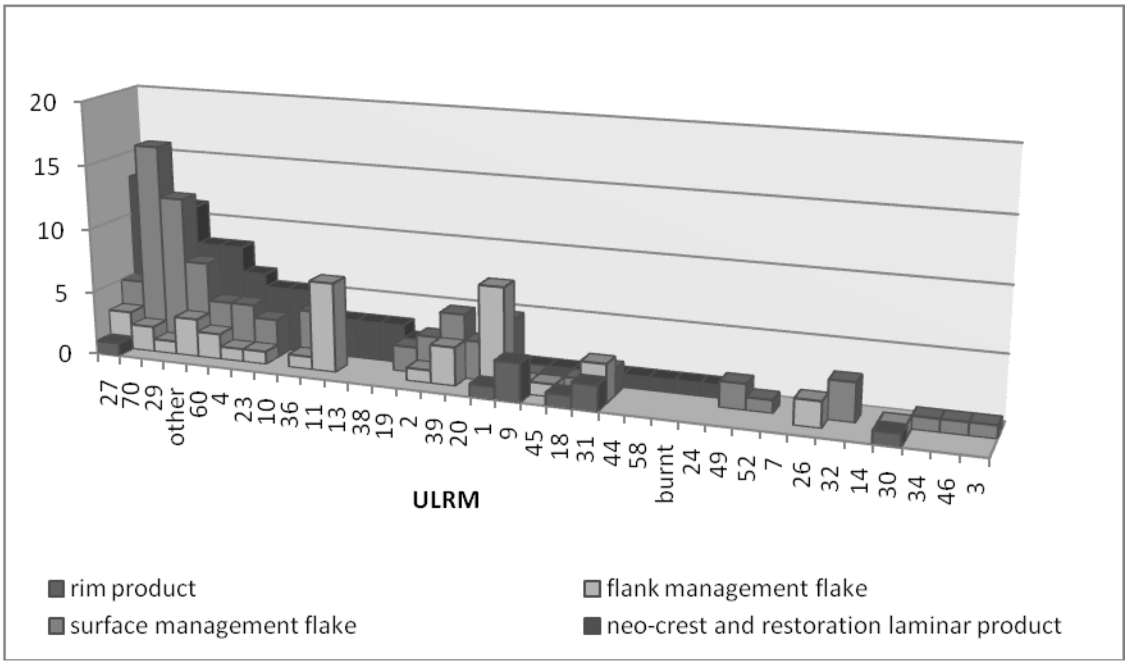


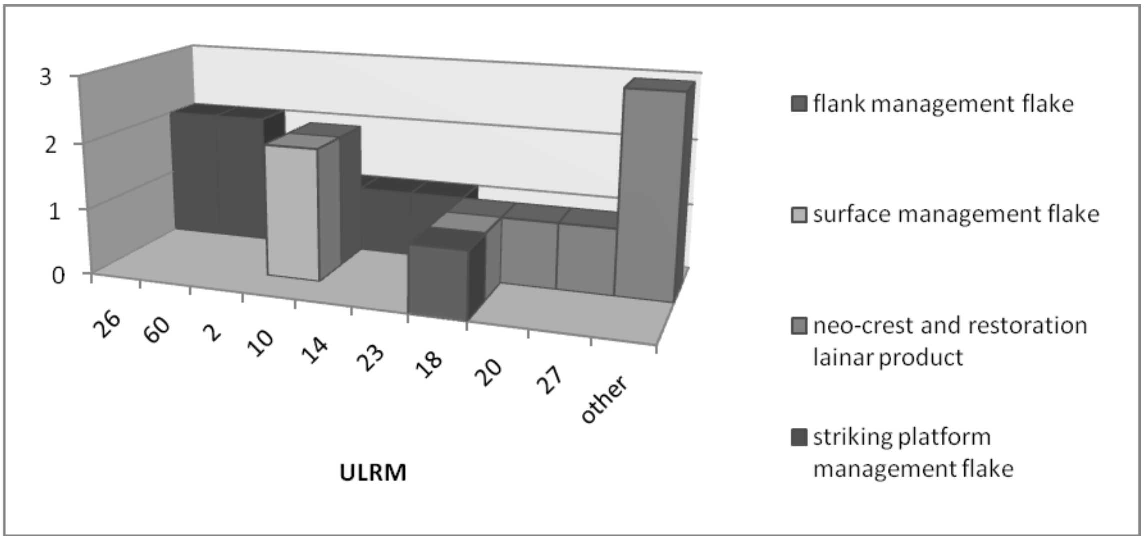
Fig. 3.30: A management intervention hardly interpretable by an economic point of view



Graph 3.32: Management products, ULRM



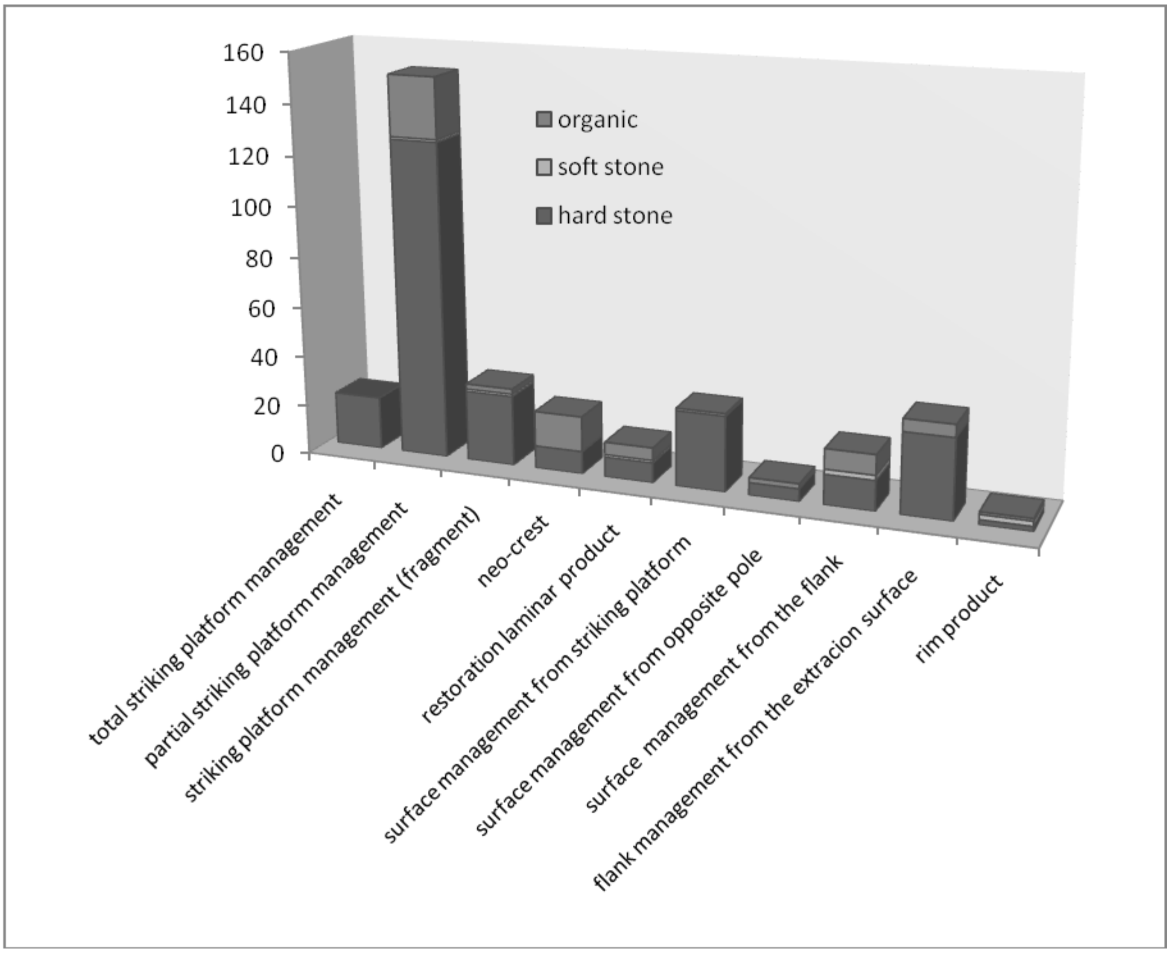
Graph 3.33: Management products, except striking platform management flakes



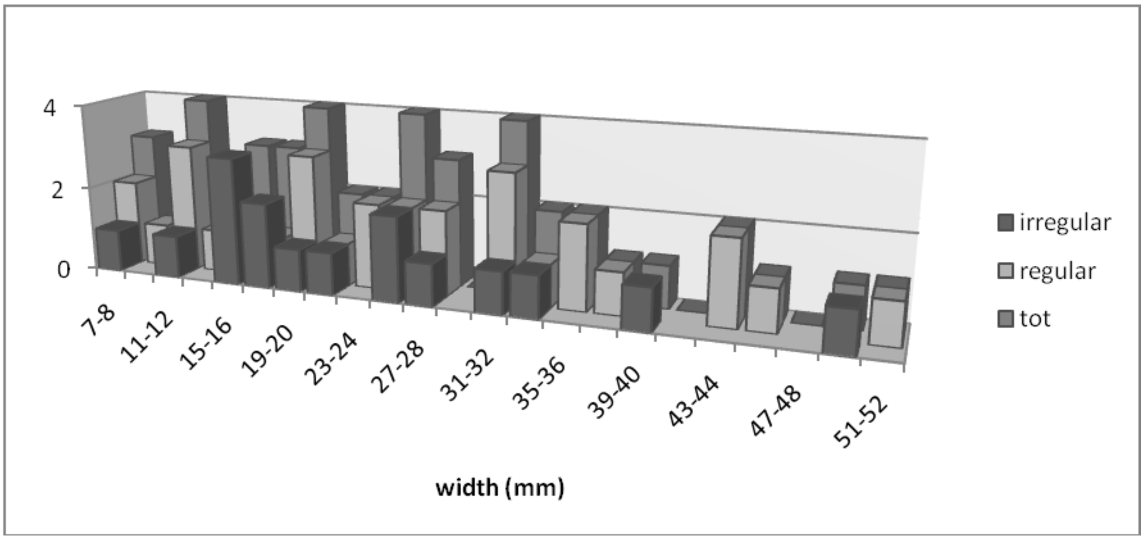
Graph 3.34: Retocuhed management flakes, layer 4 and 4a grouped, 1985 excavation

Interesting data come from the evaluation of the flaking techniques among the products issued by the management phase (Graph 3.35), which generally show to have been mostly extracted by means of hard stone direct percussion. What is remarkable is the occurrence of the organic direct percussion within specific classes. It is recognizable its higher frequencies among products that could have been extracted contextually to the laminar production without changing the flaking implement, as in example in the case of partial striking platform management flakes and surface management flakes from the flank. Relatively numerous occurrences of the technique are also recorded among laminar management products, mostly neo-crests, probably because of their being proper potentially suitable laminar blanks. Hard stone direct percussion is conversely exclusive, or represents the very most part, in all those cases where a radical intervention needs the certainty of its achievement, as in the case of total striking platform removal or the extraction surface regularization from the striking platform. Soft stone direct percussion, finally, shows negligible frequencies.

Neo-crests, here considered within the management phase for the sake of simplicity, are, as above mentioned, proper laminar blanks, many of which have been extracted by means of organic direct percussion and a certain number have also been retouched. For these reasons it has been found useful to assess their widths distribution, according to their regularity also (Graph 3.36). What is noticeable is the clustering around the bladelets, blades, large blades and mega-blades classes with clear frequency picks within each class.



Graph 3.35: Management products, technique, layers 4 and 4a grouped, 1985 excavation



Graph 3.36: Width spectrum of neo-crests, layers a and 4a grouped, 1985 excavation

3.3.8. Deactivation of production

Nine cores account for the deactivation of production phase, six for blades, two for bladelets and a reconfigured one (*Fig. 3.31*, *Fig. 3.32*, *Fig. 3.33*) (Tab. 3.31).

	Layer 4	Layer 4a	Tot
Blade cores	4	2	6
Bladelet cores		2	2
Reconfigured cores	1		1
Tot	5	4	9

Tab. 3.31: Number of cores distribution per layer

Fig. 3.31: Blade cores

Fig. 3.32: Bladelet cores

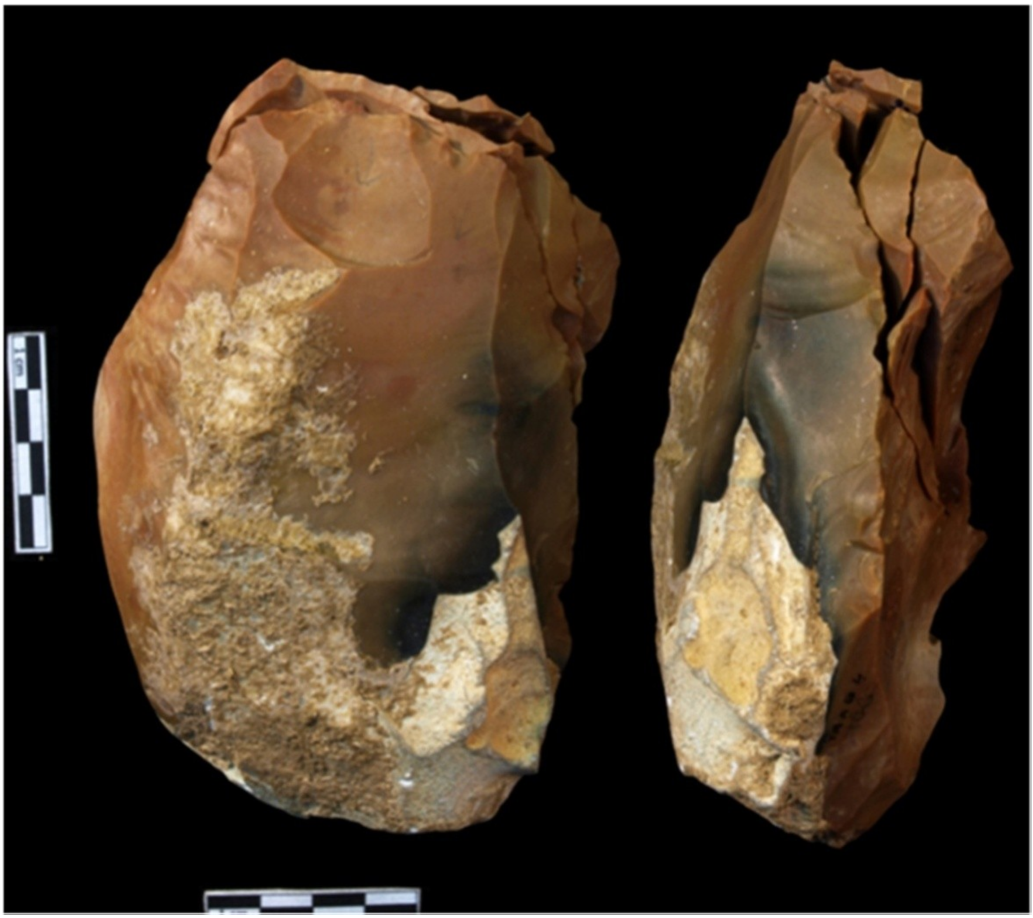


Fig. 3.33: Reconfigured blade core

3.3.8.5.<u>Blade cores</u>

Six blade cores belong to as many ULRM (ULRM 18, 30, 31, 47, 70, "other"), collected within both debris deposits and stream beds/alluvial deposits (Tab. 3.32).

ULRM	Formation	Environment of collection
30	Maiolica	Close to primary oucrop
70	Maiolica	Close to primary oucrop
31	Maiolica	Debris
47	Scaglia rossa	Stream bed , alluvial deposit
18	Scaglia variegata	Close to primary oucrop
Other	Scaglia variegata	Stream bed , alluvial deposit

Tab. 3.32: Cores, environment of collection of the raw blanks

By a rough evaluation of the core volumes, considering the parallelepiped in which can be inscribed, simply calculated as Length x Width x Thickness, it results that the smallest blade cores belong to raw blocks collected within debris and stream beds/alluvial deposits (

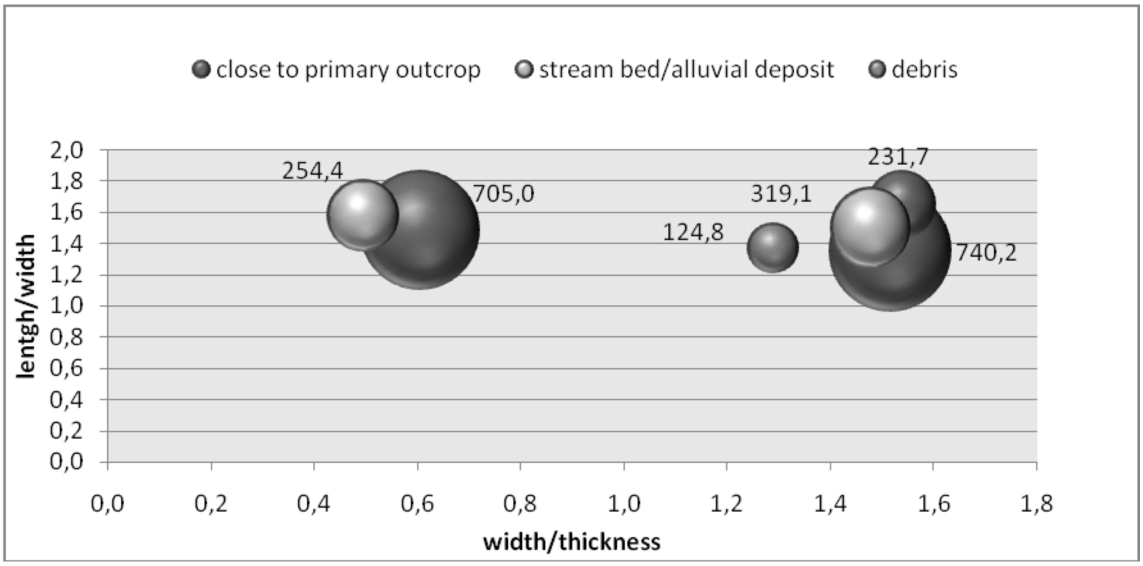
Graph 3.37). Further, they show varied sizes, with lengths between 67 and 127 mm, width between 43 and 94 mm and thicknesses between 38 and 109 mm

When comparing the L/l and l/t ratios, dimensional data reveal the existence of two distinct clusters (

Graph 3.37). As regards the length/width relationship, generally related to the area of the core occupied by the extraction surface, it suggests the exclusive occurrence of wide-front cores, being the ratio always lower than 2. Conversely, the width/thickness ratio suggests the existence of two different clusters of cores, differentiated according to their relative flatness. Lowest ratio values, in this case lower than 1, stand for thick cores, where the thickness is even higher than the width, while values higher than 1 stand for more flattened specimens.

Length	Width	Thickness
127	94	62
68	43	87
99	60	39
102	68	46
67	49	38
98	66	109

Tab. 3.33: Blade cores size



*Graph 3.37: Blade cores, comparison between L/w-w/t ratios (bubble size represents volume L*w*t cm3)*

Laminar scars readable on the extraction surfaces of the blade cores are rare. Only four widths, 12, 16, 19, 46 mm, has been measured, and account for a very large *spectrum*, which comprises blades and mega-blades, but also bladelets and large bladelets.

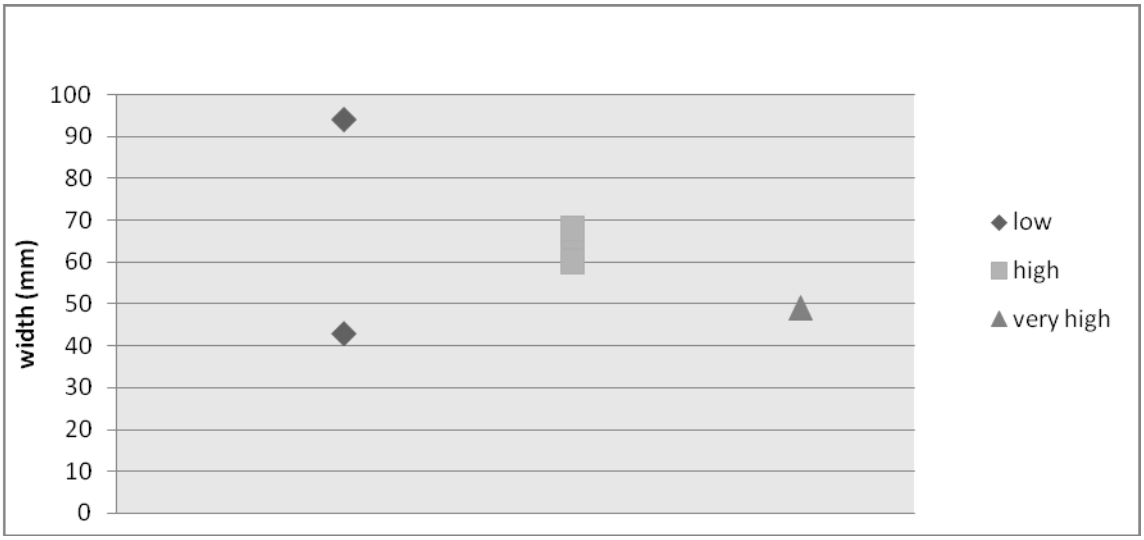
The very most part of blade cores (5 out of 6) seems to have been abandoned because of reasons not dependent by severe accidents, exhaustion of the volume of internal discontinuities, while one specimen suggests to have been discarded because of the occurrence of internal discontinuities. The following table (

Tab. 3.34) shows the last laminar scars readable on each core.

1.	Laminar scar	Regularity
2.	Central not cortical	Hinged
3.	Central not cortical	Regular
4.	Central partially cortical	Regular
5.	Central partially cortical	Hinged
6.	Lateral partially cortical	Regular
7.	*Sous-crête*	Plunged

Tab. 3.34: Blade cores, regularity of the laminar scars

The evaluation of the transversal and longitudinal convexities highlights two different patterns. As regards the latter, all specimens show low curvature degrees. The transversal convexities, conversely, are more varied and seem to exist a correlation with core width. As shown in Graph 3.38, to decreasing width values correspond increasing degrees of transversal curvature.



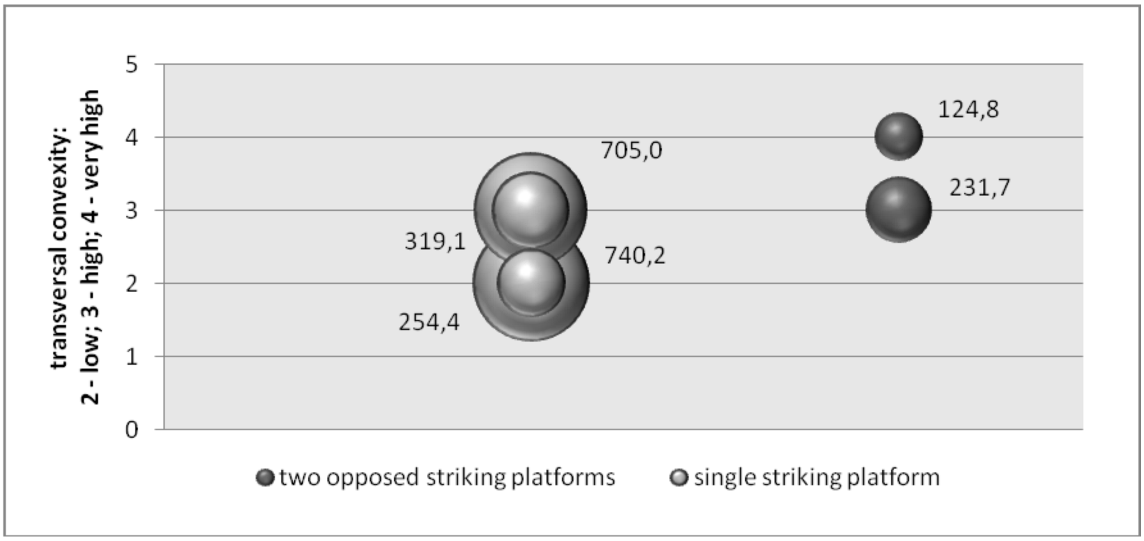
Graph 3.38: Blade cores, comparison between transversal convexity and width

The volume reduction is always carried out by means of the exploitation of a single extraction surface, mainly from a single striking platform (4 occurrences) rather than

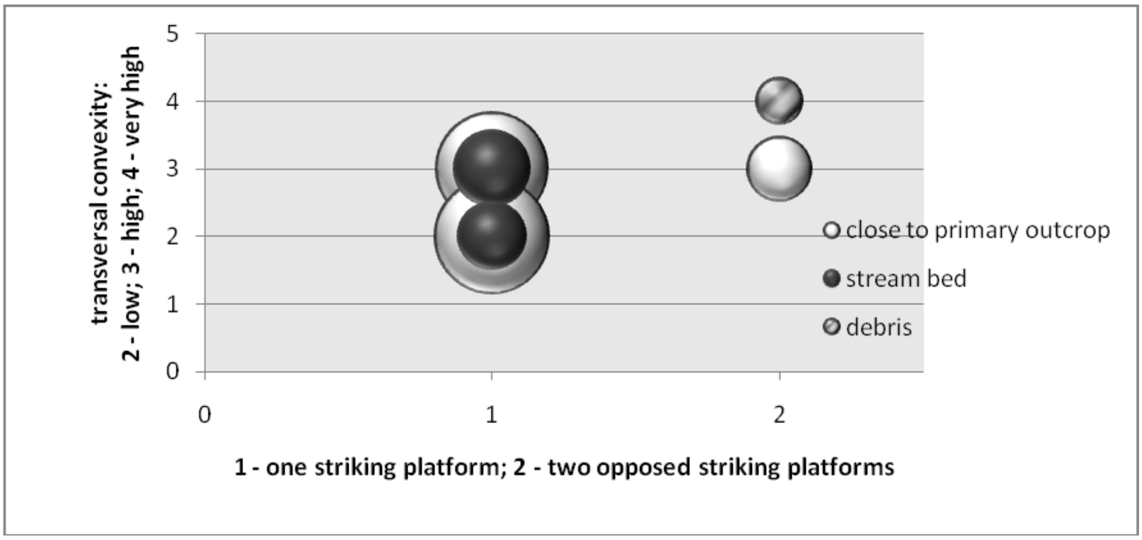
from two opposed ones (2 occurrences), with *semi-tournant* modalities, except for one case, in which a frontal modality, very close to the *faciale* modality (MONTOYA 2004), can be recognized.
Single striking platform cores show generally 70°-90° flaking angles, except in the case of the frontal/*facial* modality core, which is around 50°-70°. Striking platforms are prepared in two cases and flat and cortical in the remaining. Back is never prepared while flanks are both prepared and not prepared in equal proportion. Conversely, cores with two opposite striking platforms have generally 50°-70° flaking angles (3 out of 4 occurrences measured on two cores), one flat and one prepared striking platform each and, finally, always prepared back and flanks.

Data about blade cores highlights some clear pattern suggested by the morpho-technical and morpho-metric features cross comparison (Graph 3.39). Single-striking platform cores show the lowest centering degrees, the rarity or absence of back and flanks preparation and generally the largest volumes. Conversely, two-striking platforms cores are smaller and show higher centering degrees and constant back/flanks preparation. Data are therefore consistent with a continuous reduction process signaled by the shift from frontal to *semi-tournant* modality and by size decrease due to the doubling of the striking platforms and the arrangement/maintenance of the flanks/back architecture. Of particular interest results, in this sense, the proportional core narrowing previously registered in concomitance with centering increase (*Graph 3.38*). What is noticeable, further, is the constant low *carénage* shown by all cores, which is likely to be a desired parameter, naturally provided by the flaking process or by means of the opening of an accessory opposed striking platform.

As regards the above recognized differential core size according to the environment of collection, it can be argued the it reflects actual different granulometries. Two cores, collected in their raw state within stream bed or alluvial deposits, considered in Graph 3.40 among the small specimens, are morpho-tecnically classified among the cores which underwent minor reduction degree.



*Graph 3.39: Blade cores, comparison between volume, striking platforms and transversal convexity (bubble size represents volume L*w*t cm3)*



*Graph 3.40: Blade cores, comparison between volume, striking platforms, transversal convexity and environment of collection of the raw blanks (bubble size represents volume L*w*t cm3)*

3.3.8.6. Bladelet cores

Bladelet cores are represented by two specimens, both on Scaglia Variegata flint, belonging to two different ULRM, 18 and 27, the first coming from a roughly tabular block with calcareous cortex and the second from a sharp edged neocortical block, presumably collected within debris deposits.

They are dimensionally very similar. As shown in Tab. 3.35, absolute values of length, width and thickness, and their reciprocal relationships, testify of wide front, relatively flat cores, which is signaled respectively by the L/W and W/T ratios. The presumable reasons of abandon could be traced in one case in the occurrence of hinging accidents, while in the other no apparent reason can be detected, arguably except for possible loss of the volumetric and morpho-metric features required to extract the desired blanks. This possibility is comforted by the volume of the parallelepipeds into which cores can be inscribed, which are substantially same size, suggesting a possible volumetric threshold of abandon around 70 cm^3. Last laminar scars readable on the extraction surfaces are comprised between the bladelets and large bladelets *spectra* (Tab. 3.36). Last laminar extractions are not cortical central laminar products, both regular and hinged (Tab. 3.37).

Length	Width	Thickness	L/W	W/T	L*W*T
80	41	22	2,0	1,9	72,2
68	41	26	1,7	1,6	72,5

Tab. 3.35: Bladelet cores size

Width	Tot
9	2
10	1
15	3

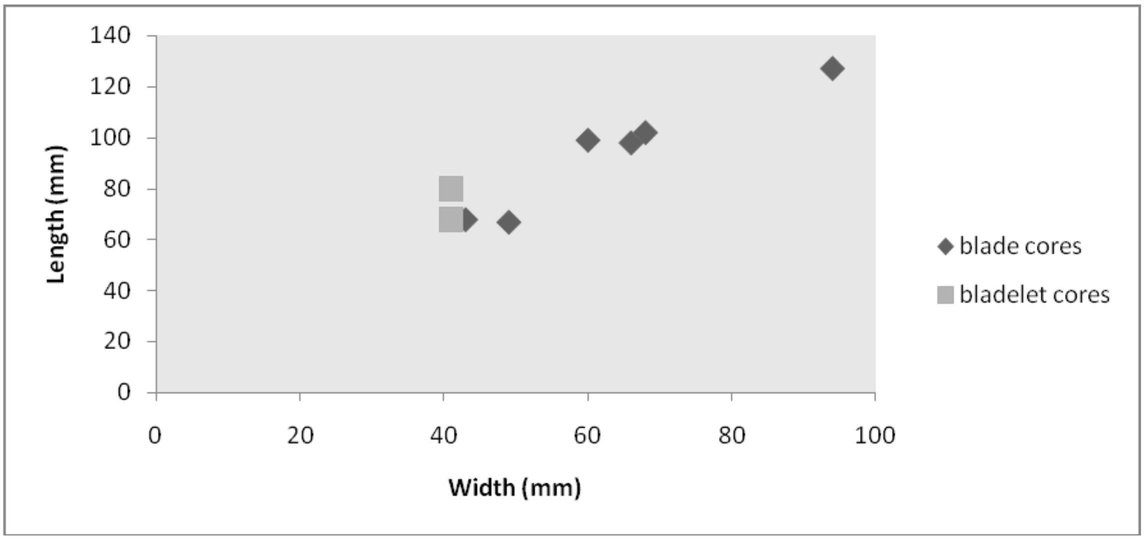
Tab. 3.36: Bladelet cores, width of the laminar scars

Laminar scar	Regularity
Central, not cortical	Regular
Central, not cortical	Regular
Central, not cortical	Hinged
Central, not cortical	Hinged

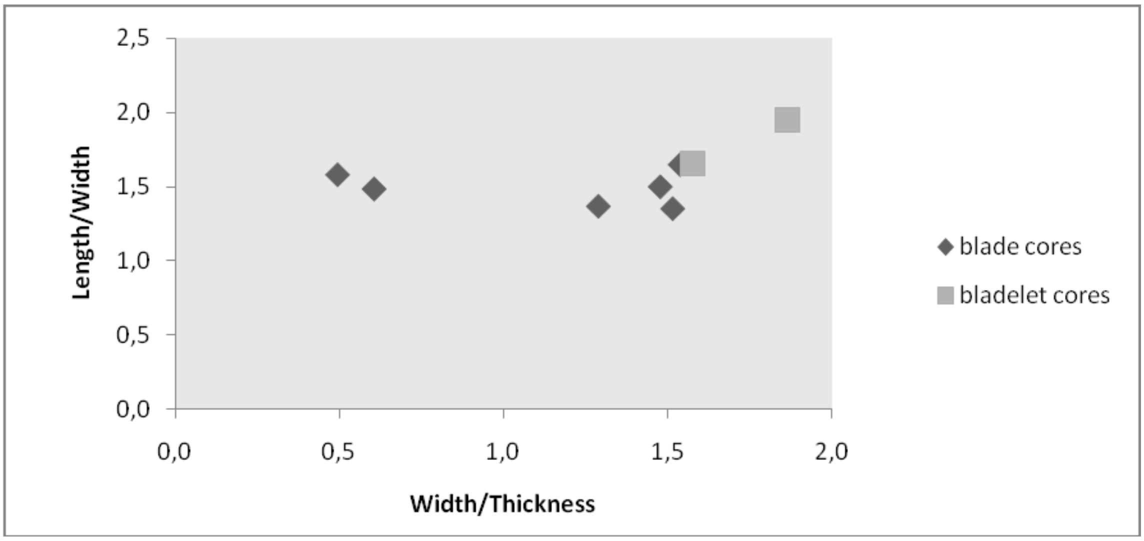
Tab. 3.37: Bladelet cores, regularity of the laminar scars

Longitudinal convexities are, like blade cores, very low, while transversal ones are generally high. Volume reduction is carried out by means of both the exploitation of a single extraction surface or two partially overlapped extraction surfaces, from two opposed striking platforms, following *semi-tournant* modalities. Flaking angles are always comprised between 50° and 70°, while striking platform is prepared only in one case, in the other being flat, as are back and flanks, managed only in one case.

Bladelet cores are too few to propose any consideration about reduction, but significant data emerge if taking into consideration the whole cores assemblage (Graph 3.41, Graph 3.42). By a dimensional and technological point of view, bladelet cores seem to correspond to a final production stage, representing the end of the continuous reduction process above hypothesized in the case of blade cores. It can be argued, therefore, that the selection of the raw materials was principally oriented towards large blocks suitable for the production of blades and large blades, while bladelets didn't consequently represent a guiding principle in raw material collection, because of their being the "tail" of larger products reduction sequences.



Graph 3.41: Comparison between blade and bladelet cores size



Graph 3.42: Comparison between blade and bladelet cores L/w-w/t ratios

Fig. 3.34: Constellation N°. 65: exploitation of a large rounded pebble, from which naturally convex laminar products have been firstly extracted. The progression of laminar production is testified by semicortical laminar products and several *tablettes.* Core is absent.

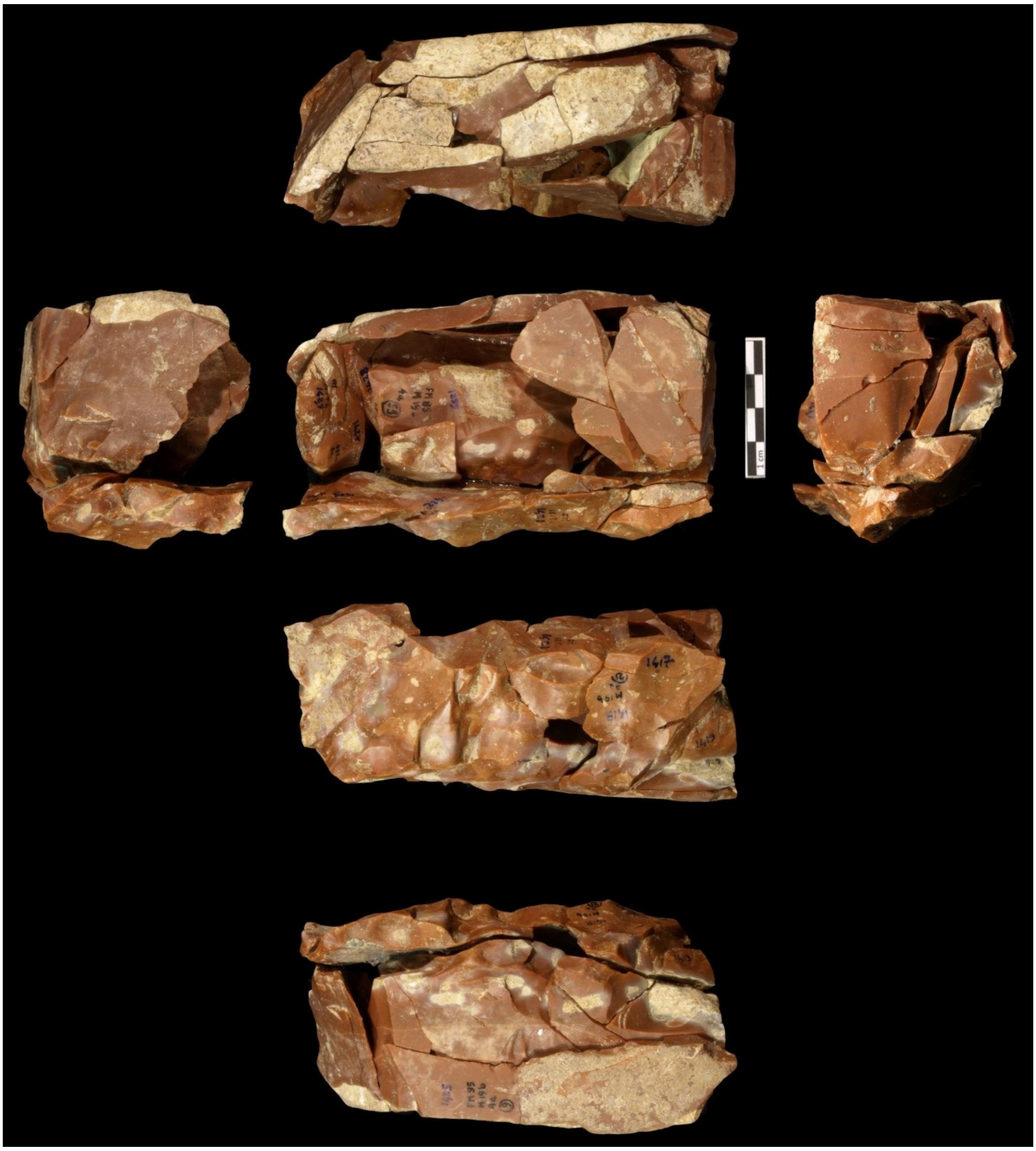


Fig. 3.35: Constellation N°. 160, exploitation of a small flint block, characterized by natural flat surfaces, for the production of bladelets from of a single bipolar extraction surface. Morpho-technical parameters are managed by the progressive extraction of *tablettes* and lateral products. Full production bladelets are almost totally absent.

3.3.9. Transformation

Retouched blanks account for about 6% of the whole assemblage. No transformation diagnostic residues have been identified, except for a few burin spalls which, for both the presence of pre-cores and initialized pre-cores exclusively on blade and flake, and their technological and dimensional features, have been tentatively classified among laminar products.

The typological composition is for the most part made of common tools and, in a very lesser extent, armatures (Tab. 3.38). Tools (*Fig. 3.36*, *Fig. 3.37*) account for about 94% of the retouched blanks, and, among these, an important role is played by retouched blades and side-scrapers. Notches and truncations, both on blade and flake, are quite frequent too, as are burins and pointed blades, while end-scrapers are not so much common. The other tool classes, denticulated blades, becs and pointed flakes, show conversely rather negligible incidences.

Six truncated backed bladelets out of nine armatures (*Fig. 3.38*), one of which bi-truncated, represent the very most part of the whole armatures set of the site, the remaining being represented by one backed point, one notched bladelet and one fragment of backed armature.

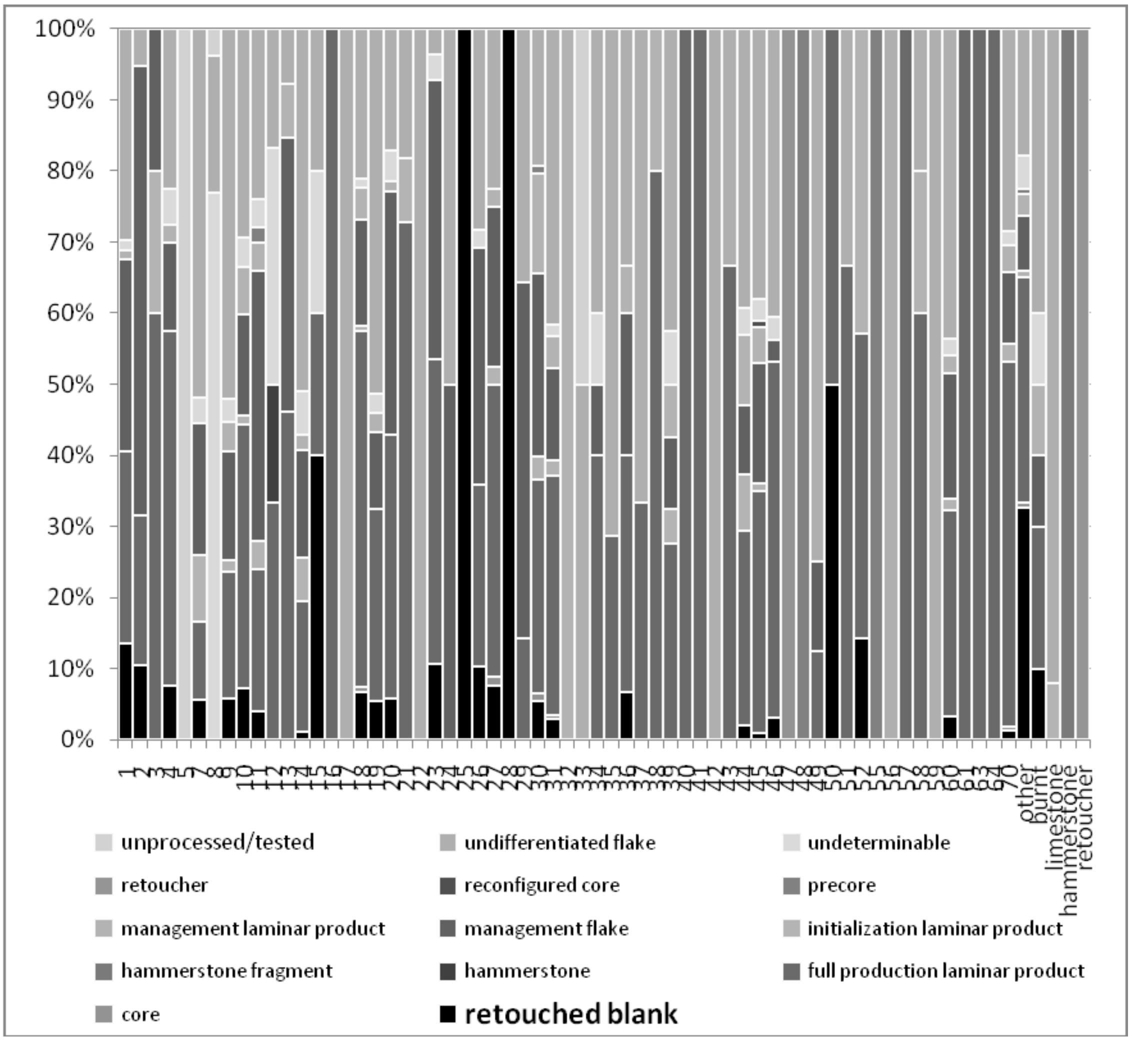
About half of the recognized ULRM include retouched blanks, with varied distributions (Tab. 3.39, Graph 3.43). At least in two cases, ULRM 25 an 28, retouched blanks, namely a pointed and a retouched blade, are the only representatives of their ULRM, which stands for the introduction at the site of ready made tools elsewhere fashioned. Unfortunately, this topic cannot be further investigated because of the large amount of retouched tools included in the "OTHER" group.

Typology	**Layer 4**		**Layer 4a**		**Tot**	
Tools	**24**	**92,3 %**	**115**	**94,3 %**	**139**	93,9 %
Bec			1	**0,8 %**	1	0,7 %
Burin	2	**7,7 %**	7	**5,7 %**	9	6,1 %
End-scraper	3	**11,5 %**	1	**0,8 %**	4	2,7 %
Pointed blade	1	**3,8 %**	7	**5,7 %**	8	5,4 %
Notched blade	2	**7,7 %**	14	**11,5 %**	16	10,8 %
Denticulated blade	1	**3,8 %**	1	**0,8 %**	2	1,4 %
Retouched blade	4	**15,4 %**	39	**32,0 %**	43	29,1 %
Truncated blade	1	**3,8 %**	8	**6,6 %**	9	6,1 %
Retouched flake	3	**11,5 %**	15	**12,3 %**	18	12,2 %
Pointed flake	1	**3,8 %**			1	0,7 %
Notched flake	4	**15,4 %**	11	**9,0 %**	15	10,1 %
Truncated flake	2	**7,7 %**	11	**9,0 %**	13	8,8 %
Armatures	**2**	**7,7 %**	**7**	**5,7 %**	**9**	6,1 %
Fragment of backed armature			1	**0,8 %**	1	0,7 %
Bi-truncated backed bladelet	1	**3,8 %**			1	0,7 %
Truncated backed bladelet	1	**3,8 %**	4	**3,3 %**	5	3,4 %
Notched bladelet			1	**0,8 %**	1	0,7 %
Backed point			1	**0,8 %**	1	0,7 %
Tot	**26**	**100,0 %**	**122**	**100,0 %**	**148**	100,0 %

Tab. 3.38: Typological classification of the retouched blanks and their stratigraphic distribution

ULRM	N of retouched blanks
1	10
2	2
4	3
7	3
9	11
10	12
11	2
14	1
15	2
18	16
19	2
20	4
23	3
25	1
26	4
27	6
28	1
30	5
31	5
36	1
44	1
45	1
46	1
50	1
52	1
60	4
70	2
other	42
burnt	1
TOT	**148**

Tab. 3.39: Number of retouched blanks per ULRM



Graph 3.43: Incidence of retouched blanks (black), per ULRM, compared to the other classes of artefacts

3.3.9.7. Tools

Large part of tool blanks is represented by undifferentiated flakes and central not cortical blades, with considerable percentages of management flakes and partially cortical central blades, reflecting the observed incidences distribution of the same classes among unretouched blanks (Tab. 3.40, Graph 3.44).

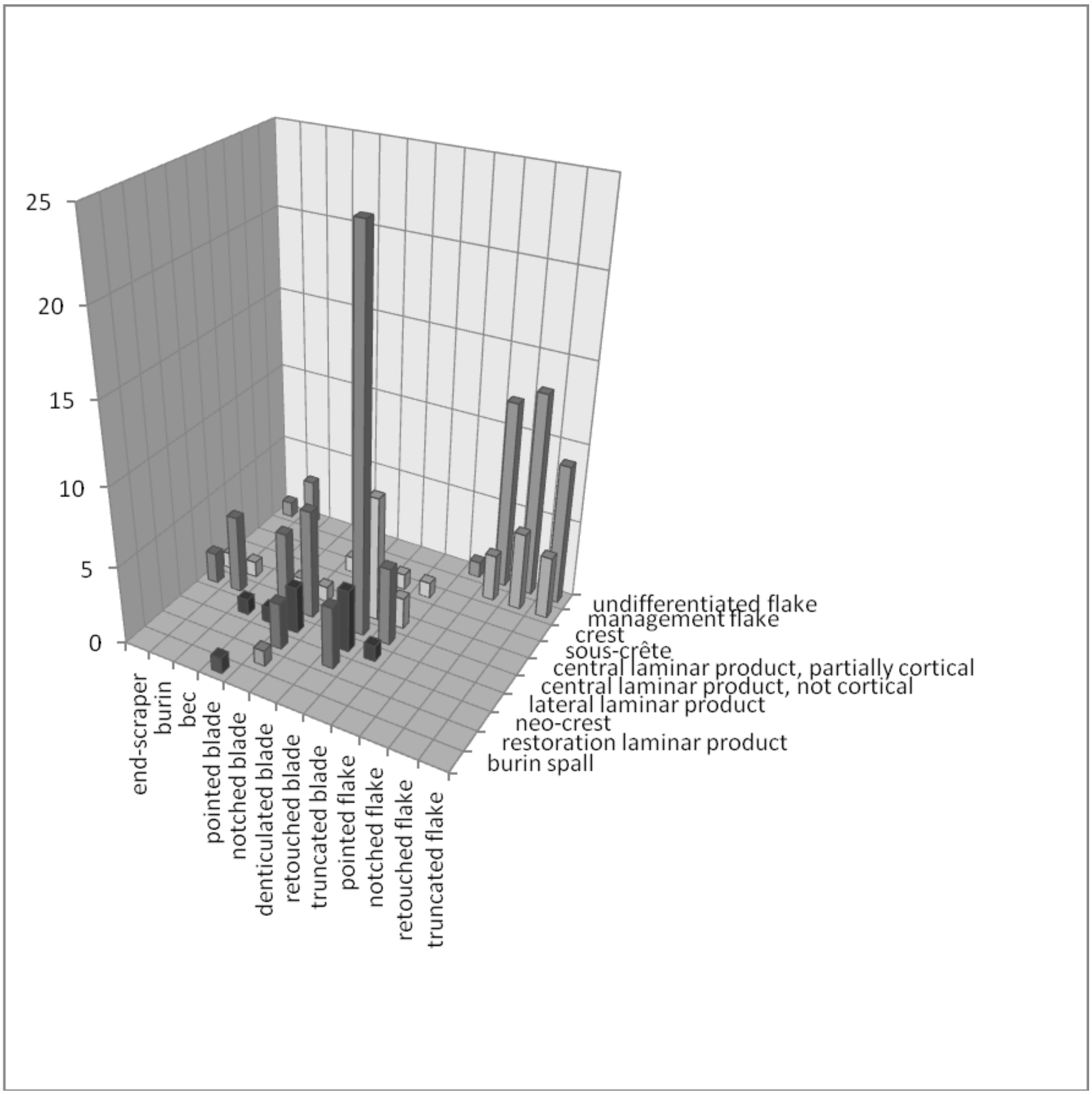
The only bec is made on a lateral laminar product while burins and end-scrapers on undifferentiated flakes and, mainly, on central laminar products. Pointed blades, which represent a distinctive tool of the assemblage, are mainly on not cortical central laminar blades, often very regular. Notched, retouched and truncated blades seem conversely to be widespread across the most part of the laminar blanks, with a clear predominance, in the case of retouched blades, of not cortical central laminar products.

Type / Blank	**end-scraper**	**burin**	**bec**	**pointed blade**	**notched blade**	**denticulated blade**	**retouched blade**	**truncated blade**	**pointed flake**	**notched flake**	**retouched flake**	**truncated flake**	**Tot**	
burin spall				1									1	0,7 %
restoration laminar product					1								1	0,7 %
neo-crest					3		4						7	5,0 %
lateral laminar product			1	1	3		4	1					10	7,2 %
central laminar product, not cortical	2	5		5	7	1	24	5					49	35,3 %
central laminar product, partially cortical	1	1		1	1	1	8	2					15	10,8 %
sous-crête							2						2	1,4 %
crest					1		1	1					3	2,2 %
management flake										3	5	4	12	8,6 %
undifferentiated flake	1	3							1	12	13	9	39	28,1 %
Tot	**4**	**9**	**1**	**8**	**16**	**2**	**43**	**9**	**1**	**15**	**18**	**13**	**139**	100,0 %

Tab. 3.40: Tool blanks

Fig. 3.36: Endscrapers (left) and burin (right)

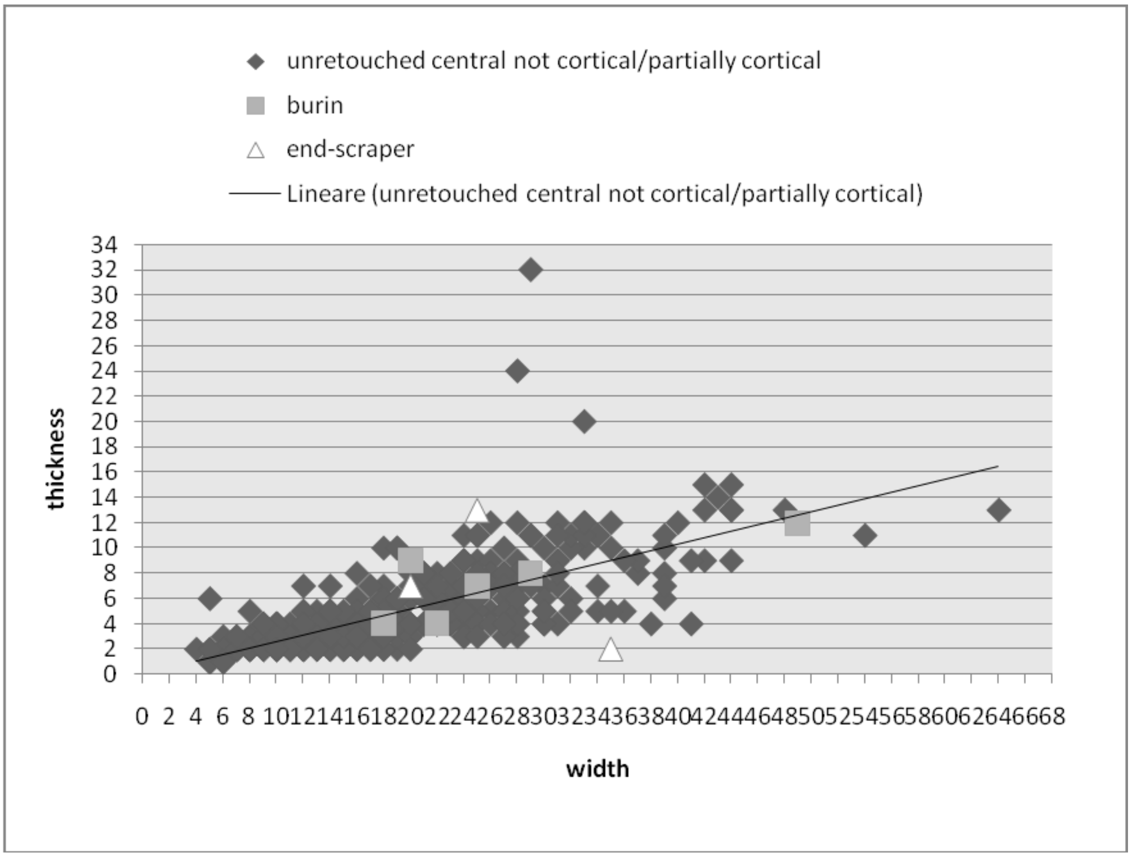
Fig. 3.37: Pointed blades



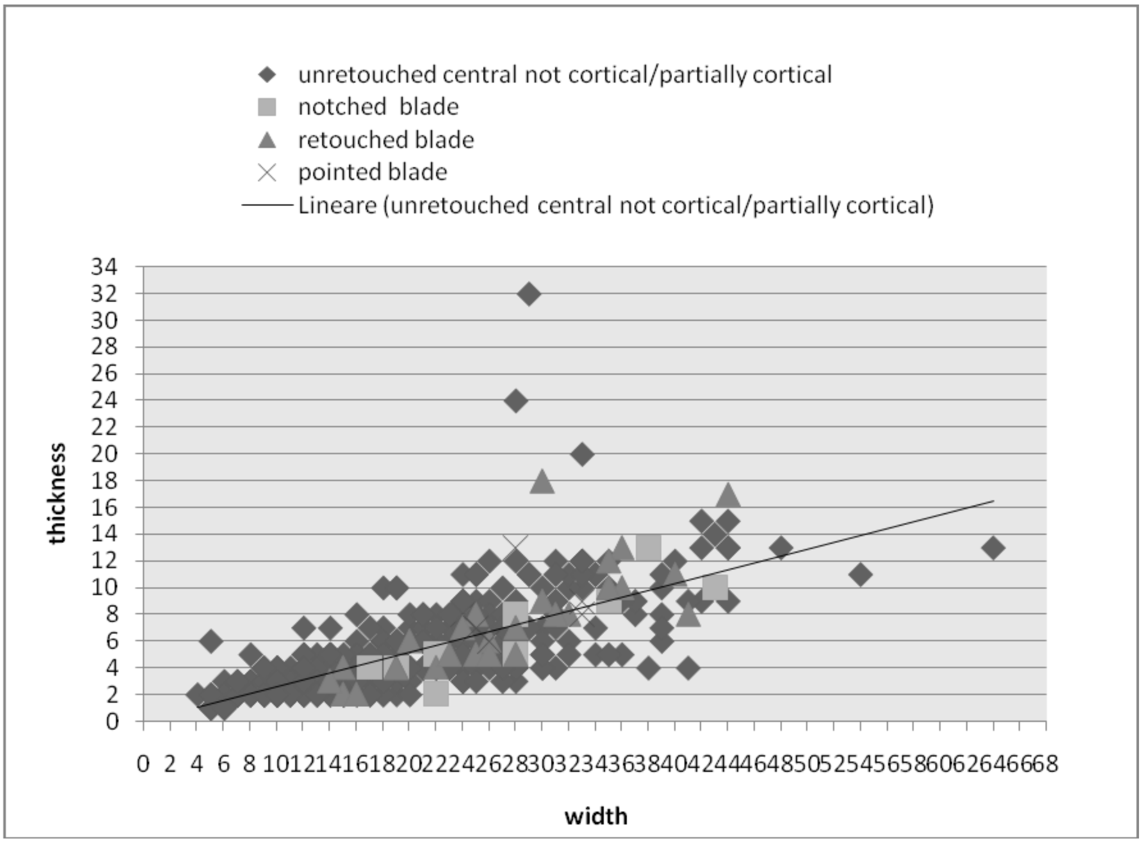
Graph 3.44: Tool blanks

A sample of five typological classes of retouched blades *l.s.,* among the most represented or most peculiar, realized on central laminar blanks, has been taken into consideration in order to assess their main morpho-metric and morpho-technical features: retouched blades, notched blades, pointed blades, burins and end-scrapers.

Graph 3.45 and Graph 3.46 show the scatter-plots of width and thickness values of retouched and unretouched blanks. Retouched and notched blades are made on a wide range of laminar calibers, from large bladelets to mega-blades. Pointed blades, conversely, are almost all clustered around the large blades values, with only two specimens 33 mm wide falling therefore on the lowest values of the mega-blades *spectrum*, suggesting that their production was subordinated to blank selection, further signaled by the recognition that six out of eight pointed blades are made on regular central laminar products, and the remaining on burin spall and lateral product. Central laminar products transformed into burins and end-scrapers are mainly blades and large blades. Only two specimens are made on mega-blades.



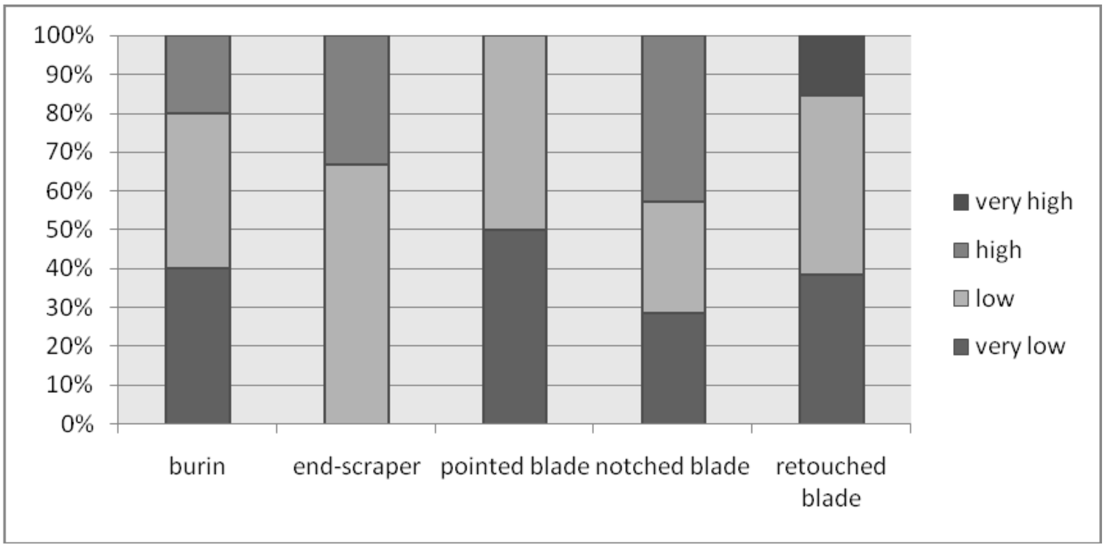
Graph 3.45: Size comparison between unretouched laminar blanks, burins and endscrapers



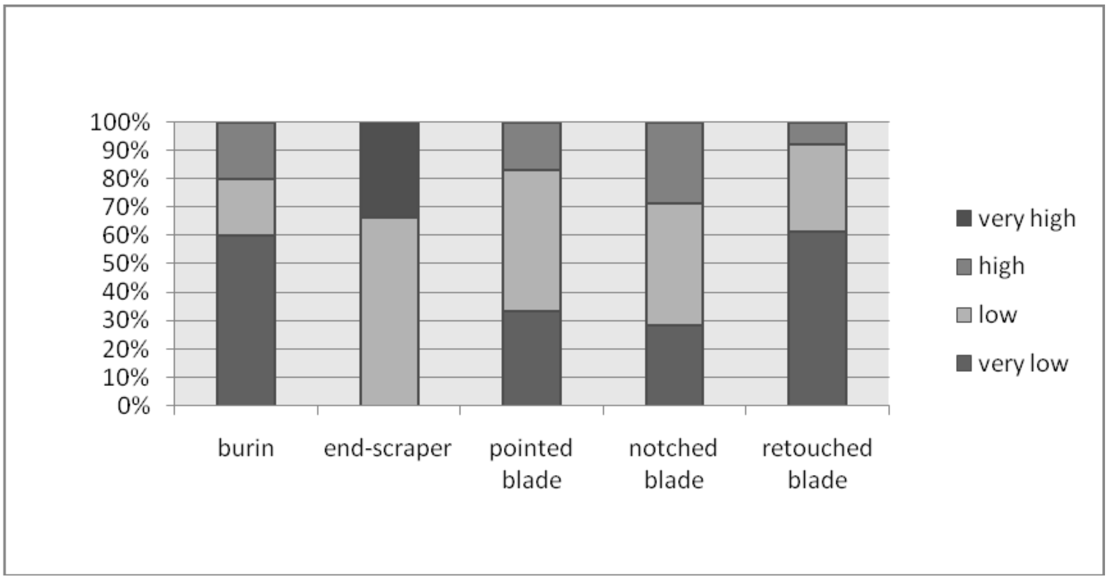
Graph 3.46: Size comparison between unretouched laminar blanks, notched blades, retouched blades and pointed blades

Longitudinal dorsal and ventral profiles (Graph 3.47, Graph 3.48) are generally low to very low in every considered tool class except for end-scrapers, which show to have been made on more curved blanks, and it is arguably that it could reflect an actual blank selection. As above observed, ventral profile curvature degree roughly depends on the dorsal one. Being the latter the outcome of more or less deliberate choices, and the former the result of such choices, it is probable that the extraction of suitable end-scrapers blanks was planned in advance. These observations are further supported by the recognition that end-scraper blanks show slightly higher transversal convexity (Graph 3.49).

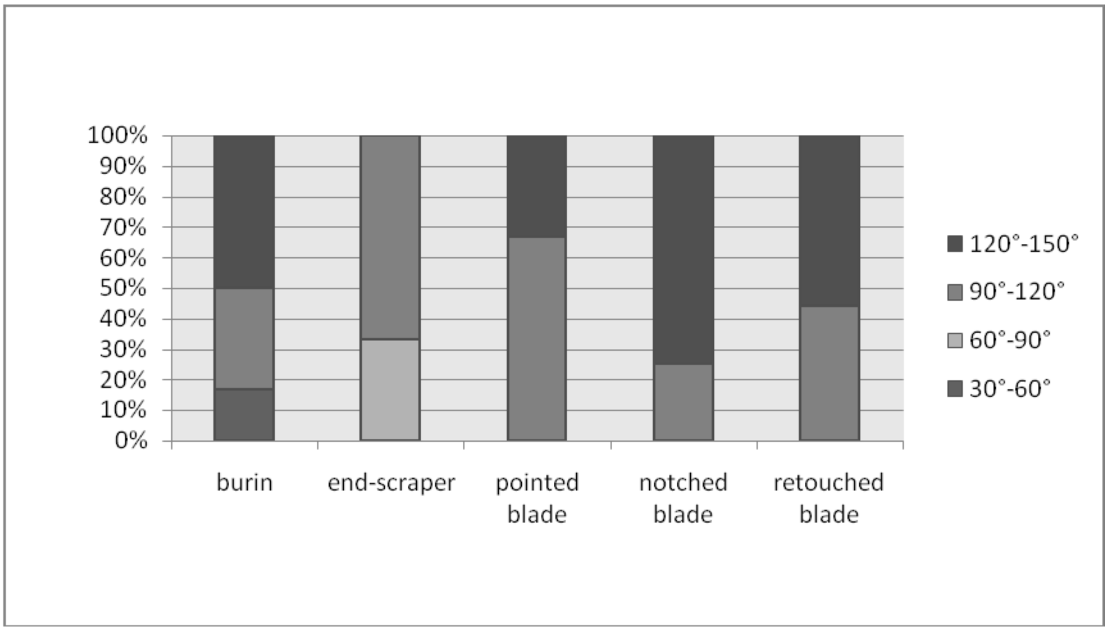
Burins, notched, retouched and pointed blades are in fact rather less transversally "convex", showing angles often comprised between 90° and 150°, while end-scrapers blanks are comprised between 60° and 120°. Of course, three end-scrapers are not sufficient to propose any model of differential blank production and selection, but, even with these small numbers, some indication in this direction has nevertheless been provided, at least that these tools slightly depart from the general observed trend, in which most of the considered specimens are made on rather straight blanks coming from rather low carinated/low centered cores.



Graph 3.47: Dorsal profile curvature of tools on blade (central laminar products)

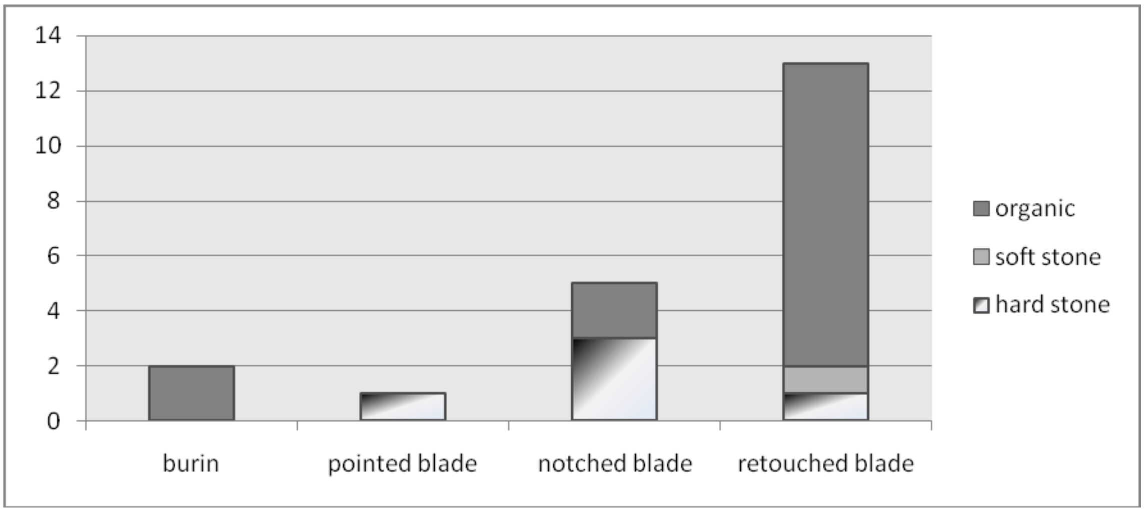


Graph 3.48: Ventral profile curvature of tools on blade (central laminar products)



Graph 3.49: Transversal convexity of tools on blade (central laminar products)

The evaluation of flaking technique (Graph 3.50) recognizable among retouched central laminar blanks is possible on a few specimens. It results that the application of direct percussion by means of soft organic hammer is widespread and largely recognizable among retouched blades blanks. Hard stone direct percussion is less represented and recognizable principally among notched blades blanks.



Graph 3.50: Recognizable technique among tools on blade (central laminar products)

3.3.9.8.Armatures

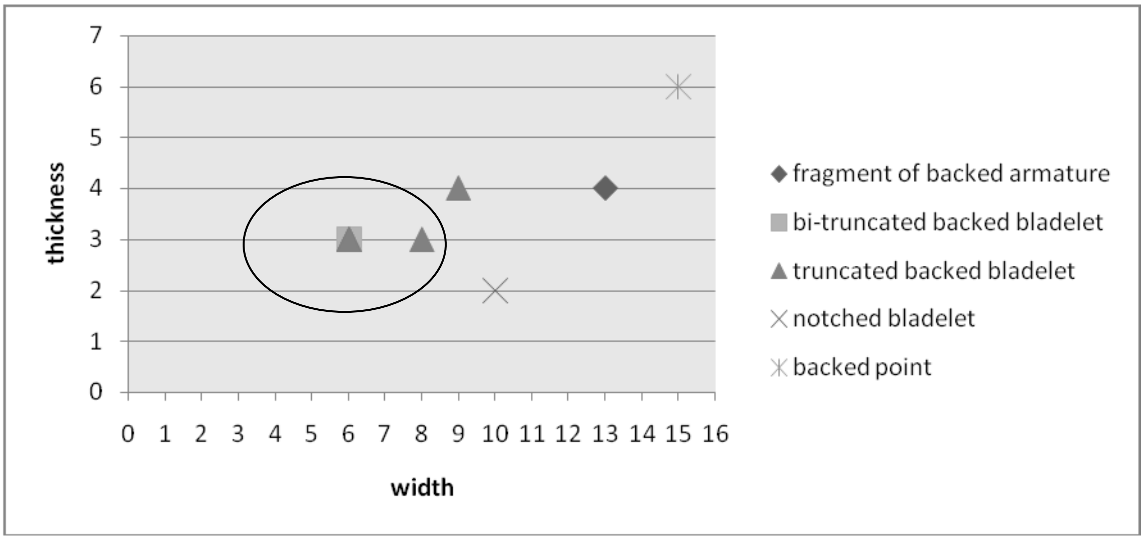
Armatures are made on not cortical laminar products. Because of the removal of substantial edge portions by abrupt retouch, it can only be argued that they were central rather than lateral. Ventral profile curvature is always very low, as is dorsal one, except for the backed point, which shows a slight dorsal curvature. *Cintrage* evaluation is not generally possible because of the presence of the back. Flaking technique, only recognizable in the case of the notched bladelet, is the soft organic hammer direct percussion.

Width values put armatures within the range of bladelets, except for the backed point (15 mm wide) which, because of the high reduction due to abrupt retouch, could have well been made on a blade blank rather than a large bladelet. Further, truncated backed bladelets show to be clustered between the widths of 6 and 9 mm, with four out of six specimens 6 mm wide, suggesting a high standardization of such implements (Tab. 3.41, Graph 3.51).

Fig. 3.38: Truncated backed bladelets (left) and backed point (right)

Type	Integrity	Length	Width	Thickness
Fragment of backed armature	Fragment	13	13	4
Bi-truncated backed bladelet	Entire	18	6	3
Truncated backed bladelet	Fragment	29	6	3
Truncated backed bladelet	Fragment	26	8	3
Truncated backed bladelet	Fragment	19	9	4
Truncated backed bladelet	Fragment	16	6	3
Truncated backed bladelet	Fragment	14	6	3
Notched bladelet	Entire	22	10	2
Backed point	Entire	65	15	6

Tab. 3.41: Integrity rate and size of the armatures



Graph 3.51: Comparison between armatures size (width and thickness)

3.3.10. Use-wear traces

Functional analysis has been carried out by Sara Ziggiotti (ZIGGIOTTI 2007) and what follows is entirely based on her work. The analysis has been aimed to test the hypothesis of possible activities carried out at the site other to the lithic production, and possibly oriented to the acquisition, treatment and consumption of foodstuffs as well as to the transformation of animal, vegetal or mineral materials.

A sample of 80 specimens, coming from layers 4 and 4a, has been selected among retouched and unretouched blanks. Globally, the state of preservation of edges and surfaces was good on about half of the sample, while the remaining was affected by various alterations, which precluded the possibility of edges analysis. Given the general good preservation of the archeological material, the author stresses the relative low incidence of recognizable active edges.

In any case, the recognized activities *spectrum* seems to be mainly oriented to the transformation of vegetal and animal resources rather than to their acquisition, whose only traces are observable on the only backed point. The other armatures show conversely negligible traces. Fosso Mergaoni, therefore, would have had a very secondary role in relation to food resources extraction.

Pointed blades have been attributed to butchering activities and cutting of soft animal tissues, while wood and animal hard tissues processing is suggested by traces due to action on resistant materials, like splitting (one scraper), scraping and thinning (retouched blades and end-scrapers). Burins have been determined to have been used to carve undeterminable materials and the traces were focused on the *biseau.* The absence or rarity of clear traces of bone and antler processing is linked by the author to the possible maintenance rather than the manufacture of implements of such materials (
Tab. 3.42).

The role of unretouched large blades is doubtful, and the traces shown by these artefacts lead to suggest they were sporadically used. An assessment of a specific large blades production chain finalized to a specific functional orientation is, at the current the state of knowledge, not possible.

Unretouched blades *spectrum* of activities is relatively varied and, although mainly linked to the processing of soft tissues or to butchering, they have been used on resistant materials too. As for large blades, blades show a very limited use, with little developed use-wear traces. Anyway, standing the varied range of activities blades should have accomplished, their production should had to be planned in their function. Unretouched bladeletes and flakes sample show no use-wear traces at all.

(ZIGGIOTTI 2007)	Retouched blade	Pointed blade	Retouched flake	End-scraper	Burin	Backed point	Large blade	Blade
Projectile						■		
Cutting low resistant material	■							■
Butchering		■						■
Scraping wet hide				■				
Scraping undeterminable material				■				
Scraping bone								■
Scraping resistant material	■				■			■
Undeterminable action on resistant material	■							
Percussion on resistant material	■						■	
Carving undeterminable material					■			
Splitting resistant material			■					

Tab. 3.42: Synthesis of the results of the functional analyses

3.3.11. Refittings

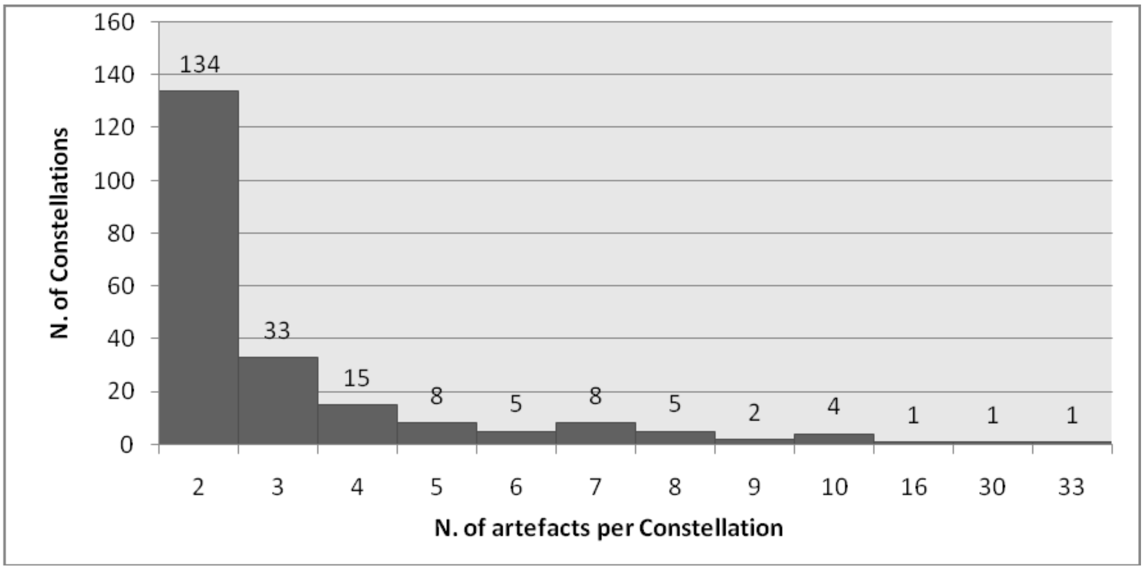
Refittings have been classified according to two levels. Every individual set of refitted artefacts *l.s.*, constitutes a "constellation", after the terminology adopted in (SISK and SHEA 2008), which have been progressively numbered. Within each constellation, several refits and conjoins (CZIESLA 1990) can be present, being the former represented by artefacts flaked from each other ("ventral on dorsal" pattern) and the latter being fragments of artefacts ("fracture on fracture" pattern). Refits and conjoins have been also progressively numbered. Constellations, refits and conjoins have, in this way, unique ID, used to easily represent them on maps, tabs and graph elaborations. Refittings have also been described, graphically too, according to a methodology elsewhere adopted (ARANGUEREN and REVEDIN 2008), borrowed from the Harris matrix protocol for the analysis and description of stratigraphic sequences. It is assumed that flaking actions are strictly stratified, in the sense that actions are followed or preceded by other actions that can be uniquely put along a sequence. The stratigraphic relations adopted are: "earlier than" and "later than", in the case of refits, and "equal to" in the case of conjoins.

Globally, 217 constellations, which comprise 115 refits and 178 conjoins, have been identified, for a total amount of 730 refitted artefacts, an average of 3,3 artefacts per constellation and a global refitting rate of about 31%. Some differences however exist if considering '82 and '85 excavations separately, because of a more systematic search in the case of the second and a more random one in the first, mainly focused on larger specimens and specific eloquent sequences: 1982 excavation returned an about 15% refitting rate (105 refitted artefacts) while 1985 excavation returned an about 37% refitting rate (625 refitted artefacts).

The number of artefacts per constellation varies from 2 to 33. Constellations composed of two artefacts are the very most part, and account for about 62% of all the constellations (Tab. 3.43, Graph 3.52). From 3 artefacts per constellation onward, the number of constellations with increasing number of artefacts shows a regular decrease from about 15% to 0,5%, the latter being represented by three large series composed by respectively 16, 30 and 33 artefacts (Fig. 3.35).

N. of artefacts per Constellation	N. of Constellations	%
2	134	61,9 %
3	33	15,1 %
4	15	6,9 %
5	8	3,7 %
6	5	2,3 %
7	8	3,7 %
8	5	2,3 %
9	2	0,9 %
10	4	1,8 %
16	1	0,5 %
30	1	0,5 %
33	1	0,5 %

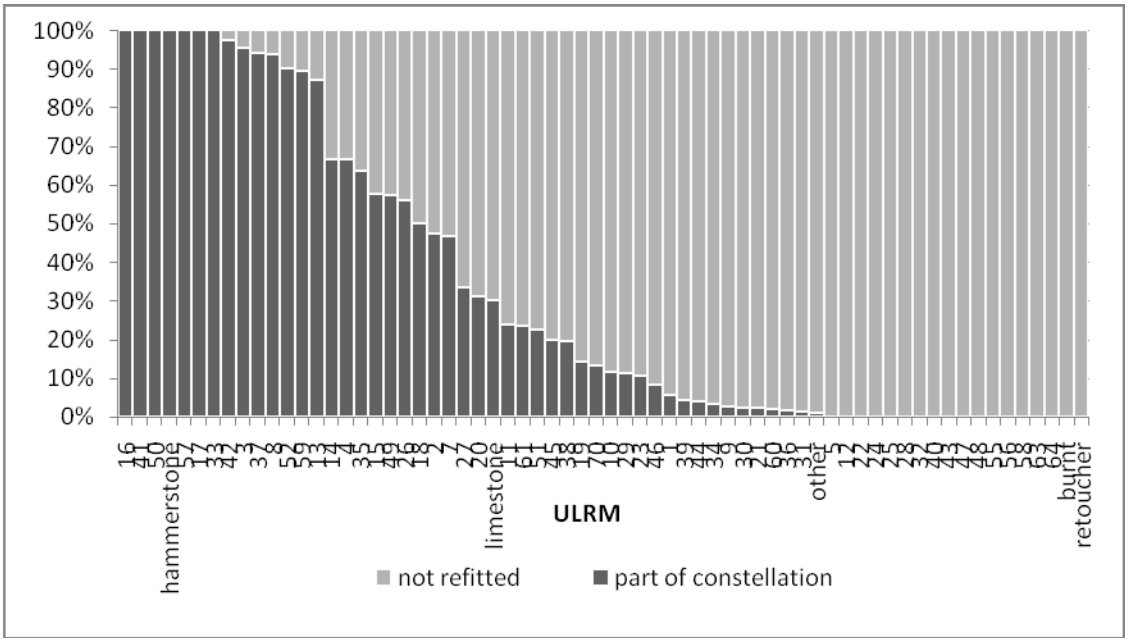
Tab. 3.43: Number of artefacts per constellation



Graph 3.52: Number of artefacts per constellation

Refitting rate according to ULRM is very variable. Graph 3.53 shows the distribution, in percentage, of refitted artefacts per ULRM, ordered according to decreasing amounts.

Usually, the wholly refitted or wholly not refitted ULRM are those with a less amount of artefacts, and data presentation according to percentages, while being more clear and immediate, could be a little misleading.



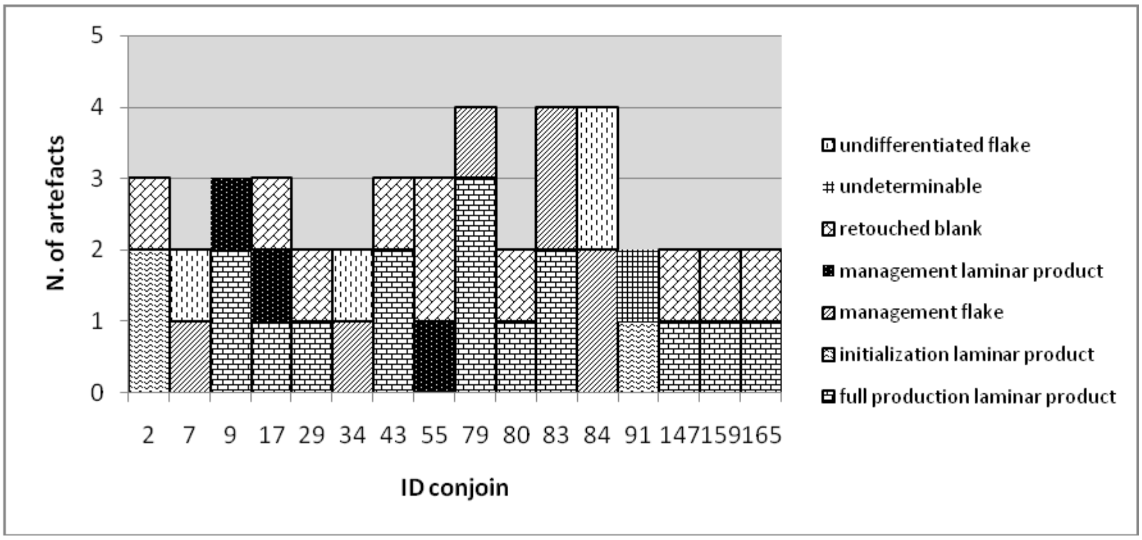
Graph 3.53: Refitting rate

The recognition of the nature and amount of conjoined artefacts provides some general suggestions useful for a better understanding of the assemblage under study, by highlighting some major interpretation problems that can be usually encountered when dealing with fragmented sets of lithic remains. In example, 43 fragmentary artefacts, part of 16 conjoins, once refitted revealed to actually belong to not homogeneous technological classes, different from the ones previously diagnosed. The most frequent cases are fragments of unretouched blanks conjoining with retouched ones or fragments of undifferentiated flakes with management ones (Tab. 3.44, Graph 3.54).

Very rarely a realistic estimate of the assemblages size can be unambiguously established, because of several factors and processes which modify, even severely, the number of specimens (HISCOCK 2002). As visible in Tab. 3.45 and Graph 3.55, the average ratio between the number of conjoined artefacts and the number of conjoins is around 2,3. This means that a quantitative evaluation of the assemblage intended to provide a very rough estimate of its pristine composition, should consider it, at best, as around the half of the total.

	Id conjoin															
Technological classes	**2**	**7**	**9**	**17**	**29**	**34**	**43**	**55**	**79**	**80**	**83**	**84**	**91**	**147**	**159**	**165**
Full production laminar product			2	1	1		2		3	1	2			1	1	1
Initialization laminar product	2												1			
Management flake		1				1			1		2	2				
Management laminar product			1	1				1								
Retouched blank	1			1	1		1	2		1				1	1	1
Undeterminable													1			
Undifferentiated flake		1				1						2				

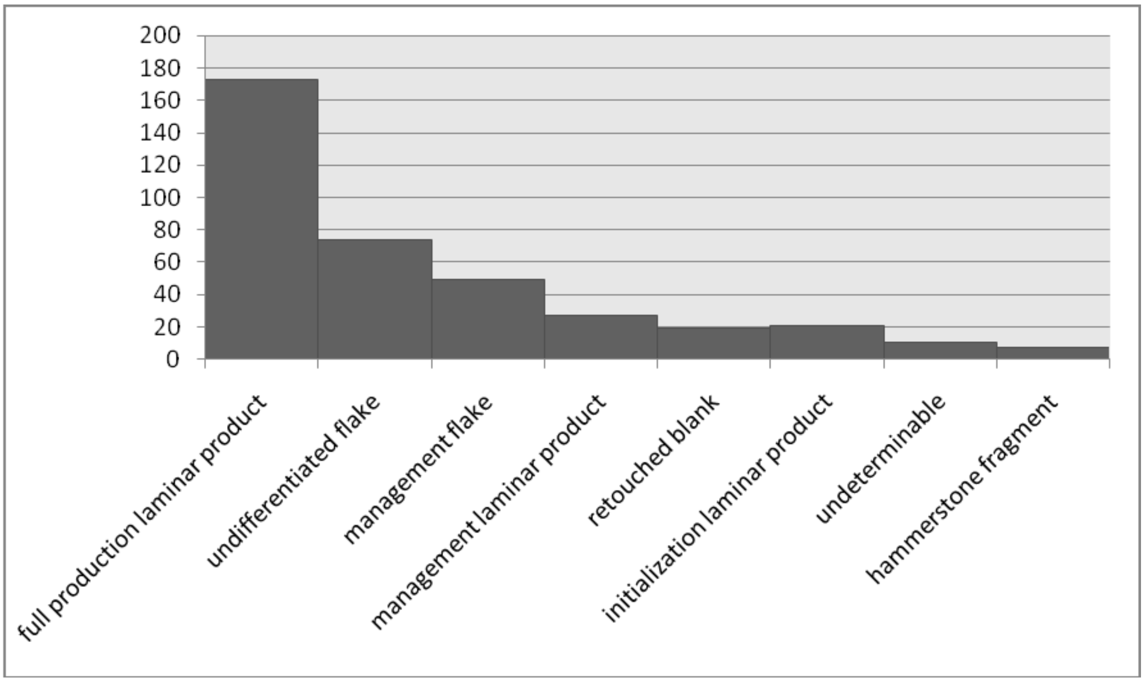
Tab. 3.44: Conjoining 'un-homogeneous' artefacts fragments



Graph 3.54: Conjoining 'un-homogeneous' artefacts fragments

Technological classes	N. of Conjoining artefacts	N. Of conjoins	Ratio artefacts/conjoins
Full production laminar product	173	74	2,3
Undifferentiated flake	74	33	2,2
Management flake	49	22	2,2
Management laminar product	27	12	2,3
Retouched blank	19	8	2,4
Initialization laminar product	21	9	2,3
Undeterminable	10	4	2,5
Hammerstone fragment	7	1	7,0

Tab. 3.45: Conjoining 'homogeneous' artefacts fragments and ratio artefacts/conjoins

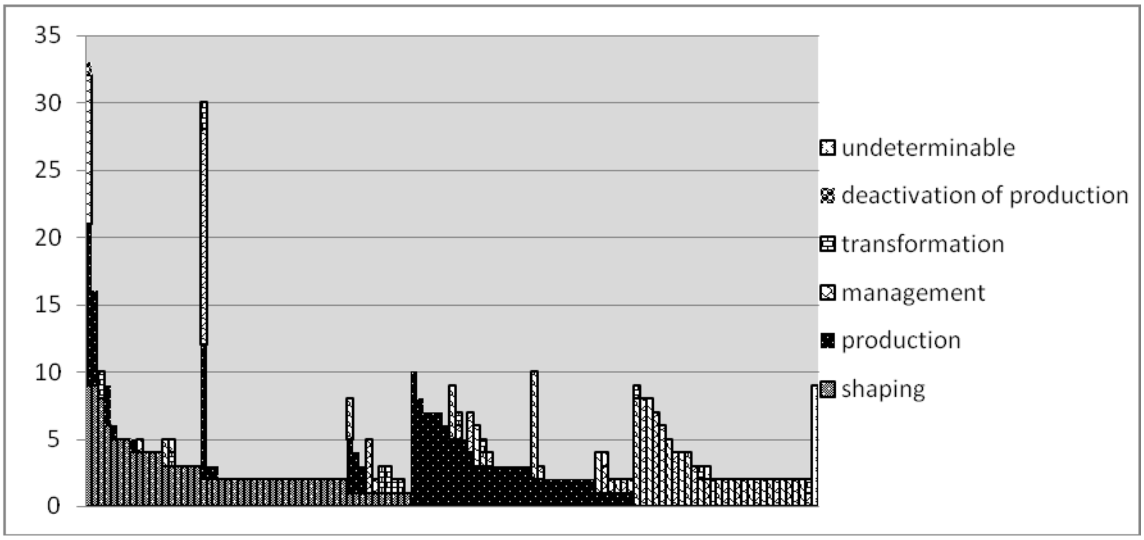


Graph 3.55: Conjoining 'homogeneous' artefacts fragments

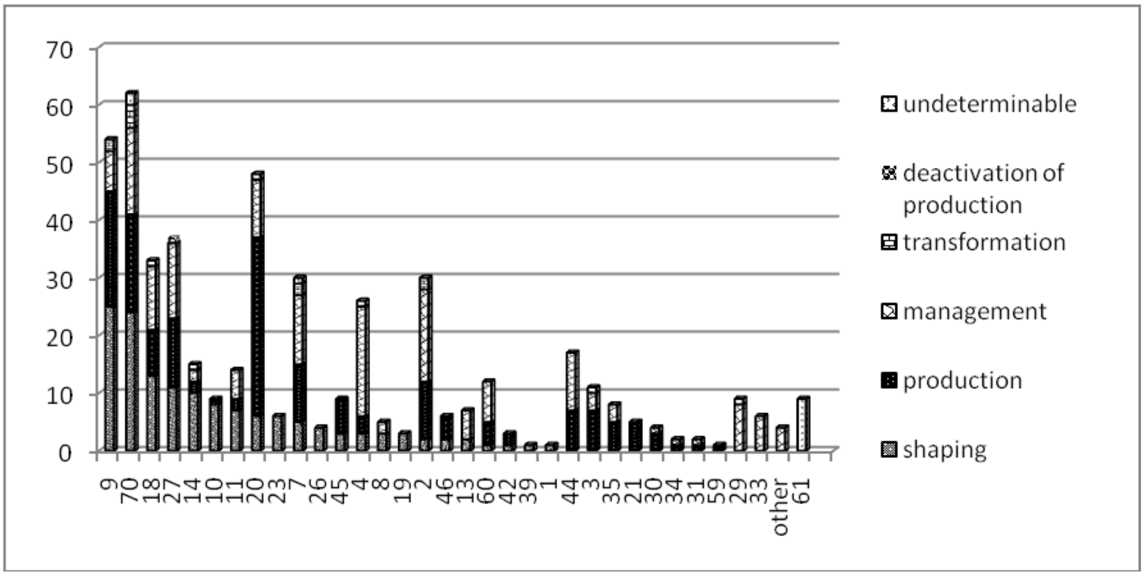
As far as refitting reduction sequences are concerned, some considerations can be advanced by the single constellations and single ULRM points of view. When examining each constellation (Graph 3.56) it can be noticed that the most part of them is composed of artefact almost exclusively belonging to one of the three main reduction phases of shaping, production and management. While, in fact, the most complete sequences show a continuous process, from shaping to transformation or core abandon, a very large number of constellations are representative of specific segments of the reduction process. While surely partially due to a research bias, it can nevertheless be imputable to the actual missing of some specific artefacts, like predetermined first choice laminar blanks, without which many of the recognized constellations cannot be further refitted. Because of the dynamic history artefacts usually undergo (i.e., manufacture at a particular site, transportation, use and discard elsewhere), lithic collections are probably never complete (HOFMAN 1981).

A reassessment of the reduction segments occurred at the site testified by refittings is partially provided by grouping the constellations according to the ULRM they belong

(Graph 3.57). As previously highlighted by the technologic analysis, most of the ULRM mainly undergone to shaping, production and management phases, and what is worth to stress is that the recovery of refitting artefacts attributable to different reduction phases strongly suggests their on-site occurrence, without adding new information to the global technological assessment of the assemblage.



Graph 3.56 Refittings per constellation



Graph 3.57 Refittings per ULRM

The general pattern observable among the refitted sequences confirms what previously suggested about the mainly represented reduction phases. A large part of the blocks, with variable incidences, undergone to a shaping phase, but the very most part of them show to have been subject to several management production cycles, thus highlighting the role of the investigated area as workshop where a certain amount of lithic raw material entered not in its raw state, but, conversely, as preformed or even exploited cores.

3.3.12. Processing implements

Generally, hammerstones and retouchers are active tools used in rocks processing that, differently from flaked raw materials, have parallel technical time and use-cycle. For this, they are not included within the reduction sequence phases above outlined. Except one reutilized core, which actually underwent a use destination shift (here considered at its final stage of use), the other two implements has been subject to independent sequences of procurement, use and abandon, and are separately considered from the flaked artefacts.

- Hammerstone on a large blade core of dark Scaglia Variegata flint (109 x 100 x 63 mm). Layer 4. The attribution to a flaking implement is due to diffuse clear rounding on the two opposite poles of the core, accompanied by large scaled detachments hardly interpretable as deliberate extractions because of their reiteration without any attempt to manage or to repair the damaged surfaces *Fig. 3.39*, left)

- Hammerstone on a large rounded limestone pebble (166 x 94 x 88 mm). Layer 4. It is composed of seven refitted parts, probably detached during its use, most of which show impact points, bulbs and clear ventral faces. For this reason, the relations among its components are comprised within the refittings rather the conjoins. It shows a series of impact traces on at least one pole, together with light straight striae on the surface (*Fig. 3.39*, right)

- Retoucher/abrader on a small flat rounded limestone pebble (84 x 64 x 22 mm). Layer 4a. It shows impact traces on two opposite poles along with parallel oblique striae on at least one surface close to the edge (*Fig. 3.40*)

Fig. 3.39: Hammerstone on a reutilized flint core (left); limestone hammerstone (right)

Fig. 3.40: Retoucher/abrader on a small flat limestone pebble

3.4. Spatial distribution

3.4.1. Foreword

Not all the artefacts were plotted during excavation. To the ones missing "xyz" information have been assigned the "xy" coordinates of the center of the sub-squares they belong to, which make them well identifiable on the maps of this chapter, while "z" has been arbitrarily assigned on the basis of the "z" values of the closest plotted artefacts. Such an expedient makes distribution appearance rather artificial, and has the inconvenient of generating single dots usually representing more than one artefact each, but it is thought to be a good means to reduce topographic data loss.

3.4.2. Site topographic features

The main information about the spatial arrangement of the archaeological remains and of the living space of the site come from the 1985 excavation. Data from the 1982 excavation can be correlated to the 1985 one in a limited extent. The reciprocal geometrical relationships of the 1982 and the 1985 excavation surfaces can be roughly reconstructed, the lithics collected during the two field seasons share many common elements, principally at the level of raw materials, and, finally, several refittings between the two sets of findings have also been found. In any case, spatial analysis conclusions will be drawn from the surface excavated in 1985.

The horizontal distribution of the archaeological remains highlights some significant patterns. Cores and flaking products define a series of concentrations set at about 1-2 m from each other. Layer 4a returned four concentrations in the southern part of the excavated surface, numbered from 1 to 4, from South. Every concentration, or structure, shows a more or less sub-circular shape, with irregular contours.

Within (in one case, between) structures are present one or more areas characterized by the absence or rarefaction of artefacts, sub-circular shape and generally smaller than 0,5 m^2. Two of these are visible respectively SE and SW of structure 1 while a larger one is present between structures 1 and 2. Structure 3 shows two main rarefaction areas, respectively S and N. In structure 4, finally, four well identifiable rarefaction areas are set all around it, forming a sort of branches extending SW, E, N and NW.

The four structures of layer 4a (*Fig. 3.41*, *Fig. 3.42*, *Fig. 3.43*, *Fig. 3.44*), formed by the accumulation of flaking products, show an area of maximum artefacts concentration, generally in a decentralized position rather than central. Outside the pertinence spaces of the structures are also present artefacts, spread across the surface with less topographic patterning. In particular, the most part of non-clustered artefacts lied along two NW-SE directrices between structures 1-2 and 3. Approximately in the center of the investigated area there was a small and thin fractured sandstone slab with some charcoals below it. In layer 4 there's a lower degree of artefacts concentration. Is anyway possible to isolate at least two clusters of findings, structures 5 and 6 (*Fig. 3.45Fig. 3.46*), showing nevertheless a more rarefaction when compared to the layer 4a ones.

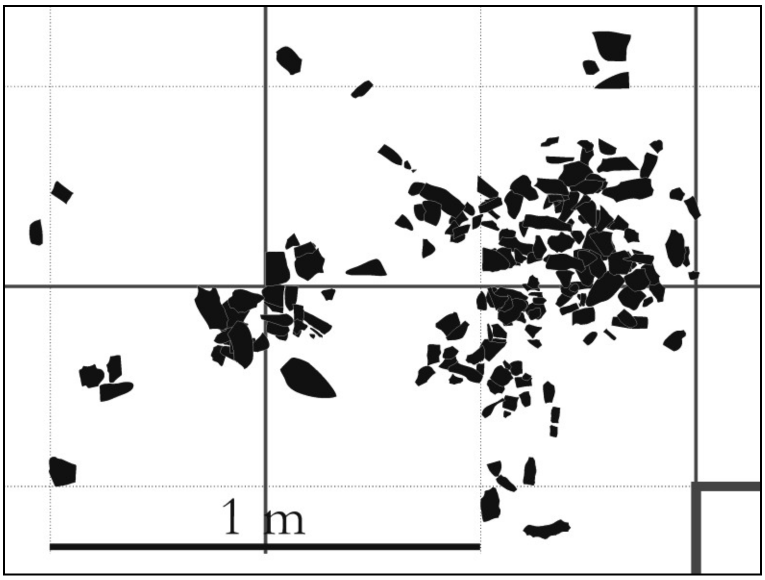


Fig. 3.41: Cluster 1

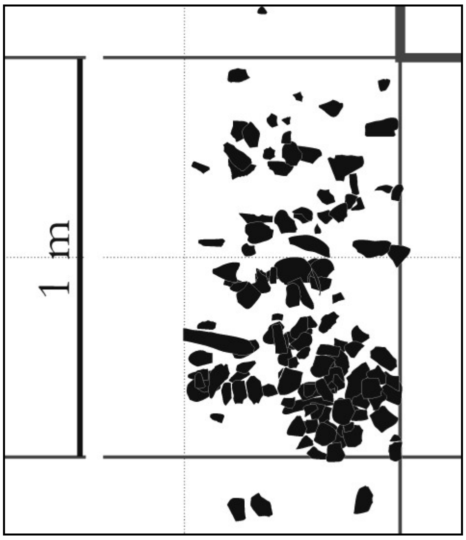


Fig. 3.42: Cluster 2

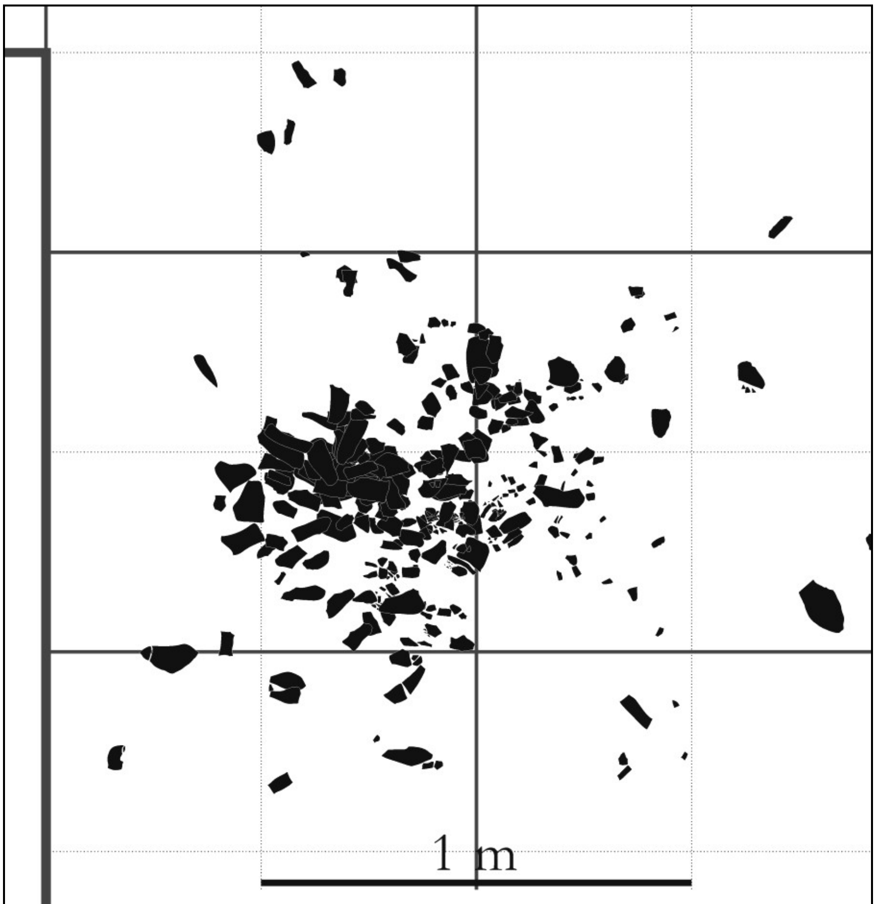


Fig. 3.43: Cluster 3

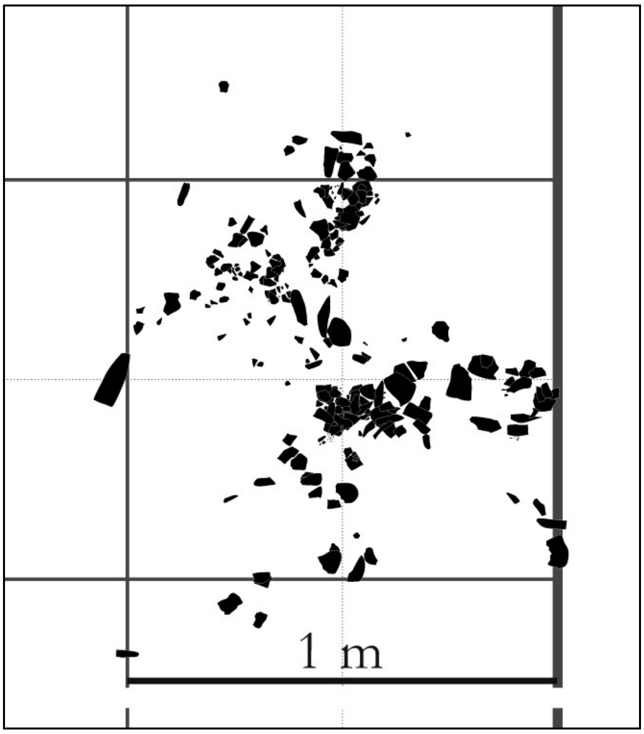


Fig. 3.44: Cluster 4

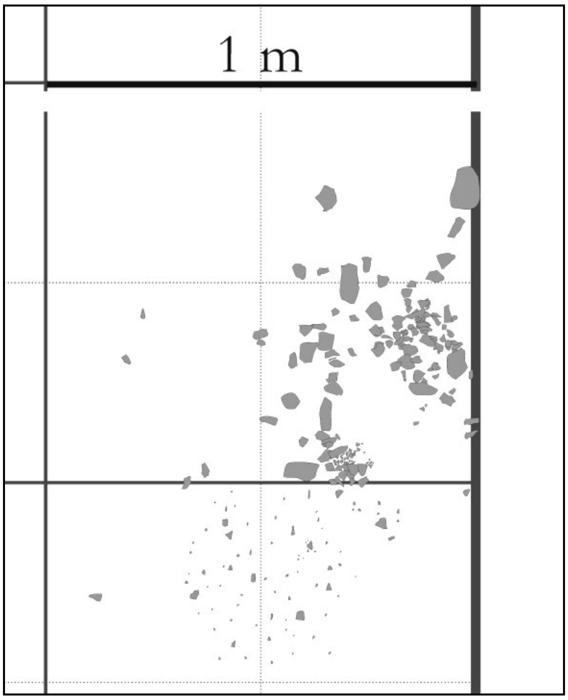


Fig. 3.45: Cluster 5

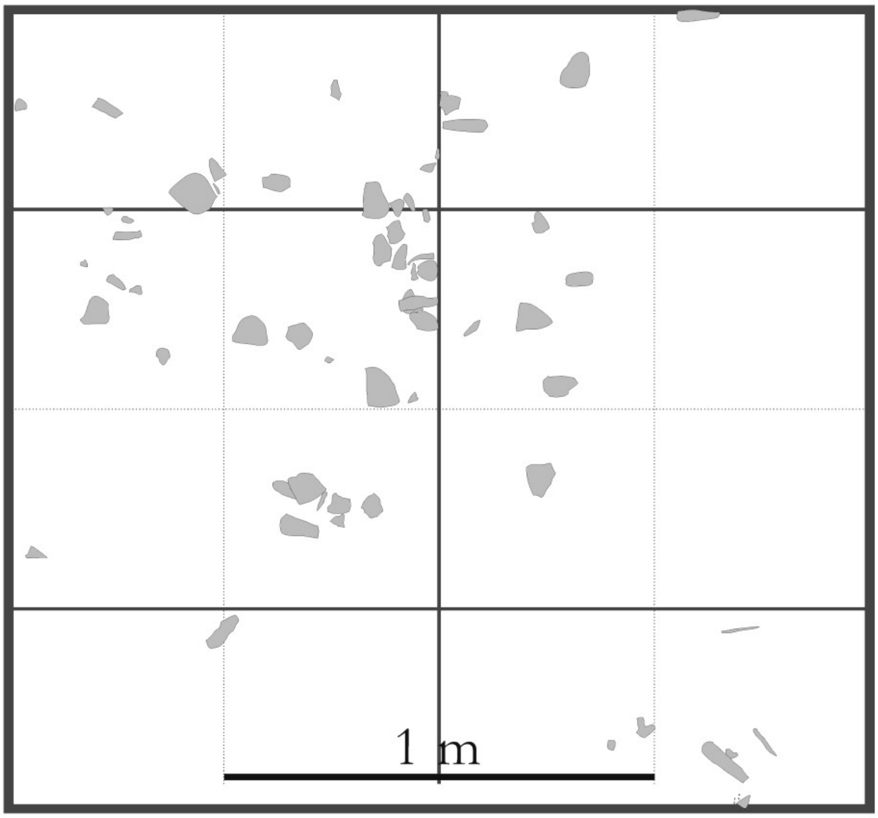


Fig. 3.46: Cluster 6

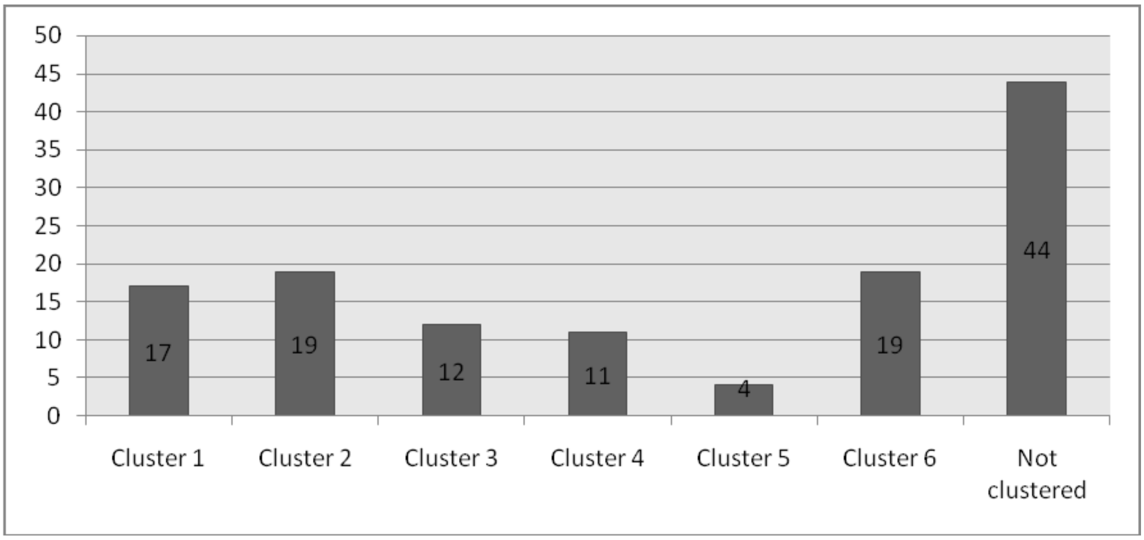
3.4.3. Raw materials

The quantitative, qualitative and topographic distribution of the raw materials related aspects are visible in Graph 3.58, Graph 3.59, Graph 3.60, Graph 3.61 and *Fig. 3.47*, *Fig. 3.48*. Every cluster, or structure, is made of artefacts referable to variable numbers of different ULRM, from 4 to 19, many of which are shared (as confirmed by refittings). Excluding the ULRM "other", "burnt", "limestone", "hammerstone" and "retoucher", and the not clustered artefacts, it results that 29 ULRM are present in no more than one cluster each, while 13 ULRM are present in 2 clusters, 5 ULRM in 3 clusters and, finally, 1 ULRM in 4 clusters, suggesting a somewhat spatially dynamic behavior and permeability of the different areas of the paleosurface.

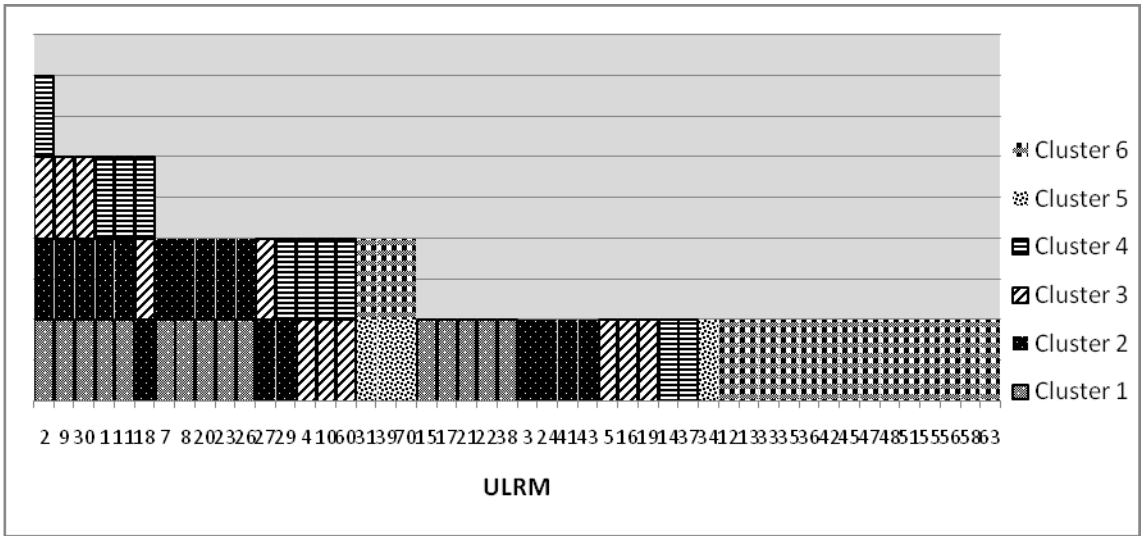
Except for cluster 5, where about 80% of the artefacts are on flint of the "Maiolica" formation, the great majority of the artefacts of the other clusters are on flint of the

"Scaglia variegata" formation, with variable incidences of the "Scaglia rossa" and "Maiolica" ones, suggesting that the lythologic composition of the single clusters reflect the natural variability in both presence and availability of the different selciferous formations of the local environment.

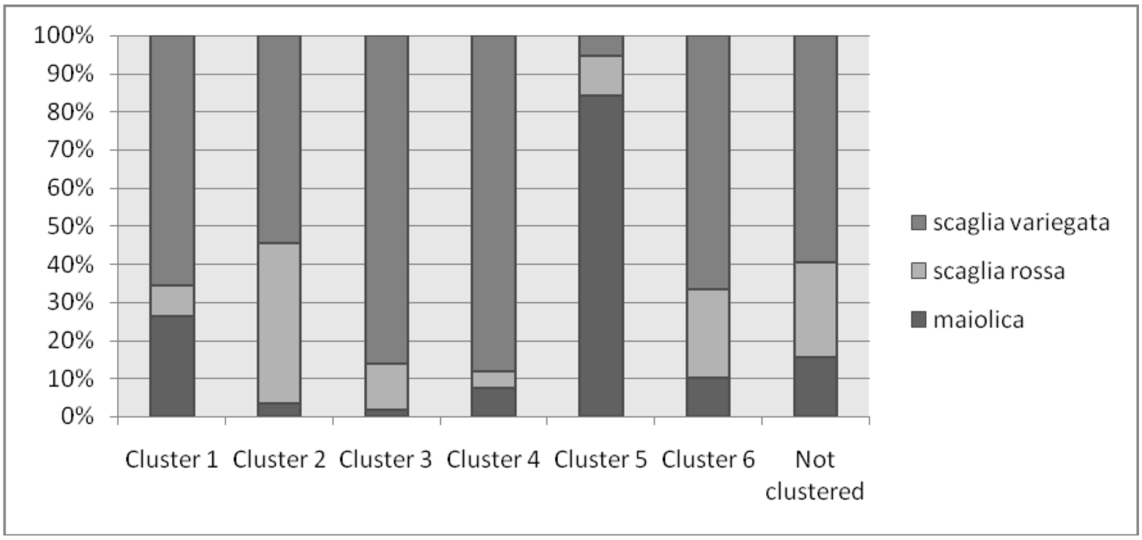
As previously highlighted, the main flint procurement environments are the debris accumulations close to primary outcrops and the fluviatile ambits. The environment of collection of the flint in its raw state is quite homogeneous except in cluster 4, where the most part of the artefacts come from pebbles recovered within alluvial deposits.



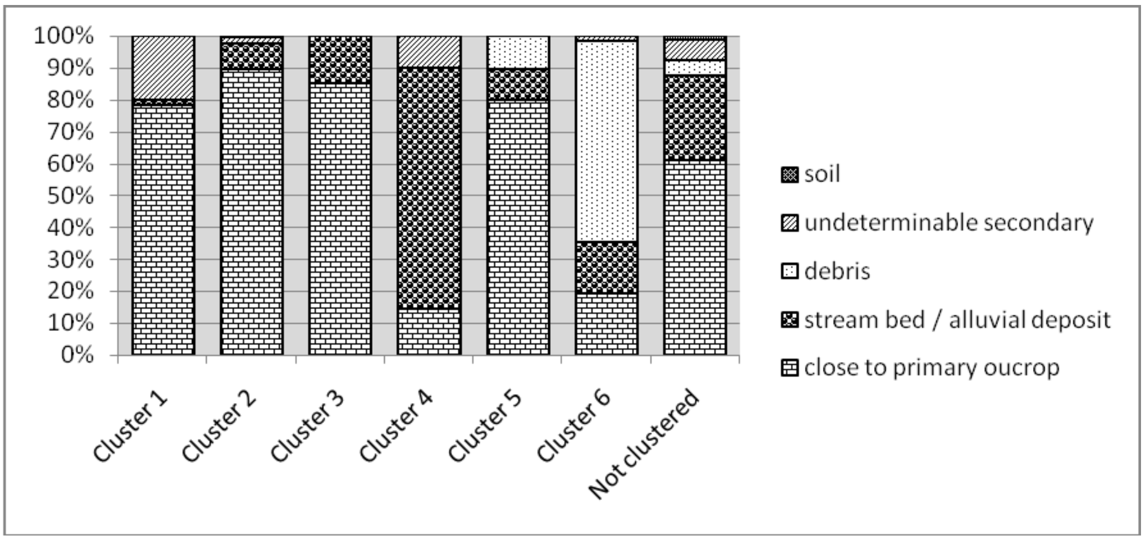
Graph 3.58: Number of ULRM per cluster



Graph 3.59: Distribution (presence/absence) of ULRM within clusters



Graph 3.60: Represented flint formations per cluster



Graph 3.61: Environment of collection per cluster

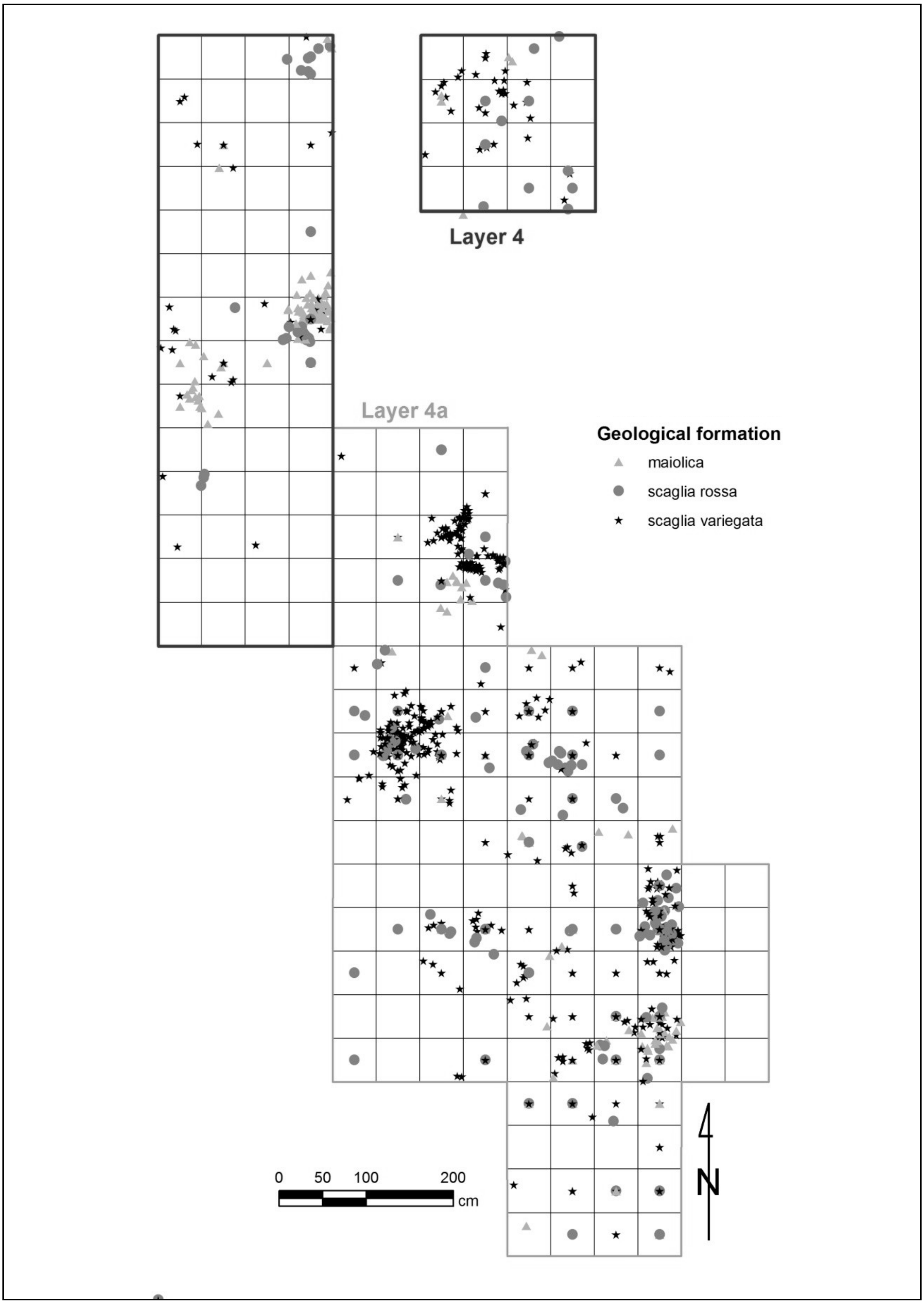


Fig. 3.47: Spatial distribution, geological formation

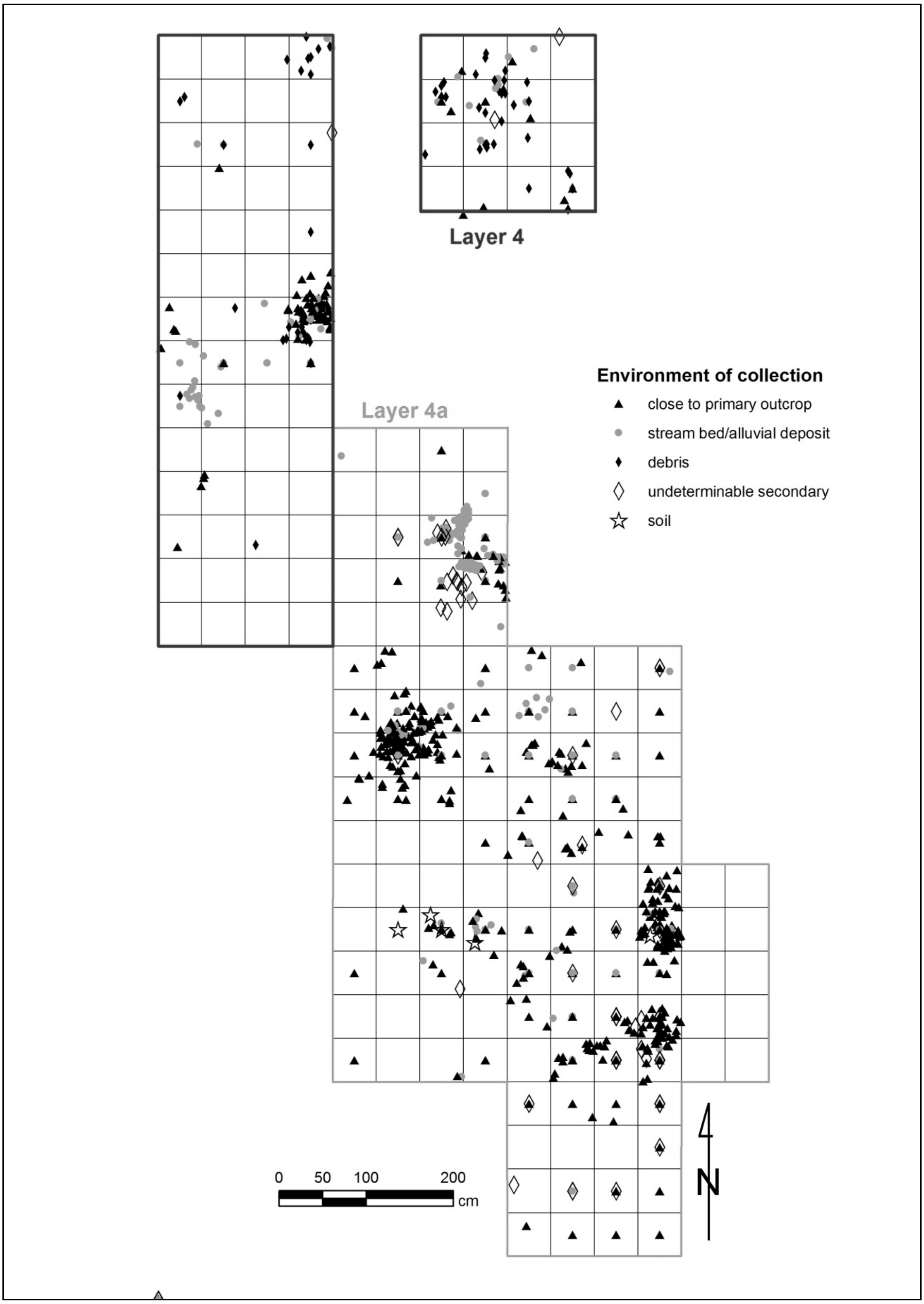


Fig. 3.48: Spatial distribution, environment of collection

3.4.4. Reduction sequences

The technological composition of each accumulation of artefacts can be regarded as an indicator of the spatial differentiations of the site general functional orientation previously outlined by the analysis of the whole assemblage. The incidence of each main class of diagnostic artefacts recovered within the single structures indicates a substantially similar functional attitude of them (Graph 3.62). Every structure shows, in fact, comparable incidences of the inferred reduction sequence phases, with a diffuse emphasis on the shaping/management/production ones. This means that the accumulations are the result of rather repetitive activities carried out at the workshops of both layer 4a and layer 4.

Artefacts referable to the shaping phase (*Fig. 3.49Fig. 3.50*) are widespread, within clusters or scattered outside them. Pre-cores are more likely present in the outer periphery of the structures, both in layer 4 and layer 4a. Conversely, semicortical and not cortical shaping flakes constitute an important component of the accumulations. The distribution of totally cortical flakes, on the other hand, shows how these generally lie unclustered outside the main accumulations or in their periphery, except in cluster 4.

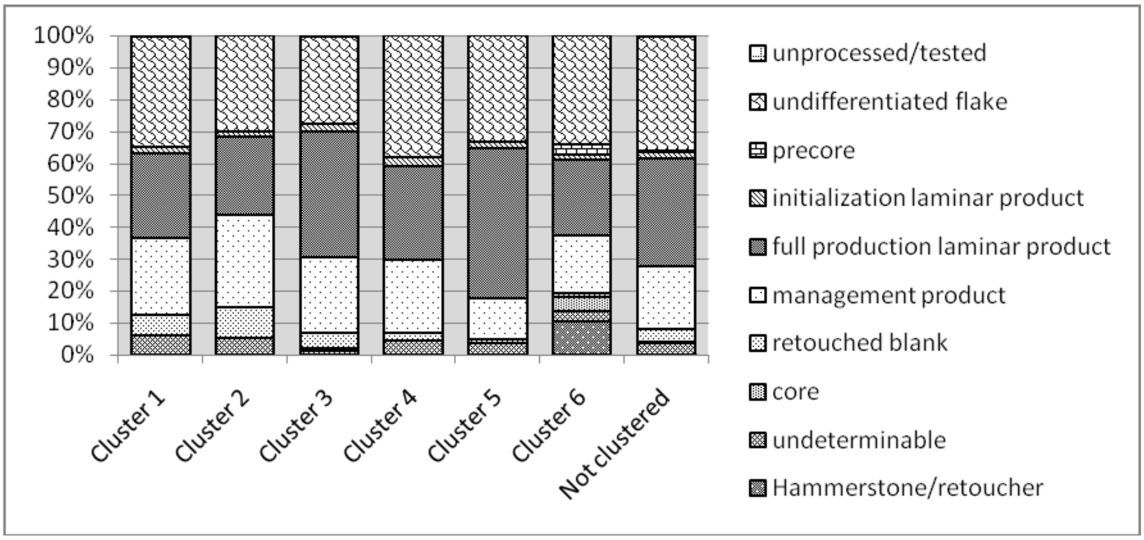
Inizialization laminar products (*Fig. 3.51*) are mainly concentrated within the structures and along a sort of NW-SE alignment in the southern part of the excavated area while full production ones are more widespread. This pattern reinforces the interpretation of the main concentration areas of the site as workshops, where shaping and laminar production initialization took place. This information, together with the one coming from other artefacts like shaping flakes, suggests the presence of further, more ephemeral and scattered workshop areas, more difficult to recognize by observing the simple distribution only. In particular, it can be noticed the presence of both totally cortical shaping flakes and initialization laminar flakes, together with full production products and management ones, in the area comprised between structures 1, 2 and 3, where a far less dense artefacts distribution can be observed. As confirmed by refittings and conjoins, this area is strictly connected with the three structures, and could have had its role in the organization and management of the whole processing area.

Management interventions (*Fig. 3.52*) artefacts follow the general trend of clustering within structures, with anyway a significant presence outside them, too. Also in this case, some particular features suggest some kind of differentiation within the production processes. While management flakes are both clustered and scattered all over the surface, management laminar products, i.e. neo-crests, are more likely to be found within or in proximity of the accumulations rather than scattered outside them.

As far as cores are concerned (*Fig. 3.54*), it's worth to recall their relative low frequency, especially when considering the number of actual units of raw material introduced and processed at the site. Anyway, their distribution shows different features, both between layers 4 and 4a, and within layer 4a alone. In the first, they are present in both clusters, and are found slightly outside them, but in an area which can be nevertheless considered within the cluster pertinence. On the other hand, the distribution of the cores found in layer 4a show further variability. First of all, they are comprised within the main accumulation area of a cluster, almost in its centre, only in the case of structure 3. The other core is close to structure 2, but not enough to consider it within the cluster direct pertinence area. Finally, no core has been found within clusters 1 and 4. Cores frequency and distribution pattern reinforces the hypothesis about the workshops of Fosso Mergaoni according with which they represent an initial/intermediate phase, well identifiable in both space and time, of the processing of units of lithic raw material.

As regards retouched blanks (*Fig. 3.53*), common tools are both within and outside the clusters, while the few armatures are localized close to them or slightly apart. Retouched blades, which are the most common tools of the assemblage, seem to distribute principally within clusters and in the above mentioned area between clusters 1, 2 and 3. It's interesting to note that, when comparing retouched and pointed blades distribution, there is almost no spatial overlapping between them. Where there are pointed blades, there are no retouched blades, as, in example, clusters 2, 3 and 4. The same is true also in the areas where artefacts are more scattered. The presence of pointed blades seems to be, at least spatially, complementary to retouched blades, except in cluster 1, where these two implements are co-present. Armatures are too few to show any particular pattern, except for the recognition of their distribution within the pertinence areas of the main clusters.

Finally, a series of three processing implements (*Fig. 3.55*), one hammerstone on a reutilized flint core, one fragmented limestone pebble used as hammerstone and a limestone pebble used as retoucher, complete the *spectrum* of the findings of Fosso Mergaoni. The limestone hammerstone elements, wholly refitted, are all comprised within the area of cluster 6, in layer 4. In the same layer is also present the other hammerstone, and its position is within a minor concentration of artefacts near cluster 5. Layer 4a, finally, returned the last processing implement, a possible retoucher, exactly in the middle of the excavated area, far from the four clusters and not comprised within any particular concentration of artefacts.



Graph 3.62: Represented reduction sequence phases per cluster

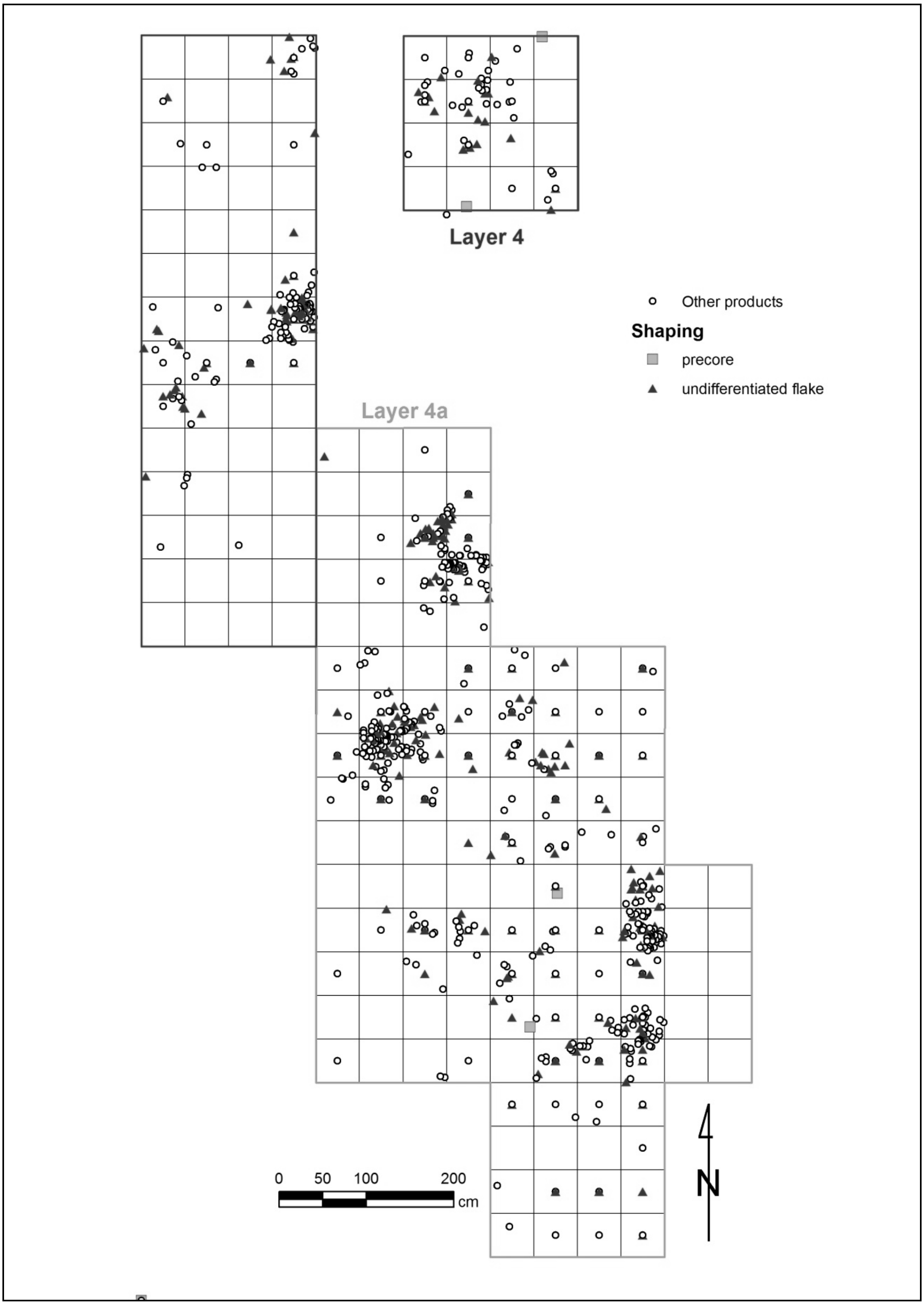


Fig. 3.49: Spatial distribution, shaping phase

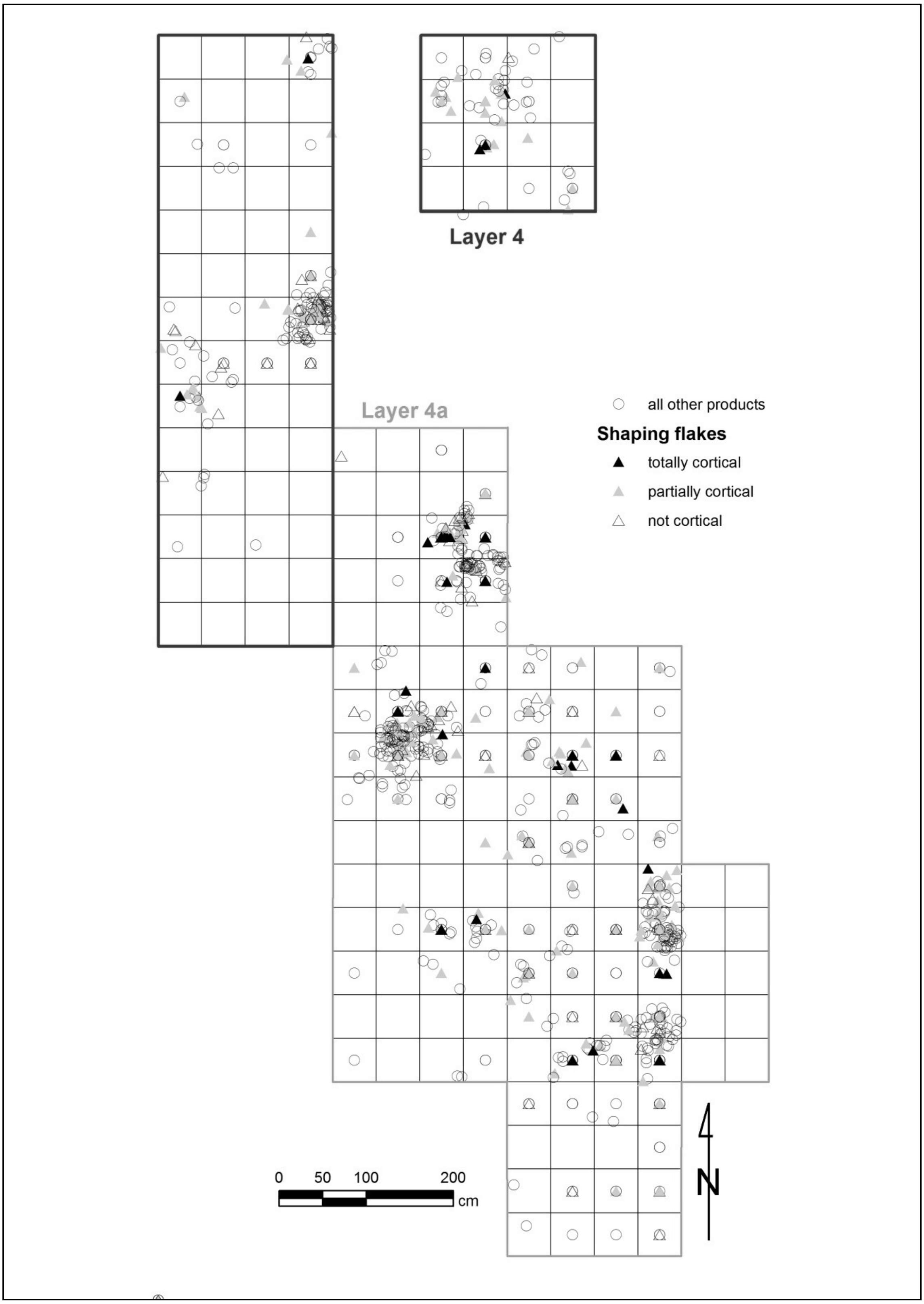


Fig. 3.50: Spatial distribution, undifferentiated flakes

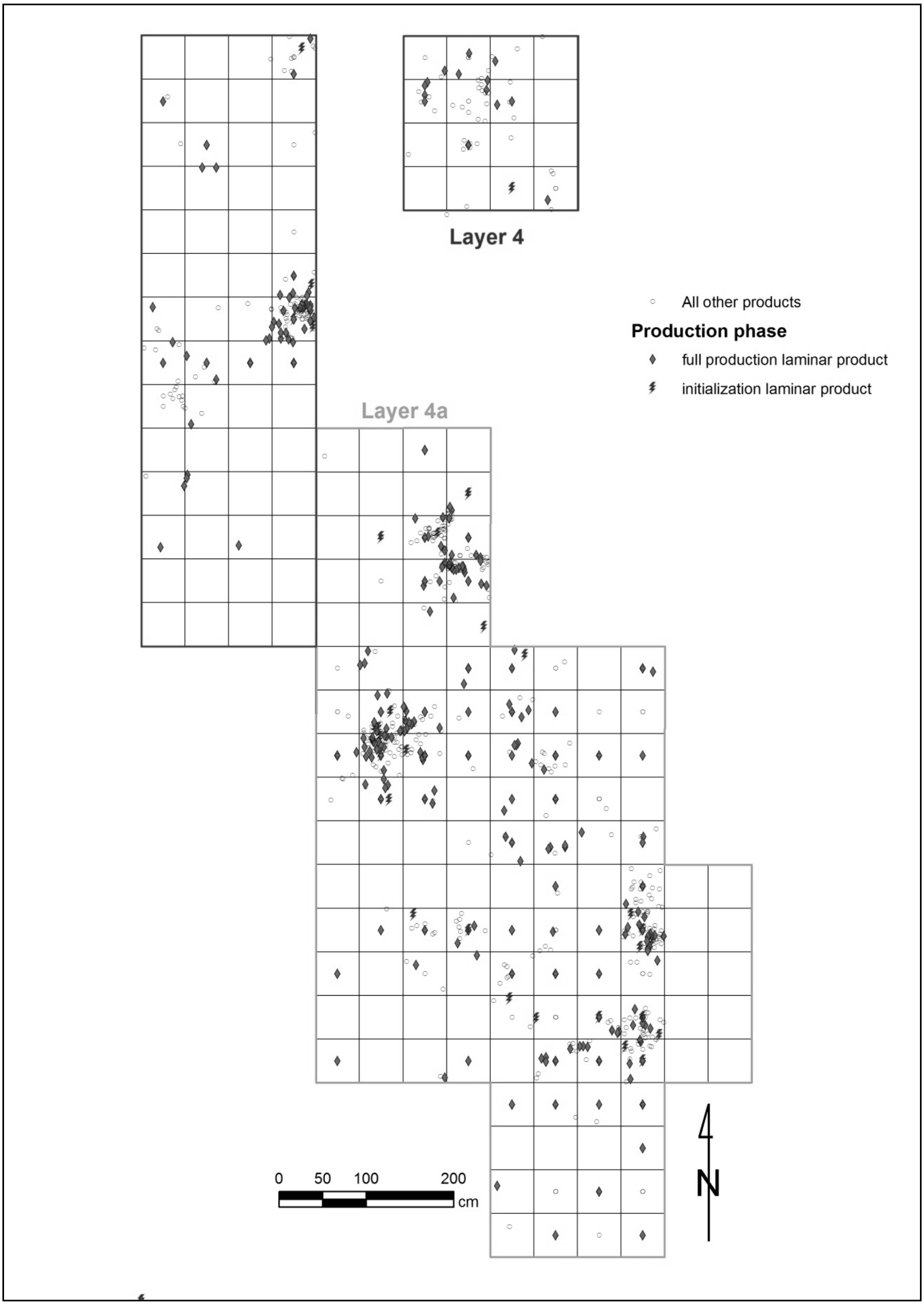


Fig. 3.51: Spatial distribution, production phase

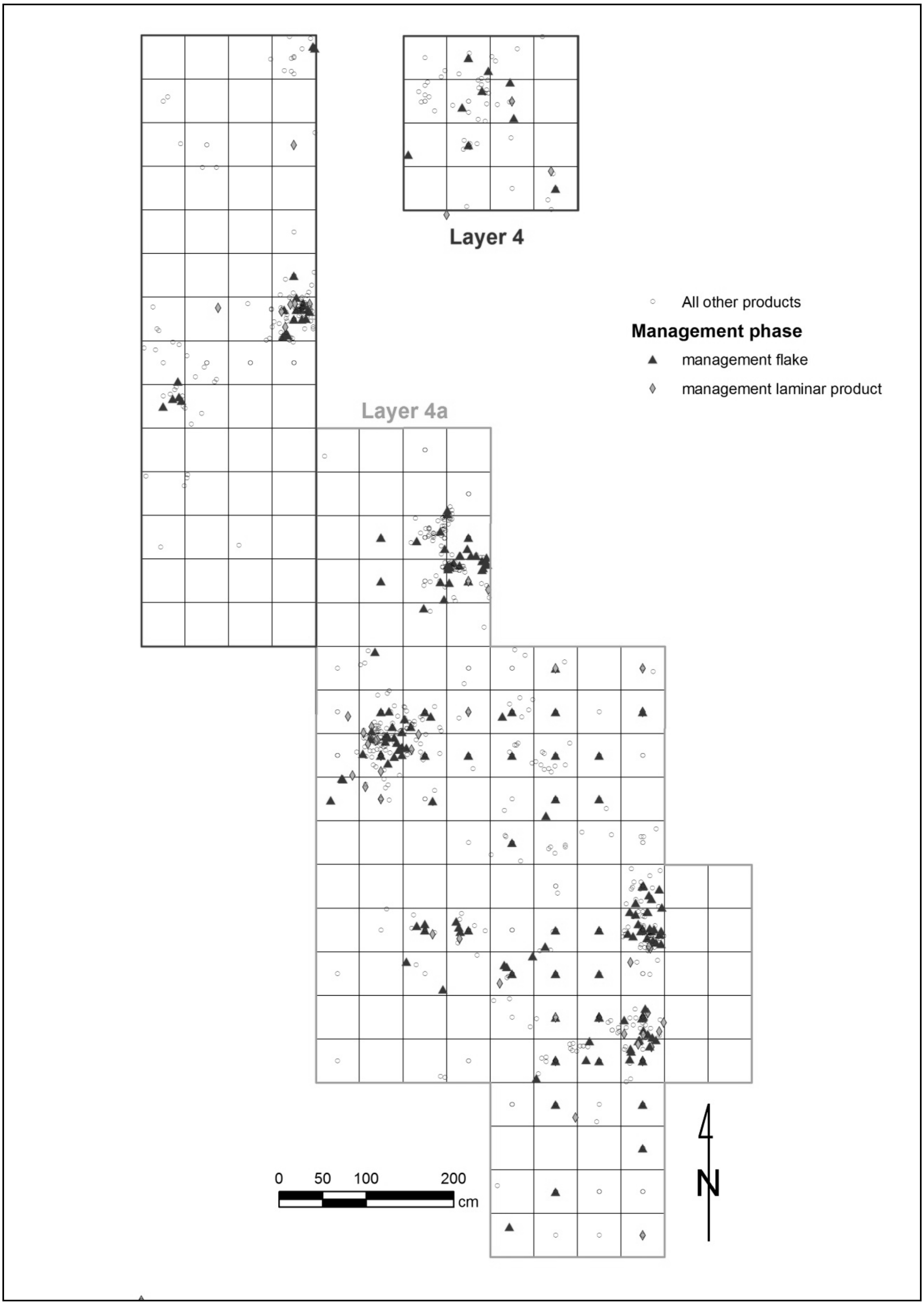


Fig. 3.52: Spatial distribution, management phase

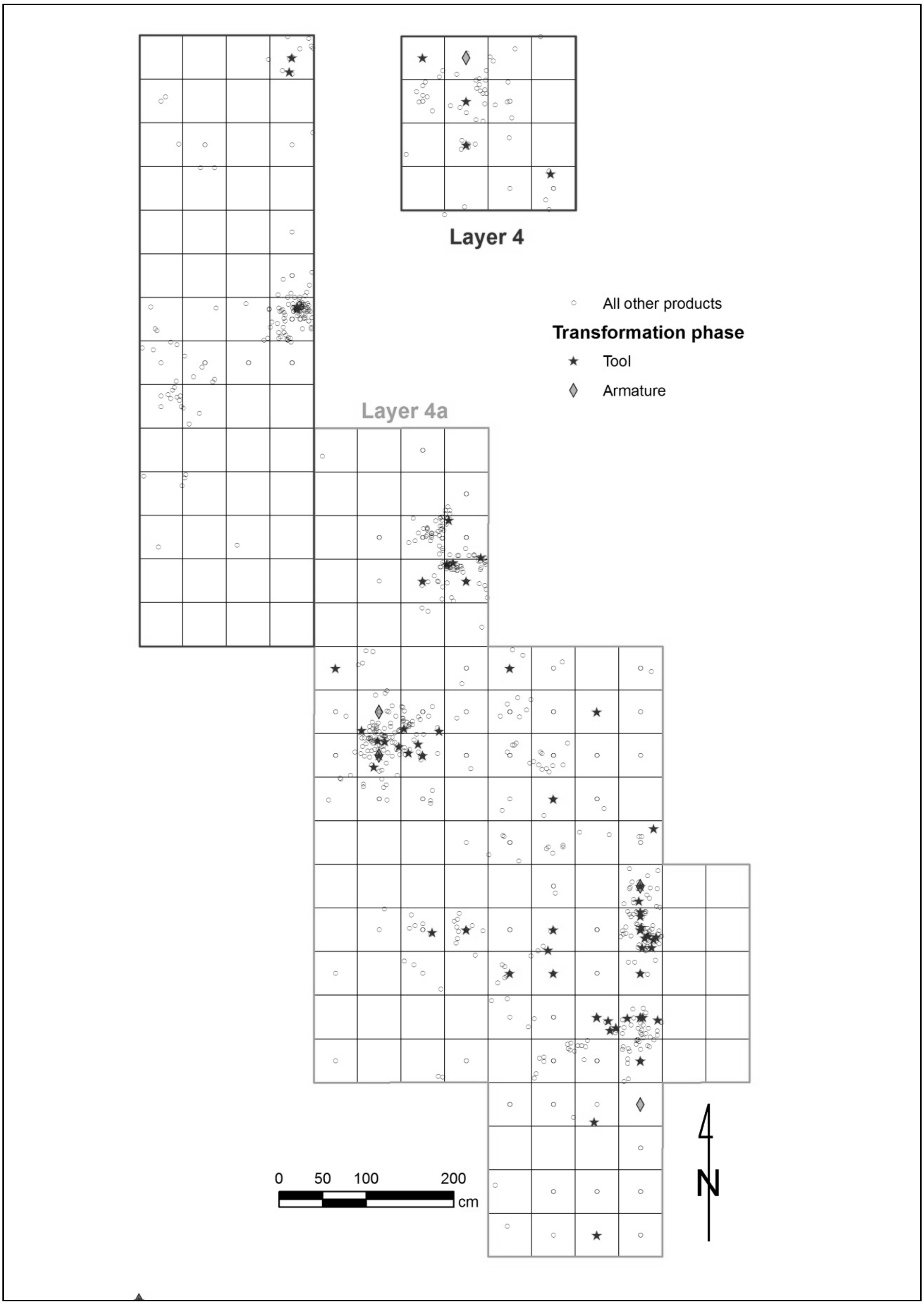


Fig. 3.53: Spatial distribution, transformation phase

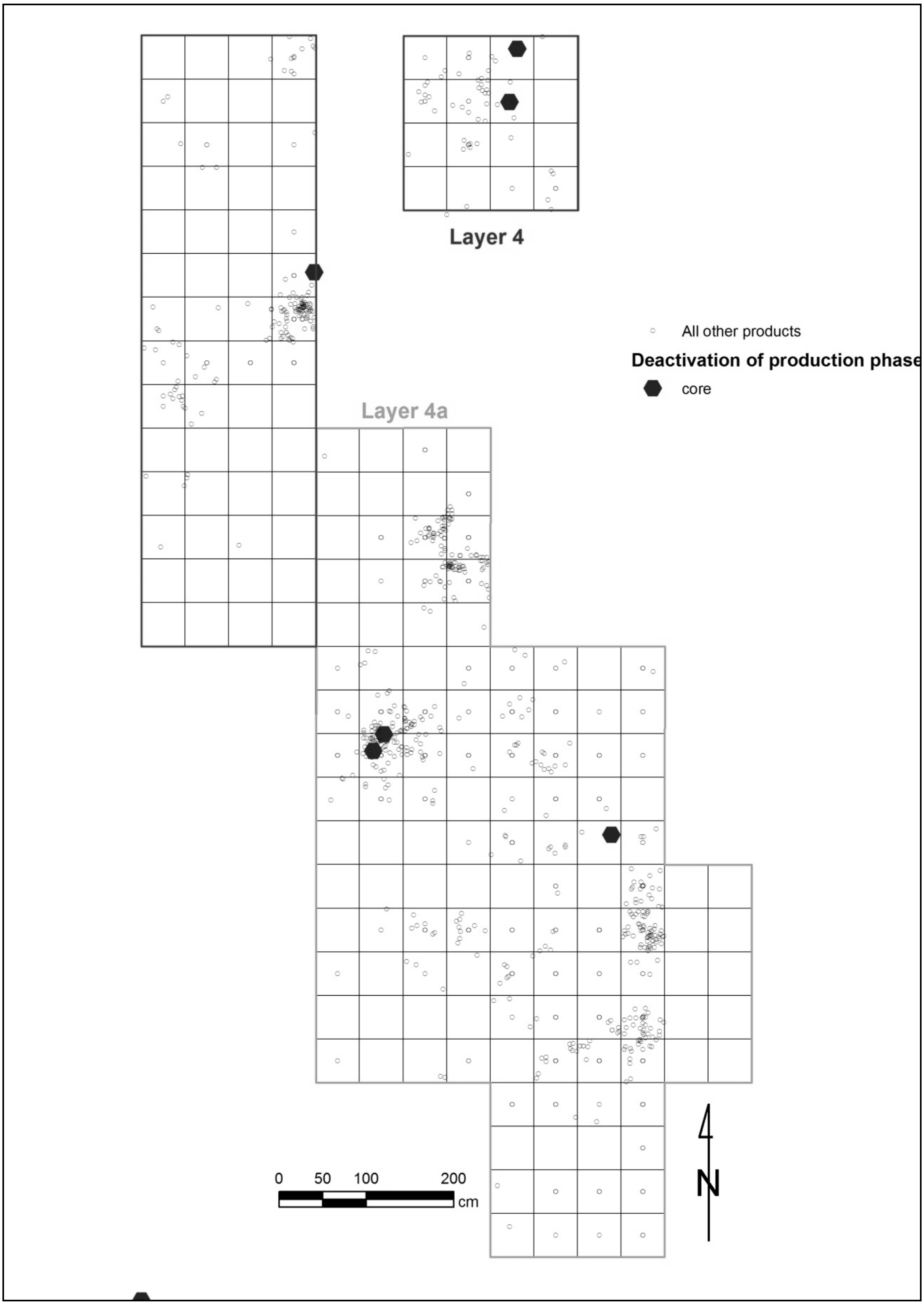


Fig. 3.54: Spatial distribution, deactivation of production

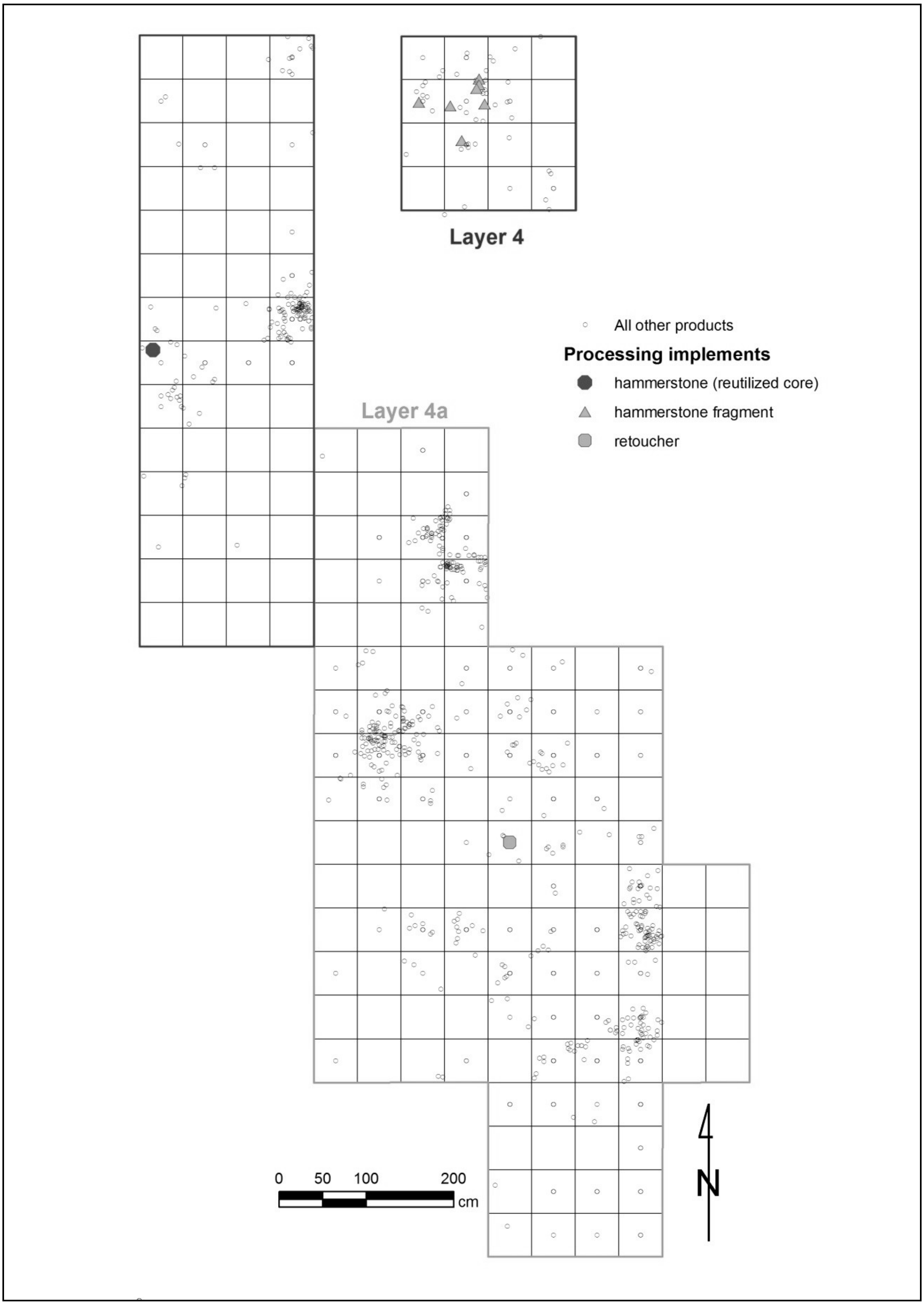


Fig. 3.55: Spatial distribution, processing implements

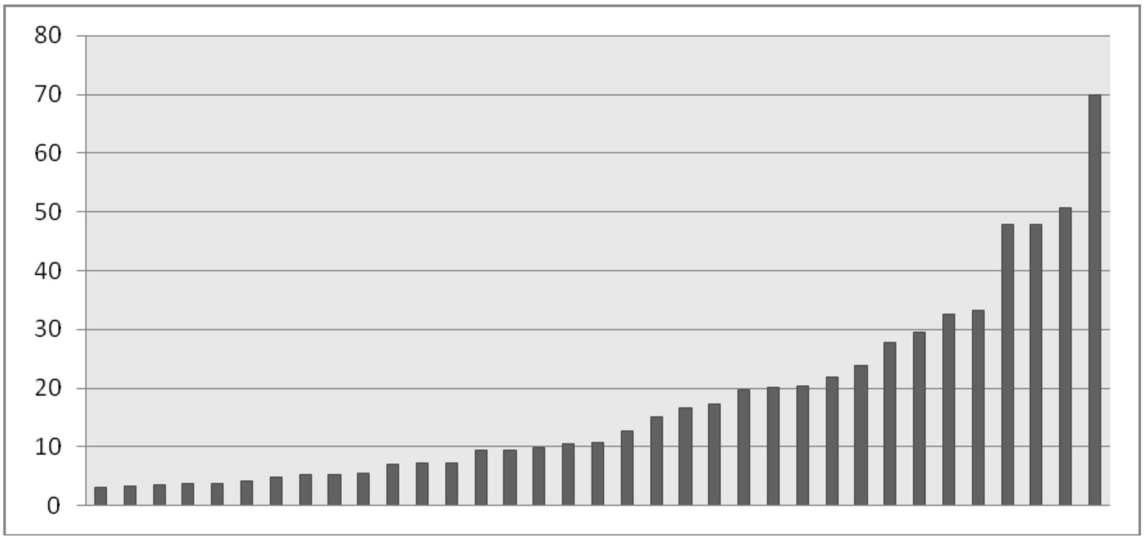
3.4.5. Conjoins and refittings

Refittings and conjoins has been represented by means of lines connecting all the items belonging to the same refit/conjoin. (*Fig. 3.56*) represents the distinction between items belonging or not to a constellation. This very simple visualization provides nevertheless a first glance on the amount and the distribution of the constellations, which, while concentrating on clusters, are also recognizable among the more scattered artefacts present on all the surface.

Conjoins and refittings depict a quite dynamic site, where artefacts are mobilized between structures and from them, mainly oriented to the laminar production, to other functional areas probably devoted to other activities. Both layer 4 and 4a show long and short distance connections. While the most part is comprised within the six accumulations, a large part of the constellations put in correlation areas and clusters set in different parts of the site.

Almost all layer 4 conjoins solve within clusters 5 and 6, without signaling, alone, any connection between the two structures (*Fig. 3.57*) While the maximum distance between conjoining artefacts is about 70 cm, the most part is less than 50 cm (Graph 3.63).

On the other hand, refittings clearly indicate the mobilization of artefacts between the clusters, connecting the N-W and the N-E sectors of the site (*Fig. 3.58*). Also in this case, refittings mainly solve inside the clusters, showing a low degree of interconnection, without precluding, however, to state the single frequentation of layer 4 paleosurface and the substantial synchronous formation of its archeological record. The maximum distance recorded between refitting artefacts of layer 4 is about 310 cm.

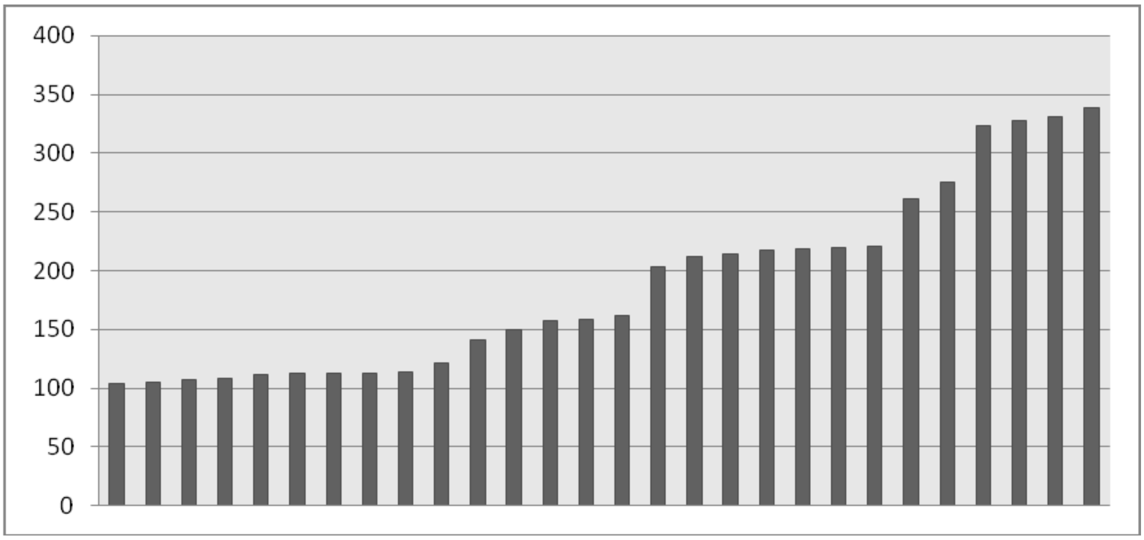


Graph 3.63: Distance between conjoining artefacts (cm), layer 4

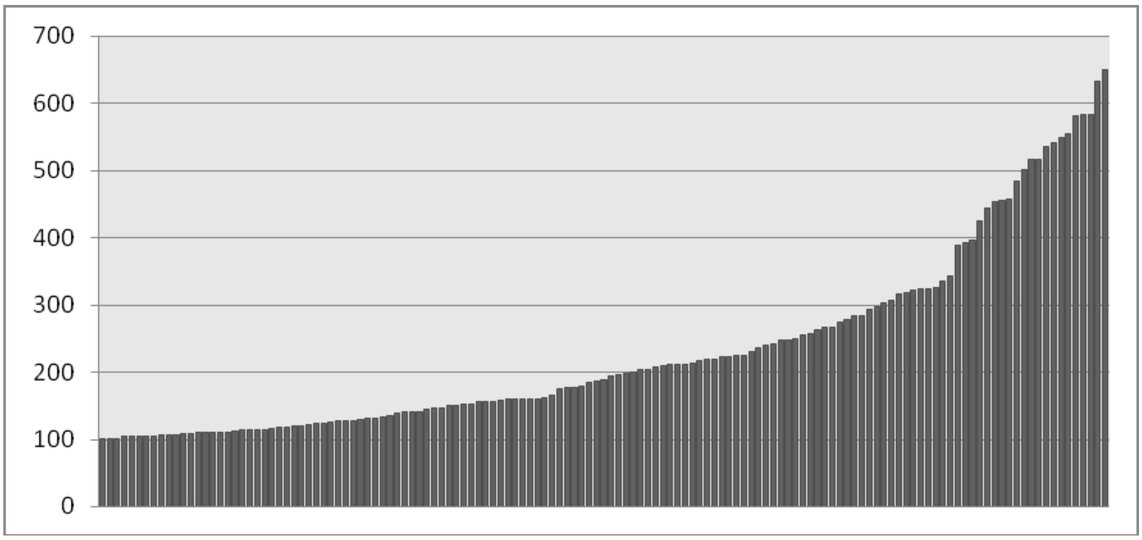
Layer 4a suggests a more intense use of the space and a greater degree of interconnection between clusters and scatters. Conjoins and refittings draw series of directions suggesting NS and EW mobilization of items, between structures and from them to other areas.

Conjoins (*Fig. 3.57*) are mainly distributed along a NS direction. They connect in particular the structures 3 and 4 each other, and structures 1, 2 and 3 with the less clustered area between them. The maximum distance recognizable between conjoining artefacts (Graph 3.64) is around 300 cm. In the graph below, where only the measures over 100 cm are reported, it's possible to distinguish at least three main distance ranges: around 100 cm, 200 cm and 300 cm, which represent the radius of the three main possible movements of artefacts: within clusters, between clusters and between clusters and inner scattered areas. Refittings, on the other hand, depict a very dynamic use of the paleosurface. Other than the NS direction, intense EW mobilizations of artefacts are also recognizable.

Refittings (*Fig. 3.58*) show how all layer 4a archaeological evidences are tightly interconnected, being clusters and the other areas linked by several relations, even from the most northern end to the most southern one. The maximum distance recognized between refitting artefacts is around 650 cm. Graph 3.65 shows how, contrary to the pattern signaled by the conjoins, the various distances measured between refitting artefacts are less clustered, showing a progressive increase from the lowest to the highest values, with a single sharp increase detectable around 300 cm. Also in this case, Graph 3.65 reports only the distances higher than 100 cm. Conjoins and refittings stand for an almost simultaneous use of the paleosurface, or, at least, for the formation of its archaeological record in a quite short period of time.



Graph 3.64: Distance between conjoining artefacts (cm), layer 4a (only measures >100 cm)



Graph 3.65: Distance between refitting artefacts (cm), layer 4a (only measures >100 cm)

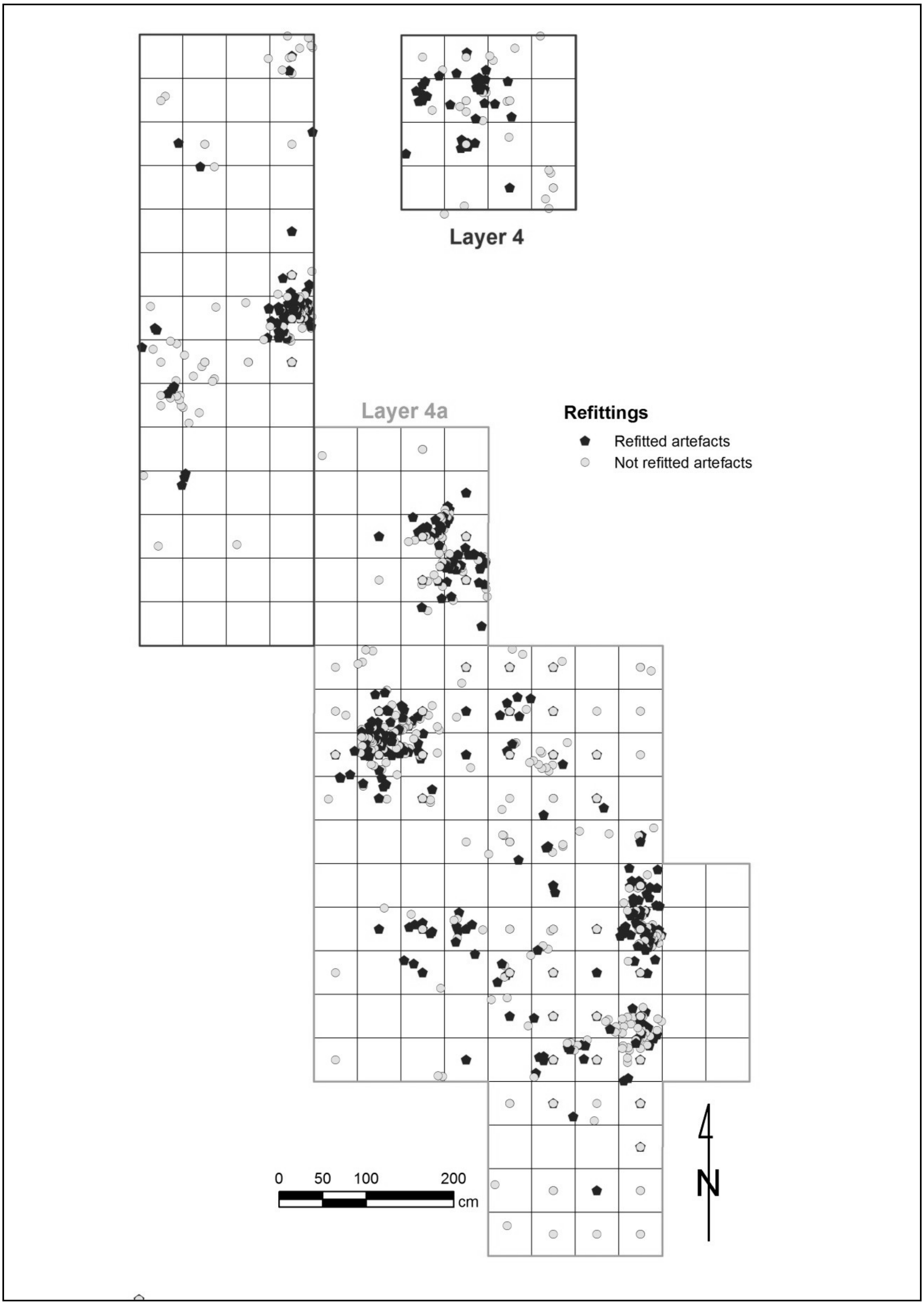


Fig. 3.56: Spatial distribution, refitted artefacts

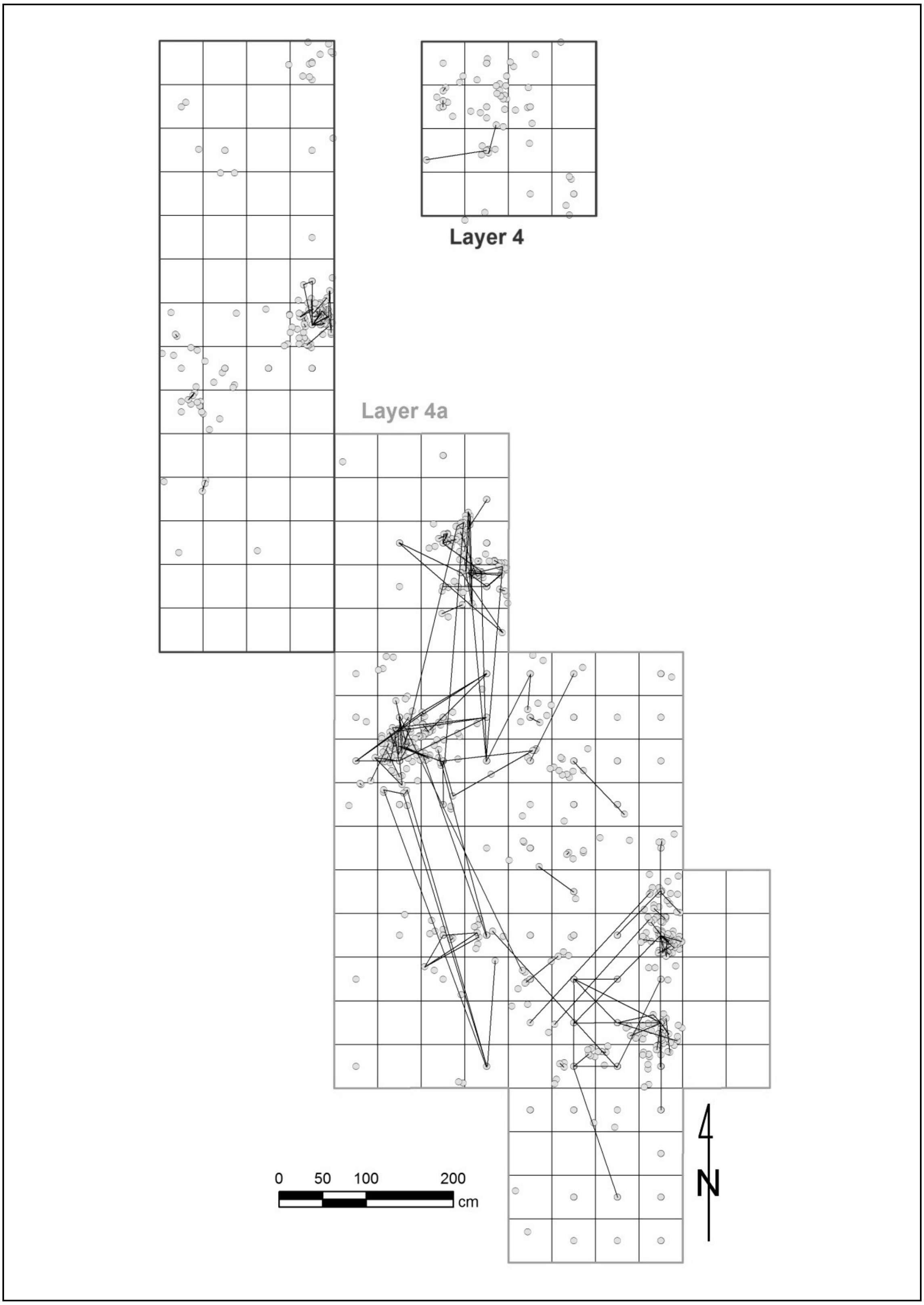


Fig. 3.57: Spatial distribution, conjoins

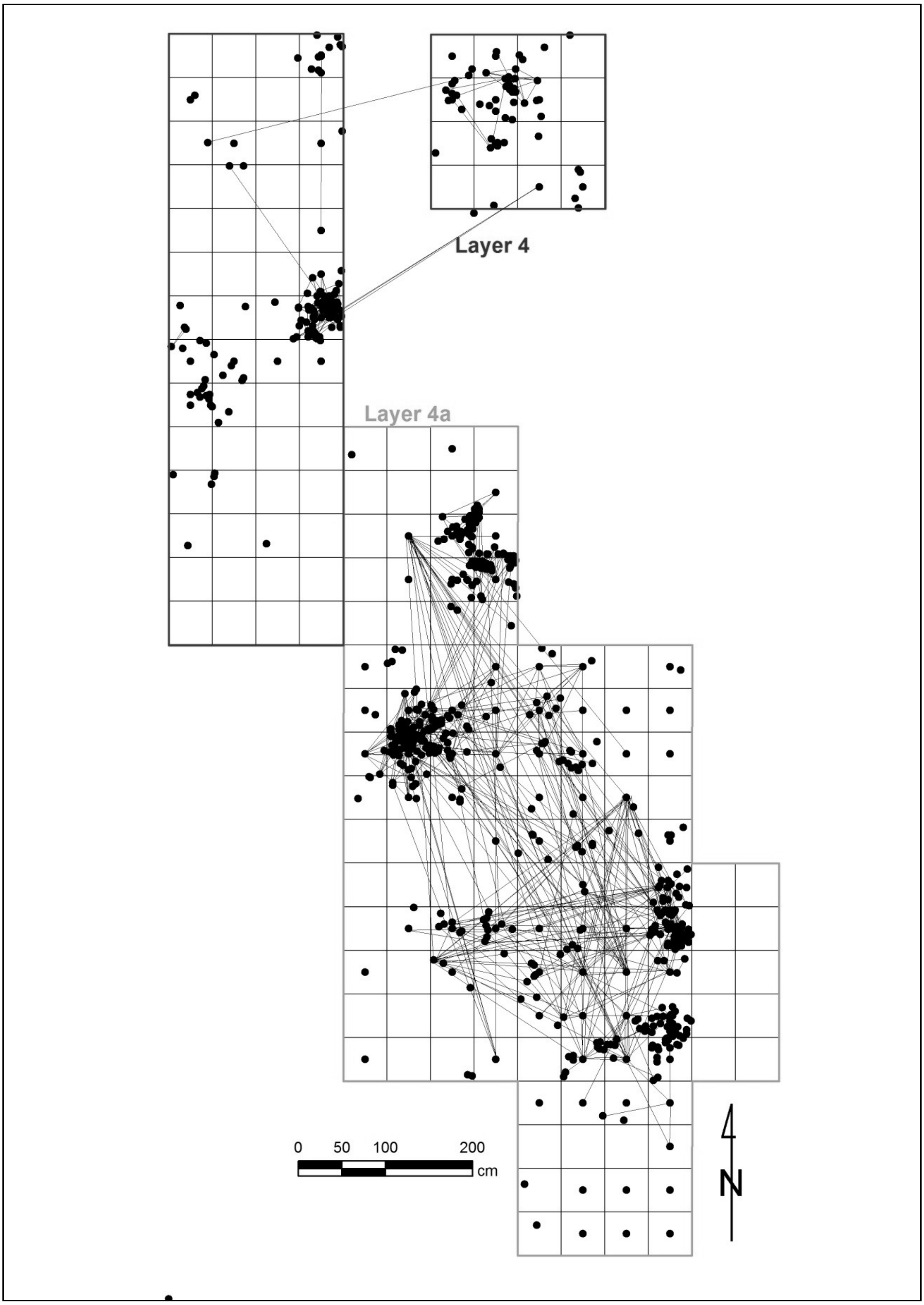


Fig. 3.58: Spatial distribution, refittings

3.5. Synthesis and discussion

The lithic assemblage is composed of more than sixty units of lithic raw material, the most part of them being groups of flaked elements coming from as many flint blocks, which underwent different economic choices resulting from different strategies of raw material management. The flint sources of the territory show great variability both in suitability and availability, which range from none to very high. The territorial distribution of the outcrops, and their nature, determines a series of potential micro-provinces of procurement across the landscape, where different amounts of more or less good quality flint blocks, differently sized, can be found.

Flints introduced/processed at the site come from Jurassic-Tertiary local formations. The most represented are the Tertiary ones coming from the Scaglia Variegata, a formation which contains large nodules and slabs of multicolor flint. The procurement was strictly local, within a few km from the site, and mainly focused on stream beds and debris deposits close to primary outcrops, which are supposed to contain the largest sized raw blocks. The quality and dimensional standards of the flints of the local area where the site is are generally high. The differential representation of the flint varieties recognizable within the assemblage can reside in factors like visibility, proximity and granulometry of the outcrops, rather than in the intrinsic properties of the geological flint formations.

At least a small amount of lithic raw material has been introduced in its almost raw state, without, perhaps, any presumable intention of storage. The shaping phase, represented by a large amount of undifferentiated flakes and few pre-cores, is an important segment of the assemblage. The production phase is well attested and the production objectives, recognizable thanks to a quite large amount of laminar blanks, can be grouped in three main ones: bladelets, blades and large blades. Mega blades also exist, but they seem not to be the outcome of standardized production processes, because of their rather random size distribution. Laminar production is for its most part carried out by means of soft organic hammer direct percussion. Another significant segment of the reduction sequences which took place at the site is represented by management interventions, and more than half of the products of this phase aimed to the striking platform restoration.

Deactivation of production and subsequent core abandon is a poorly represented phase. The quantitative contrast, recognizable when considering the number of units of lithic raw material, is evident: nine cores, mainly blade cores, represent the total amount of artefacts referable to this phase. By a dimensional and technological point of view, blade and bladelet cores seem to belong to continuous reduction processes and can be argued that the selection of the raw material was principally oriented towards large blocks suitable for blades and large blades production, while smaller laminar calibers, like bladelets, didn't represent a guiding principle in raw material collection, because of their being the end of the larger products reduction sequences.

The retouched blanks are represented by common tools and armatures. Tools, which account for the most part of the retouched blanks, are dominated by retouched blades and side-scrapers, while truncated backed bladelets correspond to the very most part of the armatures. A large part of the tools is made on undifferentiated and management flakes or on central laminar products, both cortical and not cortical. It's worth to stress that pointed blades, a very peculiar tool of the assemblage, are almost always realized on very regular not cortical central blades. Armatures are made on not cortical central bladelets.

Functional analysis, while stressing the very low incidence of active edges and, consequently, a limited use of the artefacts, recognized a *spectrum* of activities that seems to be mainly oriented to the transformation of vegetal and animal resources rather than to their acquisition.

More than 200 refitting/conjoin constellations, for a global refitting rate of about 31%, together with the morphology and the technological composition of the artefacts clusters, suggest a quite good preservation of the original spatial distribution and the primary deposition of the archeological content. The distribution of the archaeological remains define a series of concentrations, sub-circular in shape, with irregular contours and an inner area of main concentration. Within and between structures are also present some areas showing a less density of lithic findings. Outside the structures are also present scattered artefacts, spread across the surface along a NS direction.

A certain spatial dynamism and a reciprocal permeability of the different sectors of the two paleosurfaces are signaled by several indicators. First of all, it should be mentioned the sharing of the some units of lithic raw material by two or more clusters, index of the mobilization of the flaking products extracted from the same raw blocks. This dynamism is further and definitely confirmed by the spatial distribution of the refitted artefacts, which also indicate a nearly synchronous frequentation of layer 4a paleosurface and, subsequently, layer 4 one.

Each cluster testifies of rather repetitive activities, suggested by the similarity in their technological composition. Some peculiarities are observable in the distribution of certain technological and typological classes like, i.e., the totally cortical flakes, which are rarely present within clusters but, rather, scattered outside them. On the other hand, crests and neo-crests are more likely to be found within the accumulations. Retouched blanks, too, show some differential distribution, as observed about the possible spatial complementarity of pointed and retouched blades and the frequent proximity to structures of the armatures.

The settlement choices of the epigravettians who frequented Fosso Mergaoni can be framed within environmental factors, and are linked to the resources that its position allowed to access and exploit. The functional orientation of the site, as recognized by the techno-economic analysis carried out on its lithic assemblage, provides the key to shed light on the relation between natural and cultural elements, whose interaction is the responsible of the archaeological record formation. As revealed by the flint outcrops territorial evaluation, low altitude locations, in proximity of stream beds and slope bases, like the one where the site is set, are generally the ones with great availability of large flint blocks. If taking into account the features of the raw materials introduced and processed at Fosso Mergaoni, it results quite clear that the lithic resources of the area met the technological needing of the group, providing suitable blocks for the production of the recognized laminar blank calibers.

The site can be primarily interpreted as a workshop area. Because of the fact that it insists on a series of loose deposits rich in flint clasts, it can also be partially considered as a extractive site. In fact, the raw blocks were probably recovered within a very short distance. Moreover, the recognition of ephemeral combustion areas, together with the identification of a limited series of activities, whose traces has been detected by the functional analyses, and the presence itself of retouched blanks, testifies of the not iper-specialization in flint procurement and processing.

It can be argued that the site was frequented for short periods of time, during special task expeditions, by groups of hunter-gatherers whose residential camps could have been located more eastward, over the Apennine foothills. The recovery of some retouched blanks made on flint varieties which doesn't find comparisons with any among the recognized units of lithic raw material, in other words, introduced as ready made tools, suggests that people reached the site partially equipped.

The discrepancy between the number of cores and the number of blocks actually worked, together with the quantitative significance of the intermediate phases of the reduction sequence, suggests that, at least in the excavated area, blocks were introduced as partially pre-worked items and, after some production/management cycles, they were carried somewhere else. This hypothesis is further supported by the rarity of totally cortical flakes.

Finally, the presence of two occupation layers shows that the place was known and the frequentation was repeated through time. Even if the chronological separation between the two frequentation events is not possible to determine, their detection is nevertheless crucial, for the aim of the reconstruction of the insediative pattern, because suggests a reiterated activity, carried out for the same reasons in the same place, probably during different resource acquisition cyclic expeditions.

4. GROTTA DI POZZO

4.1. Presentation of the site

4.1.1. Localization

The site is found in the Abruzzi region, in the province of l'Aquila, in the Fucino basin, close to the Sirente-Velino mountain chain (*Fig. 4.1*, *Fig. 4.2*). The basin takes its name from the lake Fucino, which undergone several reclaim and drainage interventions since roman times. Even if the Fucino elevates to about 600 m.a.s.l., it is almost entirely surrounded by high mountainous areas, which must be necessary passed to reach it. Grotta di Pozzo, whose genesis is due to gelifraction, collapses and lake action erosion, is at an altitude of 720 m.a.s.l., on the southern fringe of the basin. The narrow gorge where it is set, the Valle di Forchetta, is nowadays interested by the presence of a small stream characterized by seasonal activity. The cave, located between two different environments, the plain and its rocky surroundings, could have had a privileged position regarding the access to diversified resources. Further, its N-E oriented opening and the wide visual radius over the plain, allowed the cave both a good insulation during the first half of the day and the control on the ungulates movements across the landscape (D'ANGELO 2010; MUSSI, et al. 2008; MUSSI M., et al. 2003).

Fig. 4.1: Grotta di Pozzo, localization of the site

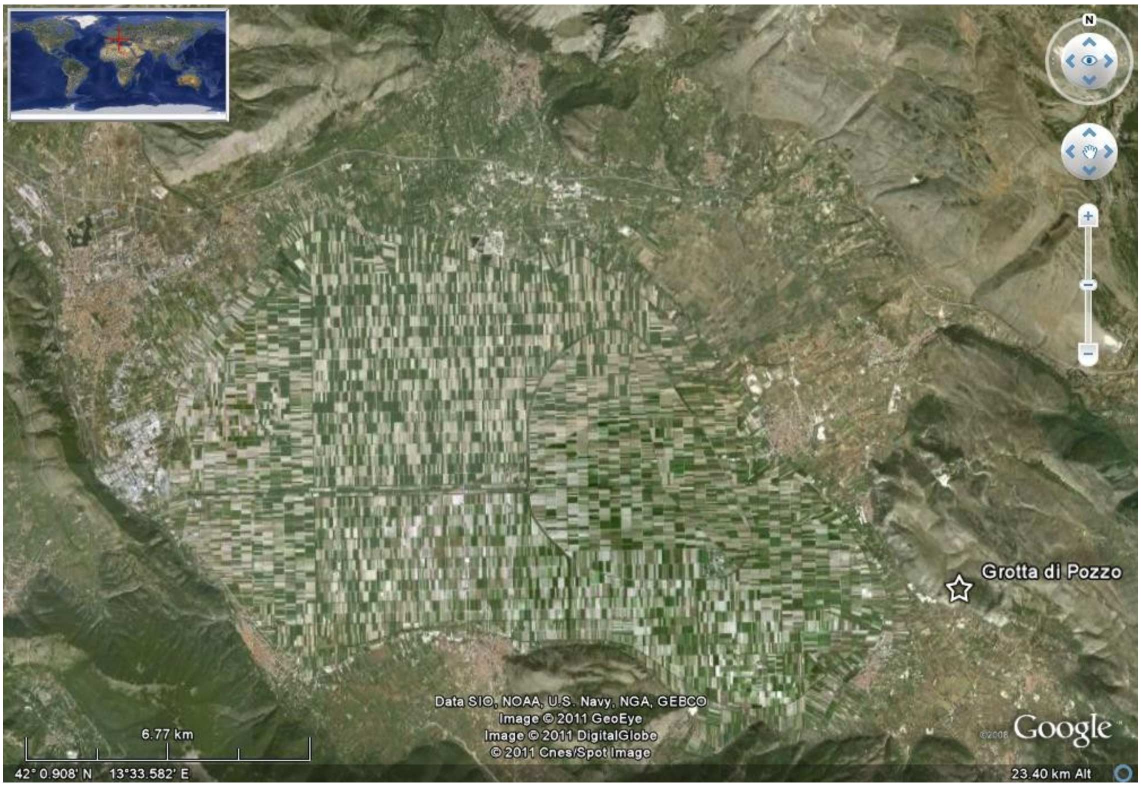


Fig. 4.2: Grotta di Pozzo, localization of the site

4.1.2. The excavations

The site was discovered after surveys and test excavations carried out in 1992, and since 1993, is the object of systematic investigations directed by prof. Margherita Mussi of the University of Rome "Sapienza".

The currently sheltered surface is composed by an atrial and an inner sector, the latter being entirely filled by deposit (*Fig. 4.3*). It is arguable that the cave extends 3-4 m further towards the interior. In the atrial sector, up to 2007, about 24 square meters have been excavated, removing some 30m^3 of deposit (D'ANGELO 2010). In the *talus* in front of the cave, few meters North the main inner excavation area, a 1x1 m test excavation has been carried out in 1995. Since 2005, further series of investigations in the East outer sector, currently in course of excavation, exposed a 6 m^2 surface and a stratigraphic sequence deposited at the end of the LGM (D'ANGELO 2010; MUSSI, et al. 2008).

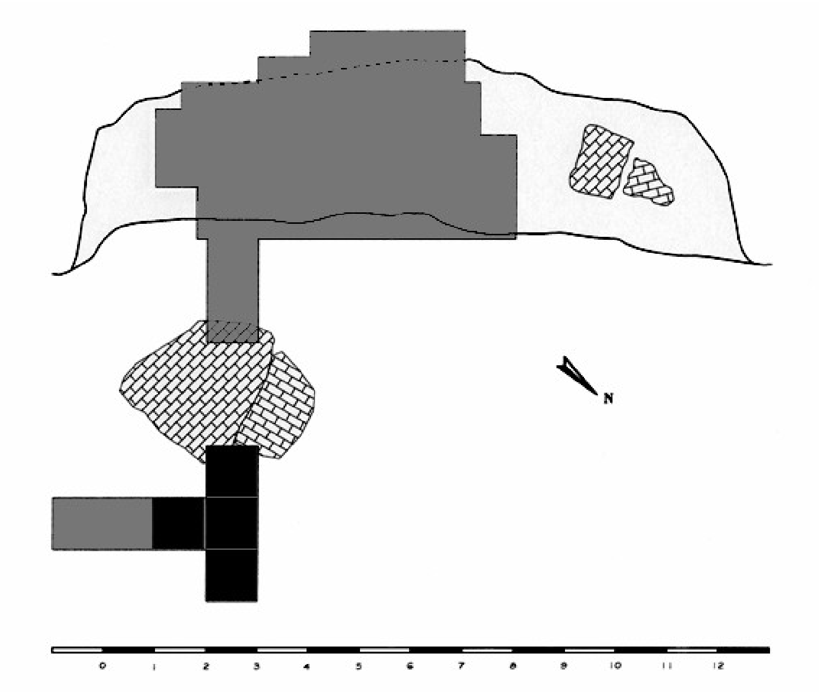


Fig. 4.3: General map of the site, of the excavated areas (cave and talus) and of the largest collapsed blocks (D'ANGELO 2010)modif. The material recovered in black squares represents the object of the present work

4.1.3. Stratigraphy and chronology

The stratigraphic sequence (*Fig. 4.4*) (MUSSI, et al. in press; MUSSI, et al. 2008) documented within the currently sheltered area starts with fluvio-lacustrine deposits (Unit I), lying on limestone blocks, and related to the LGM Fucino paleolake high stand. The following stratigraphic unit (Unit II) shows large angular blocks collapsed from the vault lying on an eterometric deposit with angular clasts. The subsequent unit III is characterized by an alternation of stratified debris with more or less matrix and differently sized clasts, within which thin dark anthropic layers, rich in organic matter, are intercaled. Unit IV, separated by the underlying ones by an erosion event, is made of a coarser debris deposit, characterized by the alternation of debris and anthropic layers with abundant organic matter. The above unit V, made of a fine grained colluvial deposit intermixed with a coarser fraction with small size gravels and calcareous sub-angular clasts, is separated from the overlying unit VI by a further erosion event. In unit VI, dated to the early Holocene, abundant silty deposits containing other coarser debris material, are intercaled with anthropic layers which released large amounts of archeological material, especially in the form of gastropod shells lying on ashy lenses. Unit VII, dated to later Holocene phases, is interested by the widespread presence of rounded Neolithic pits, which often reach unit VI and the underlying ones.

The stratigraphy exposed in the outer sector (*Fig. 4.5*) revealed a sequence of six layers, from DF1 to DF6, made of fine grained slope debris deposits, variably rich in angular clasts and frequently interested by the presence of concretion layers. Current researches are also aimed to establish correlations between the inner and the outer sequences.

A set of AMS radiocarbon dates frame with good accuracy the absolute chronology of the late Pleistocene stratigraphic sequence (Tab. 4.1) (MUSSI, et al. 2008). While the principal archaeological layers have been directly dated, Units I and II are correlated to the LGM on a geologic and paleoenvironmental basis. The first evidences of human frequentation at the end of the LGM, culturally framed in the early Epigravettian, are present within Unit III and in the outer deposits of the *talus,* dated to about 20.000-17.000 calBP. After a stratigraphic and chronologic gap, due to erosional events, in the sequence of the Unit IV, dated to 15.500-14.000 calBP, is represented a more intense use of the site, both in terms of duration of occupation and of activities carried out. The lithic production, classified in the late Epigravettian, is abundant, diversified and comprises elements made on "exotic" flint. Unit V, probably referable to the Younger Dryas, closes the Pleistocene sequence. It contains redeposited deposits and a few artefacts.

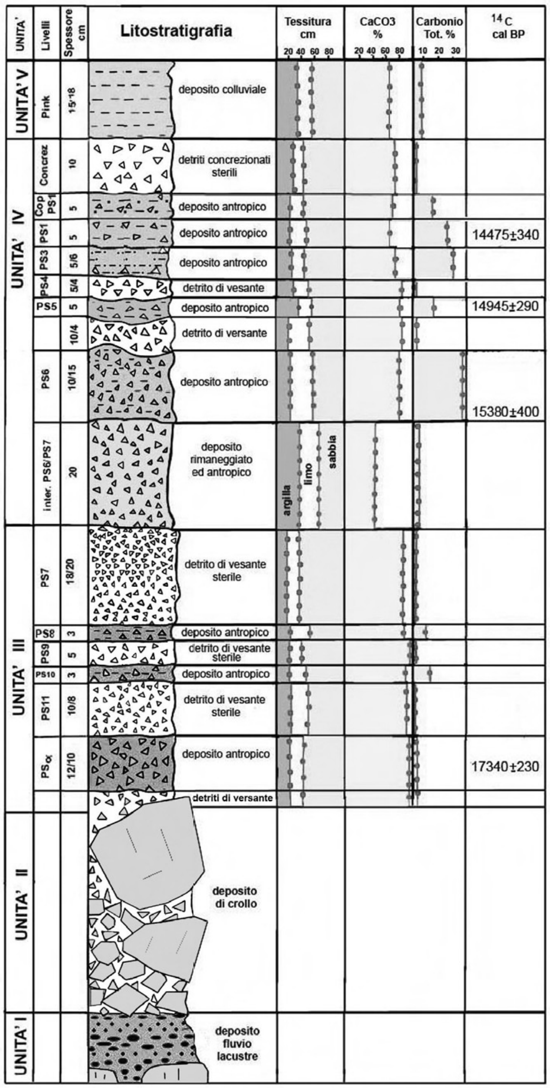


Fig. 4.4: Litostratigraphic units of Grotta di Pozzo (MUSSI, et al. 2008).

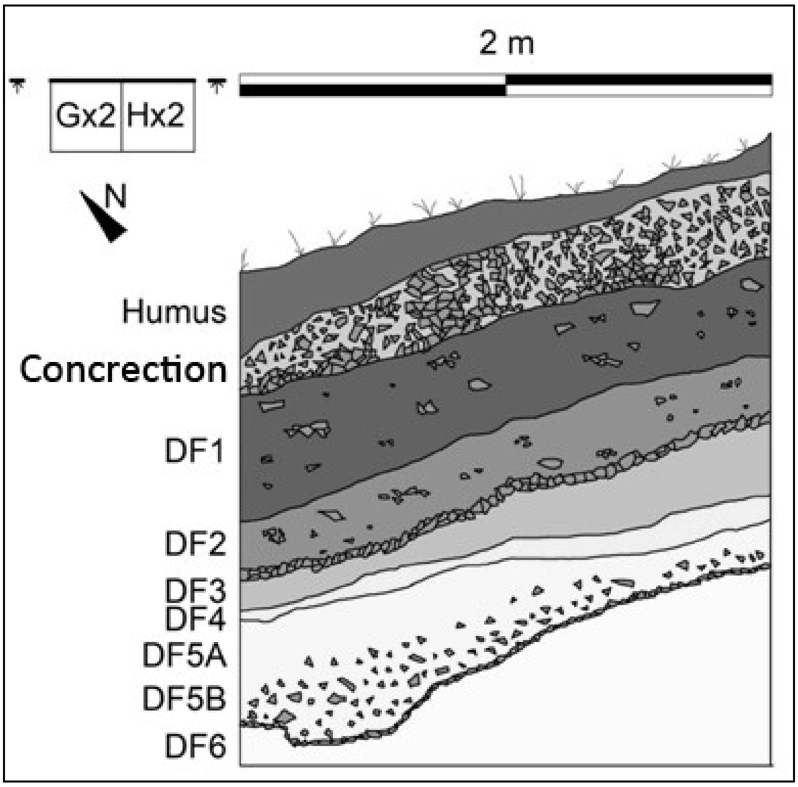


Fig. 4.5: Stratigraphy of the 'external sounding' in the talus

INNER STRATIGRAPHIC SEQUENCE				
Layer	**Lab.**	**Sample**	**Date BP**	**Date cal BP**
PS1	GX-27906	Vertebrae *Salmo trutta*	12.320 ± 50	14.475 ± 340
PS5	GX-27907	Herbivore bone	12.590 ± 40	14.945 ± 290
PS6e	AA-78136	Bone	12.820 ±130	15.380 ± 400
PSα	GX-30436	Herbivore bone	14.100 ± 70	17.340 ± 230
PSβ	LTL-1363A	Bone and charcoal	15.790 ± 90	19.015 ± 230
OUTER STRATIGRAPHIC SEQUENCE				
Layer	**Lab.**	**Sample**	**Date BP**	**Date cal BP**
DF4	AA-78134	Charcoal	16.495 ±90	19.810 ± 310
DF5	AA-78135	Charcoal	14.585 ±80	17.860 ± 340

Tab. 4.1 Radicarbon chronology (MUSSI, et al. 2008) modif.

4.2. Lithic production

4.2.1. General composition

Object of the present work is the lithic assemblage recovered during the 1995, 2005, 2007 and 2008 field seasons[4] (squares T4, Gx2, Hx1, Hx2 and Hx3) carried out in the outer cave *talus*. The total amount of artefacts recovered in the considered area is 442, subdivided in 284 determinable items, 12 undeterminable ones and 146 small flakes and debris (<15 mm in module). Their vertical and horizontal distributions reveal two major concentrations in layers DF4 and DF5, which released, respectively, about 55% and 21 % of the total assemblage (Tab. 4.2, Graph 4.1), in squares Gx2 and Hx2, respectively 48 % and 37 % (Tab. 4.3). The frequencies distribution of the broad technological classes, considered through the whole stratigraphic sequence (Graph 4.2), shows a certain uniformity and highlights a substantial homogeneity of the composition, at least in layers DF4 and DF5.

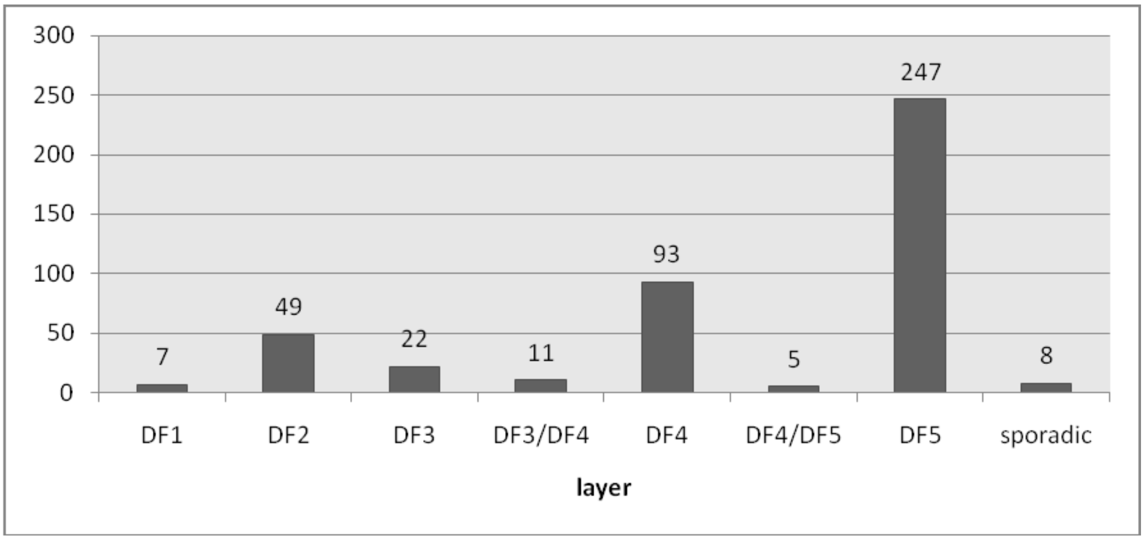
The rather steep slope of the *talus*, the inversion recognizable in the radiocarbon dates and the diffuse presence of pseudo-retouches on the edges of the artefacts, along with, on the other hand, the high homogeneity of the assemblage, from both the techno-typological and lythological points of view, the quite large amount of the small fraction (expecially around 5 mm in module) and the recovery of two conjoining fragments of a blade, suggest that the archaeological material undergone to moderate postdepositional processes of transport and delocalization from its original spatial and stratigraphic configuration.

The 1) limited amount of archaeological material, 2) its possible partial intermixing and 3) its overall interstratigraphic composition similarity, suggests and authorizes to approach the archaeological material as a whole.

[4] 1995 excavation in T4 released a single artefact

Layer	N	%
DF1	7	1,6
DF2	49	11,1
DF3	22	5,0
DF3/DF4	11	2,5
DF4	93	21,0
DF4/DF5	5	1,1
DF5	247	55,9
Sporadic	8	1,8
TOT	442	100,0

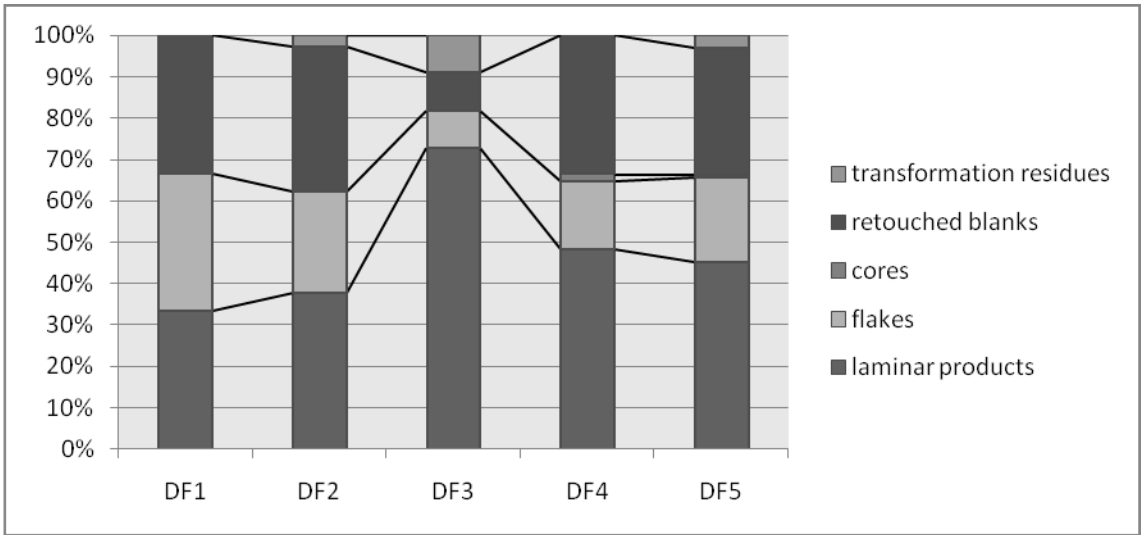
Tab. 4.2: Artefacts amount per layer



Graph 4.1 Artefacts amount per layer

Square	N	%
Gx2	215	48,6
Hx1	43	9,7
Hx2	164	37,1
Hx3	19	4,3
T4	1	0,2
TOT	**442**	100,0

Tab. 4.3 Artefacts amount per square



Graph 4.2: Frequency distribution of the main technological classes per layer

4.2.2. Reduction sequence, general observations

A wide inventory of technological classes is represented, showing variable interclass features and frequencies (Tab. 4.4). All the phases of the reduction sequence are represented, pointing, to a certain extent, to the recognition of flaking activities to have been occurred. These are mainly signaled by particular by-products testifying of the shaping of flint blocks and their exploitation finalized to the extraction of lamino-lamellar products and the manufacture of tools and armatures.

Quantitative variability is, in the simplest cases, the reflection of the intensity with which particular activities have been performed, but, beyond the frequencies shown in Tab. 4.4, a further series of morpho-technical and morpho-metric parameters depict a slightly more complex situation, by an interpretative point of view. In any case, at first glance, the main represented artefacts classes are the unretouched, full production, laminar products and the retouched blanks, both tools and armatures. Undifferentiated flakes, about 16% of the total, are the following main represented class of artefacts. About 1/3 of the assemblage is composed of small flakes and debris smaller than 15 mm, most of which being microflakes resulted by retouch.

Class	**N**	**%**
Undifferentiated flakes	48	16,2
Initialization laminar products	4	1,4
Full production laminar products	113	38,2
Management laminar products	12	4,1
Management flakes	9	3,0
Cores	3	1,0
Retouched blanks	88	29,7
Transformation residues	7	2,4
Undeterminable (> 15mm)	12	4,1
TOT	296	100,0
Small flakes and debris (< 15 mm)	146	

Tab. 4.4: Frequency distribution of the main technological classes

4.2.3. Raw materials

All the lithic artefacts are made on flint, except two bladelets made on quartzite and jasper. Among the artefacts with residual cortex, diagnostic of the environment of collection of the raw flint blocks, about 60% was collected within secondary deposits, probably close to primary outcrops, signaled by little elaboration of the natural surfaces. The remaining was collected within alluvial deposits (32%) and secondary undeterminable deposits (Tab. 4.5).

The aspects related to raw materials characterization will not be evaluated, postponing this kind of analyses to further research projects. It can however be mentioned that, as for the other sites of the Fucino Basin, lithic raw material procurement is a problematic matter, as both in the basin itself and the immediate surroundings, flint or other suitable lithic raw materials outcrops are almost totally lacking. Large flint outcrops are conversely present some 30 km East of the site, where several lithotypes have been recognized to be very similar to the ones recovered at the site (D'ANGELO 2004, 2010; MUSSI 2001; MUSSI, et al. 2008).

Environment of collection	**N**	**%**
Close to primary outcrop	31	55,4
Stream bed/alluvial deposit	18	32,1
Undeterminable secondary	7	12,5
Tot	56	100,0

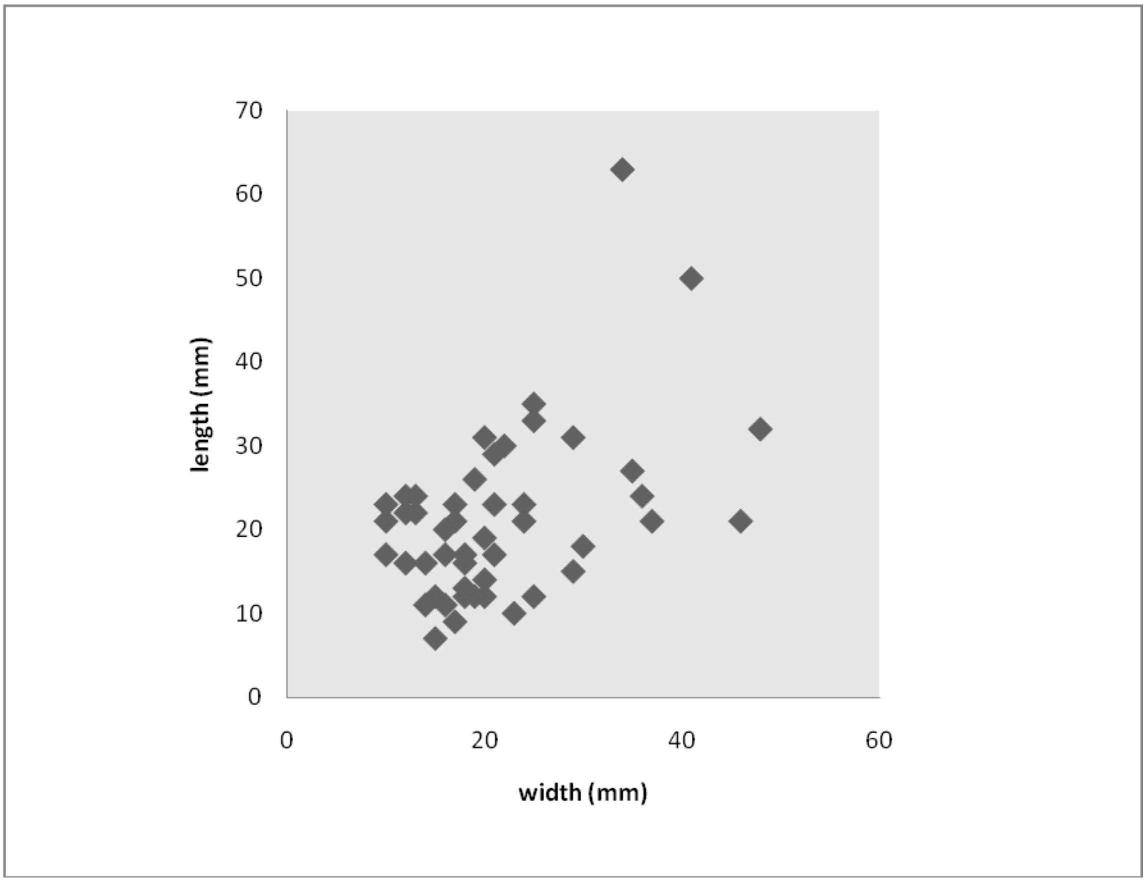
Tab. 4.5: Flint environment of collection

4.2.4. Shaping

Less than fifty flakes represent the artefacts ascribable to shaping interventions, probably carried out on blocks already shaped and/or partially exploited, signaled by the very small amount of totally cortical flakes and the outnumbering of the not cortical ones (Tab. 4.6). Flakes size doesn't exceed 70 mm in length and 50 mm in width (Graph 4.3).

Undifferentiated flakes	N	%
Totally cortical	3	6,3
Partially cortical	16	33,3
Not cortical	29	60,4
Tot	48	100,0

Tab. 4.6: Cortex amount among undifferentiated flakes



Graph 4.3 Undifferentiated flakes size

4.2.5. Production

The progression of lamino-lamellar production is testified by three separate artefact classes, ascribable to three different moments of the technical process (Tab. 4.7).

Laminar production	Laminar product	N	%
Initialization	Bilateral crest	4	2,2
Full production	*Sous-crête*	2	1,1
	Central, semicortical	16	8,8
	Central, not cortical	138	76,2
Cintrage maintaining	Lateral, semicortical	4	2,2
	Lateral, not cortical	17	9,4
	TOT	181	100,0

Tab. 4.7: Technological classification of the unretouched laminar blanks

Four initialization products represented by bilateral crests (*Fig. 4.6*), being respectively 12, 14, 18 and 20 mm wide, put the opening of at least part of the laminar production within both the bladelets and the blades calibers, suggesting that part of the laminar production started from partitioned production objectives. Anyhow, the incidence of such laminar products is so low as to prevent further speculations in this direction. Conversely, what is worth is that their presence signals that part of the blanks could probably have been realized in the site rather than imported.

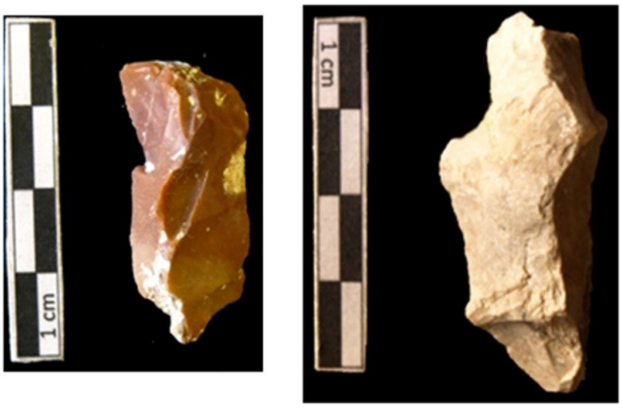


Fig. 4.6: Crested blades

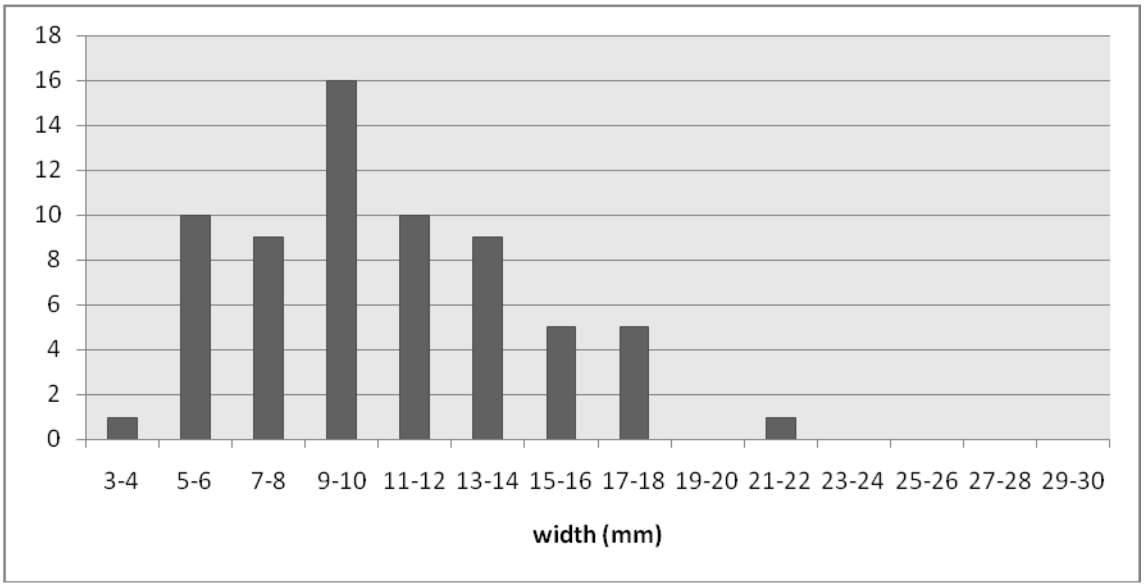
About 76% of the laminar production is represented by not cortical central blanks. The presence of *sous-crêtse* and partially cortical specimens suggest continuous reduction processes to have occurred, but the quantitative difference between these latter and the full production ones strikingly points to interpret this pattern as the partial outcome of the introduction of ready made blanks.

Full production laminar blanks (*Fig. 4.7*) are extremely regular and principally clustered around the bladelets calibers. Widths distribution spans from 3-4 mm to 21-22 mm (Graph 4.4), covering the microbladelets-blades range. While these classes represent the extreme tails of the distribution, this is centered around 9-10 mm, signaling a strongly bladelet-oriented production, with a significant occurrence of both microbladelets and large bladelets, and, to a lesser extent, blades.

Fig. 4.7: Unretouched laminar blanks

As regards the principal morpho-metric and morpho-technical features, the most recognizable flaking technique is the soft organic hammer direct percussion (Tab. 4.8); dorsal scars direction indicates a prevalent unidirectional modality of exploitation of the cores (Tab. 4.9); section is both triangular and trapezoidal (Tab. 4.10); ventral profile is mainly straight and, secondarily, *torse* (Tab. 4.11); transversal convexity ranges from 90° to 150° (Tab. 4.12).

Lateral laminar products calibers are partitioned and comprise microbladelets, bladeletes and blades. Their distribution is not continuous but show a lack in the range between 11 and 16 mm (Graph 4.5), which encompasses the large bladelets *spectrum*.



Graph 4.4 width distribution, central not cortical laminar blanks

Technique	N	%
Hard stone	9	32,1
Soft stone	4	14,3
Organic	15	53,6
TOT	28	100,0

Tab. 4.8: Flaking technique, full production laminar blanks

Dorsal scars	**N**	**%**
Unidirectional	63	87,5
Bidirectional	8	11,1
Crossed	1	1,4
TOT	**72**	100,0

Tab. 4.9: Dorsal scars direction, full production laminar blanks

Section	**N**	**%**
Triangular	29	41,4
Trapezoidal	36	51,4
Polygonal	5	7,1
TOT	70	100,0

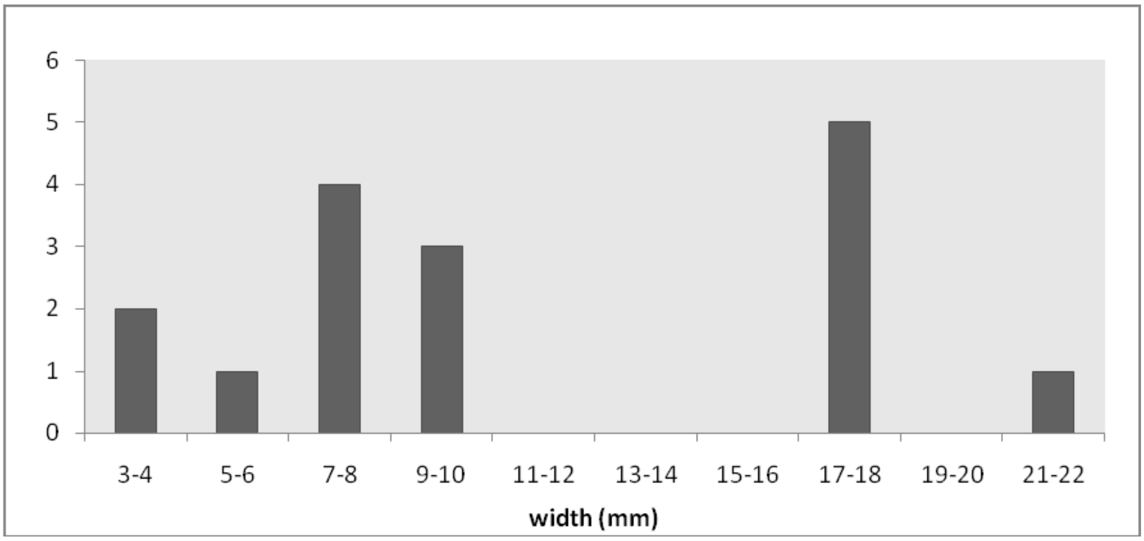
Tab. 4.10 Section, full production laminar blanks

Ventral profile	**N**	**%**
Straight	22	53,7
Curved	5	12,2
Straight, slightly plunged	1	2,4
Torse	13	31,7
TOT	41	100,0

Tab. 4.11 Ventral profile, full production laminar blanks

Transversal convexity	**N**	**%**
30°-60°	1	1,4
60°-90°	3	4,2
90°-120°	31	43,7
120°-150°	34	47,9
150°-180°	2	2,8
TOT	71	100,0

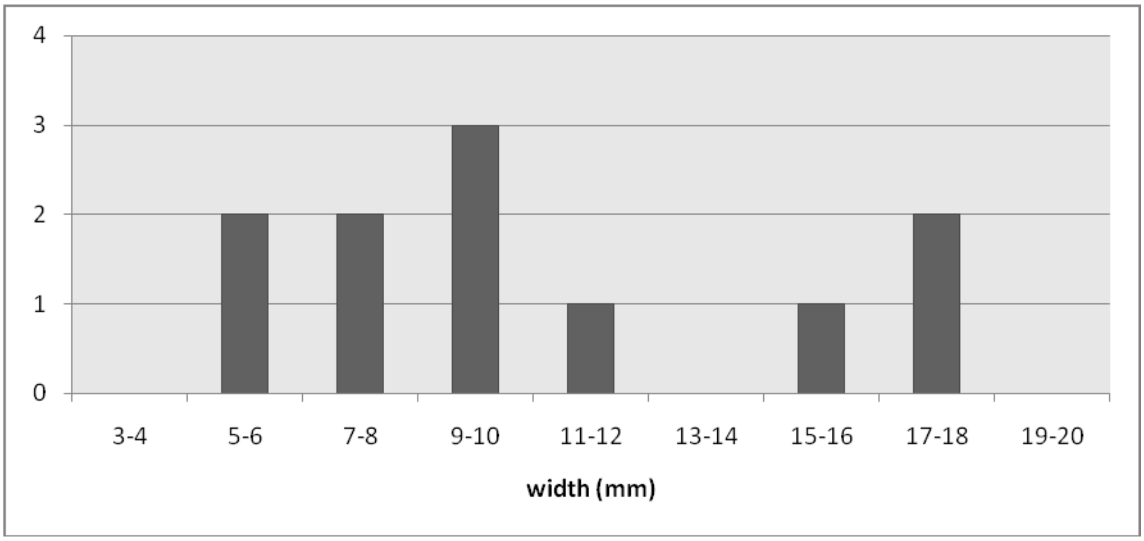
Tab. 4.12 Transversal convexity, full production laminar blanks



Graph 4.5 Width distribution, lateral laminar products

4.2.6. Management

Management interventions are signaled by both flakes and laminar products, aimed to the removal and recovery of accidents on the extraction surface, the re-conformation of the longitudinal convexity and the resharpening of the striking platform. Altogether represent about 7% of the assemblage. The distribution of the width of the laminar management products, namely neo-crests and other reparation products, span from bladelets to large bladelets and blades (Graph 4.6), suggesting that management interventions occurred at the site involved a rather wide range of blank calibers.



Graph 4.6 Width distribution, neocrests and surface management laminar products

Fig. 4.8: Management laminar products

4.2.7. Transformation

The set of retouched blanks and of the diagnostic transformation residues is varied and well represented in the assemblage (about 30% of the assemblage). Retouched blanks are almost equally distributed between tools and armatures, respectively accounting for 54,5% and 45,5% (Tab. 4.13).

TYPOLOGY		N	%
TOOLS (54,5 %)	Endscraper	3	3,4
	Endscrapers/point	1	1,1
	Burin	4	4,5
	Bec	2	2,3
	Retouched blade	9	10,2
	Notched blade	6	6,8
	Truncated blade	6	6,8
	Backed blade	1	1,1
	Retouched flake	6	6,8
	Notched flake	5	5,7
	Truncated flake	1	1,1
	Pièce esquillée	3	3,4
	Pièce mâchurée	1	1,1
ARMATURES (45,5 %)	Fragment of backed armature	10	11,4
	Shouldered point	4	4,5
	Backed truncated bladelet	6	6,8
	Truncated bladelet	1	1,1
	Backed point	1	1,1
	Pointed bladelet	3	3,4
	Retouched bladelet	9	10,2
	Notched bladelet	6	6,8
TOT		88	100,0

Tab. 4.13: Typological classification of the retouched blanks

4.2.7.9.Tools

Tools (*Fig. 4.9*) are made on both blades and flakes, with a clear predominance of the first, being retouched, notched and truncated blades more common than their flake counterparts (Tab. 4.13, Graph 4.7). Endscrapers and burins are almost equally represented. One composite endscraper and two becs are also present. Retouched blades are the most common tool, followed by notched and truncated blades, while backed blades are represented by a single specimen. Among the tools on flake, scrapers are the most widespread. It is worth to signal the presence of three *pièces esquillée* and one possible *pièce mâchurée*.

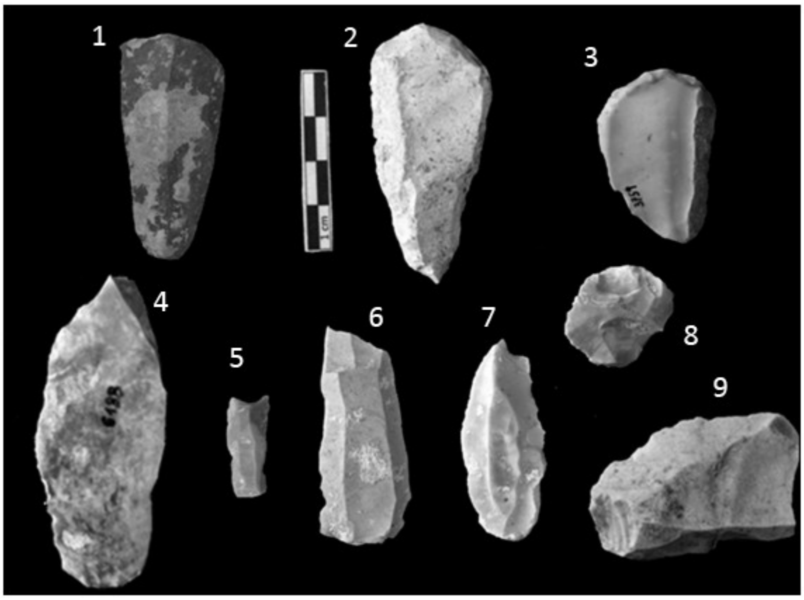
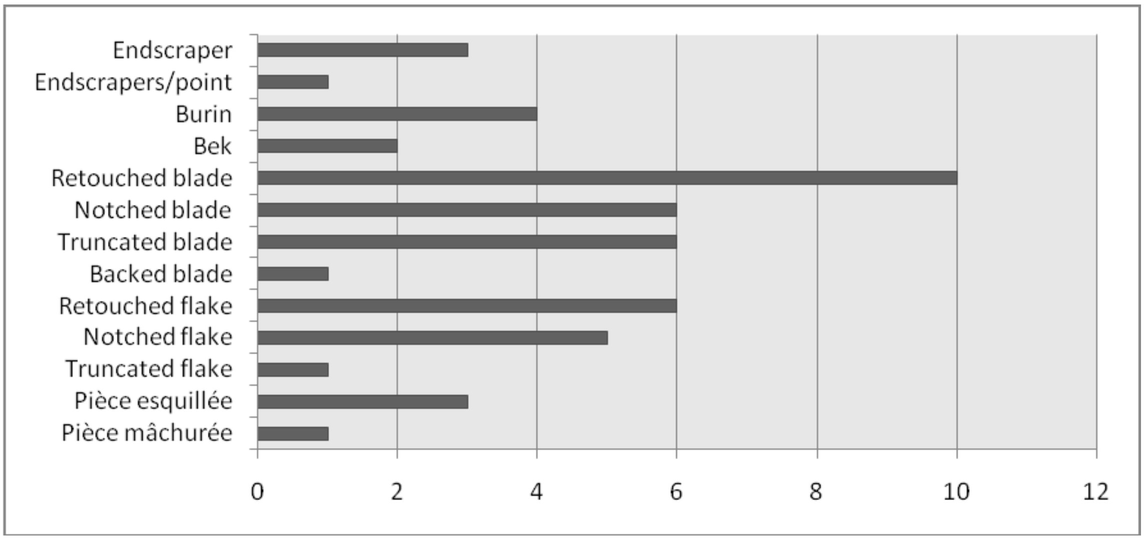


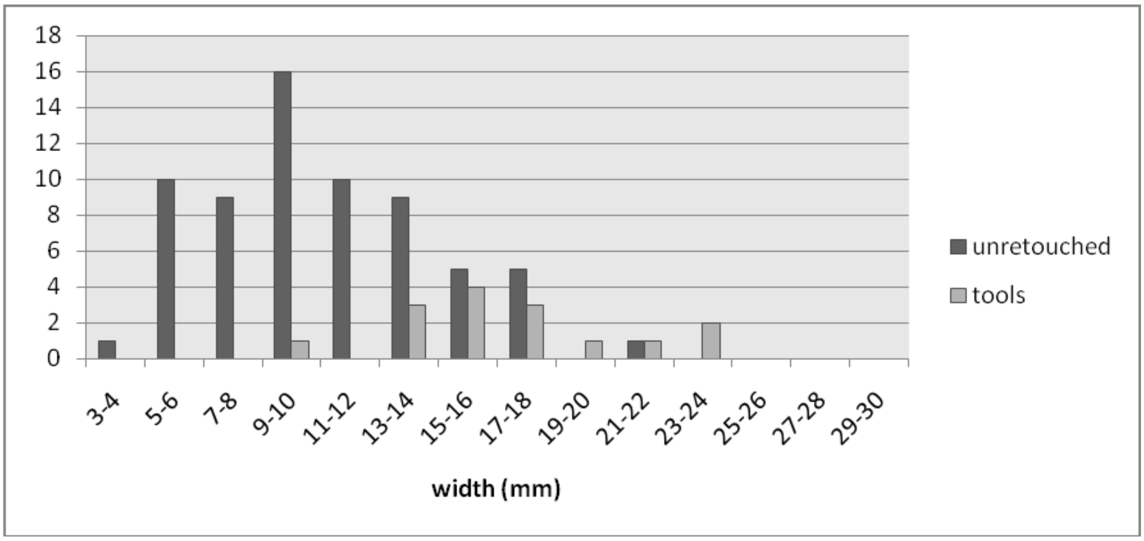
Fig. 4.9: Tools (1-3-endscrapers, 4-burin, 5-bec, 6-truncated blade, 7-retouched blade, 8- pièce esquillée, 9-pièce mâchurée)



Graph 4.7: Tool types frequency distribution

The width frequency distribution of the retouched laminar blanks shows quite clearly a phase displacement and partial exceeding of their dimensional range respect to the one of the unretouched blanks (Graph 4.8). This means that, while the corpus of unretouched blanks accomplished the technological requirements of tools manufacture, on the other side its composition suggests a different primary orientation towards narrower blanks.

As regards the principal morpho-metric and morpho-technical features of the blanks exploited in tools manufacture, dorsal scars direction indicates the prevalent unidirectional pattern (Tab. 4.14); section is mainly trapezoidal and triangular, polygonal in a lesser extent (Tab. 4.16); ventral profile is mainly straight and *torse* (Tab. 4.15); transversal convexity principally ranges from 90° to 150° (Tab. 4.17).



Graph 4.8: Width spectra of unretouched and retouched laminar blanks

Dorsal scars	**N**	**%**
Unidirectional	21	84,0
Bidirectional	4	16,0
TOT	**25**	100,0

Tab. 4.14: Dorsal scars, tools

Ventral profile	**N**	**%**
Straight	8	42,1
Curved	4	21,1
Straight, slightly plunged	2	10,5
Torse	5	26,3
TOT	**19**	100,0

Tab. 4.15: Ventral profile, tools

Section	**N**	**%**
Triangular	7	31,8
Trapezoidal	11	50,0
Polygonal	4	18,2
Totale complessivo	**22**	100,0

Tab. 4.16: Section, tools

Transversal convexity	**N**	**%**
60°-90°	2	9,1
90°-120°	7	31,8
120°-150°	13	59,1
TOT	**22**	100,0

Tab. 4.17: Transversal convexity, tools

4.2.7.10. Armatures

Armatures assemblage (*Fig. 4.10*) is dominated by generic fragments of backed implements, which outnumber every other class, and by notched and retouched bladelets. Pointed bladelets and backed points are quite rare, as are the truncated bladelets. On the other side, backed truncated bladelets and shouldered points are rather common (Tab. 4.13, Graph 4.9).

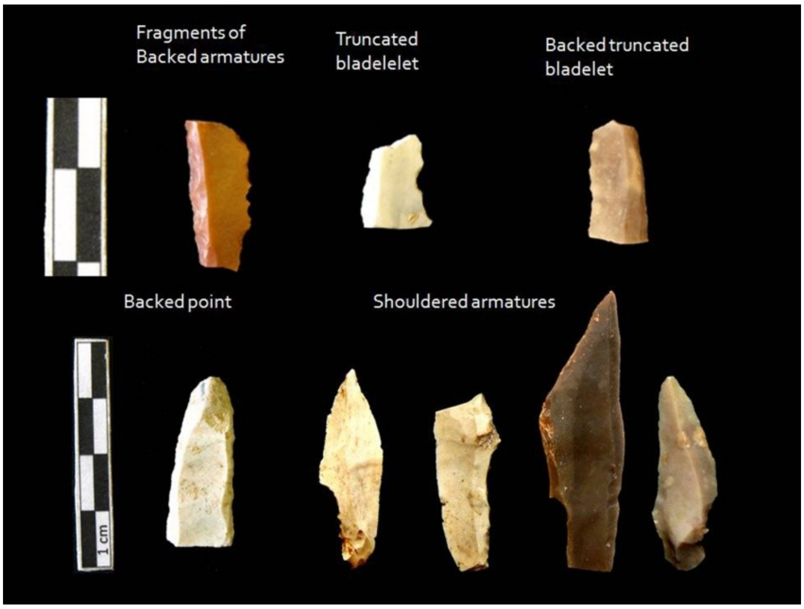
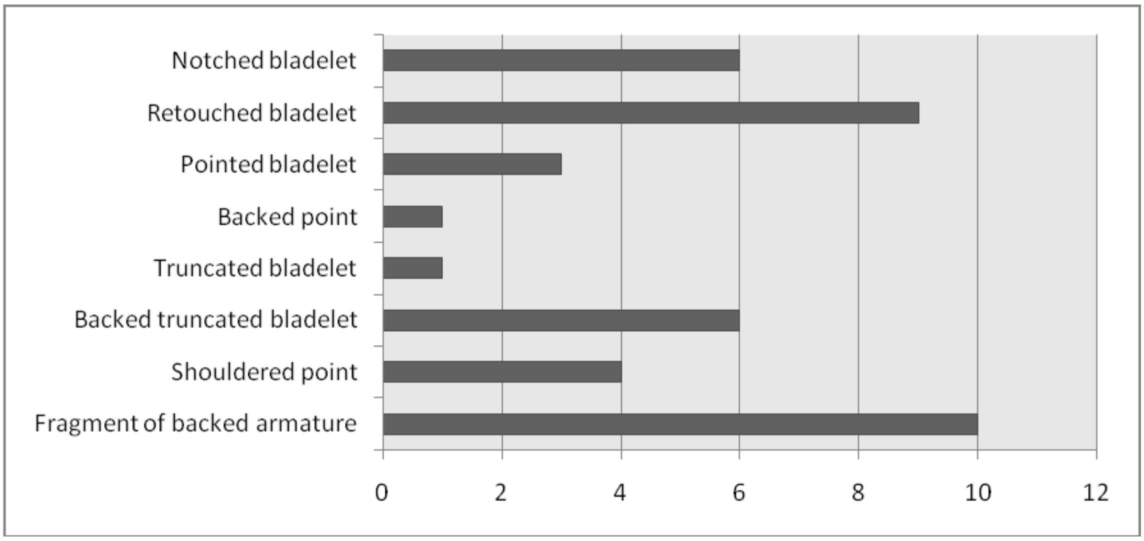
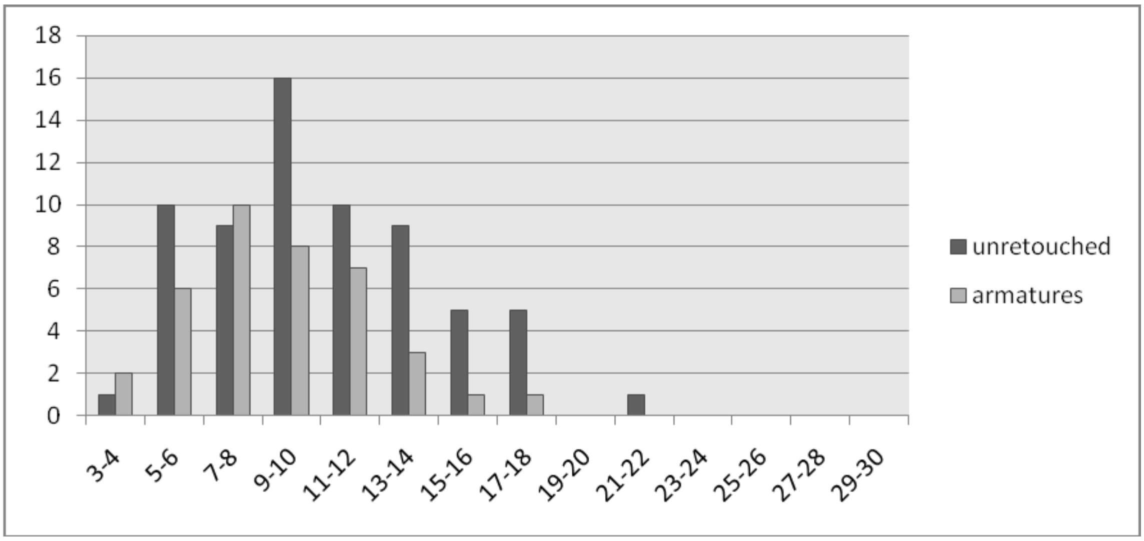


Fig. 4.10: Armatures



Graph 4.9: Armature types frequency distribution

Width frequency distribution clearly show a similar pattern for unretouched laminar blanks and armatures (Graph 4.10), with the particularity that the frequency peak of the armatures is on the 7-8 mm class while the unretouched ones on 9-10 mm. This is arguably due to the fact that abrupt retouch strongly affects the width dimension of the blanks, resulting in a generalized 1-2 mm narrowing of the artefacts.



Graph 4.10: Width spectra of armatures and unretouched laminar blanks

Three out four shouldered points are entire and the last is a proximal fragment. The entire ones (length: 37-55 mm; width: 12-16 mm; thickness: 3-4 mm) are rather small and robust. Blank calibers are comprised within the bladelets and large bladeletes. In all the cases, blanks are regular, not cortical, characterized by straight profiles, triangular or trapezoidal section. Dorsal scars are always unidirectional, signal of the fact that the straightness and the thinness of the distal end were provided by the natural core convexity, in one case, or conversely didn't represent a desired feature, in two cases. Flaking technique has been diagnosed in two cases: soft organic hammer direct percussion and hard stone direct percussion.

More generally, the principal morpho-metric and morpho-technical features of the blanks exploited in armatures manufacture are: dorsal scars principally unidirectional (Tab. 4.18); section, when recognizable, mainly triangular, (Tab. 4.20); ventral profile mainly straight and, in a lesser extent, *torse* (Tab. 4.19); transversal convexity principally from 90° to 150° (Tab. 4.21).

Dorsal scars	**N**	**%**
Unidirectional	32	88,9
Bidirectional	3	8,3
Crossed	1	2,8
TOT	36	100,0

Tab. 4.18: Dorsal scars, armatures

Ventral profile	**N**	**%**
Stratight	22	75,9
Curved	1	3,4
Straight, slighlty plunged	2	6,9
Torse	4	13,8
TOT	29	100,0

Tab. 4.19: Ventral profile, armatures

Section	**N**	**%**
Triangular	18	62,1
Trapezoidal	11	37,9
TOT	**29**	100,0

Tab. 4.20: Section, armatures

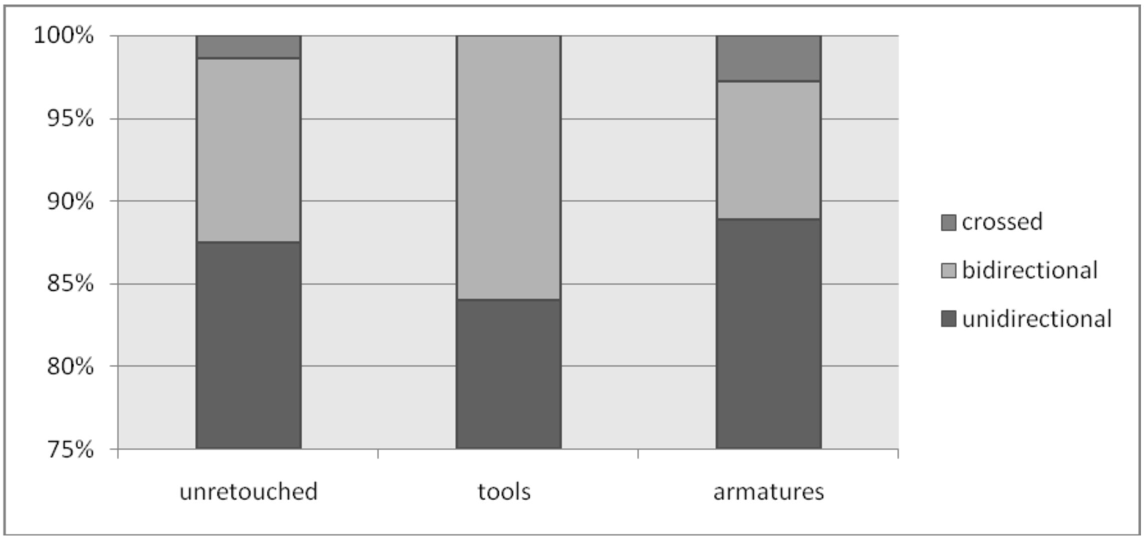
Transversal convexity	**N**	**%**
60°-90°	2	6,7
90°-120°	10	33,3
120°-150°	17	56,7
150°-180°	1	3,3
TOT	30	100,0

Tab. 4.21: Transversal convexity, armatures

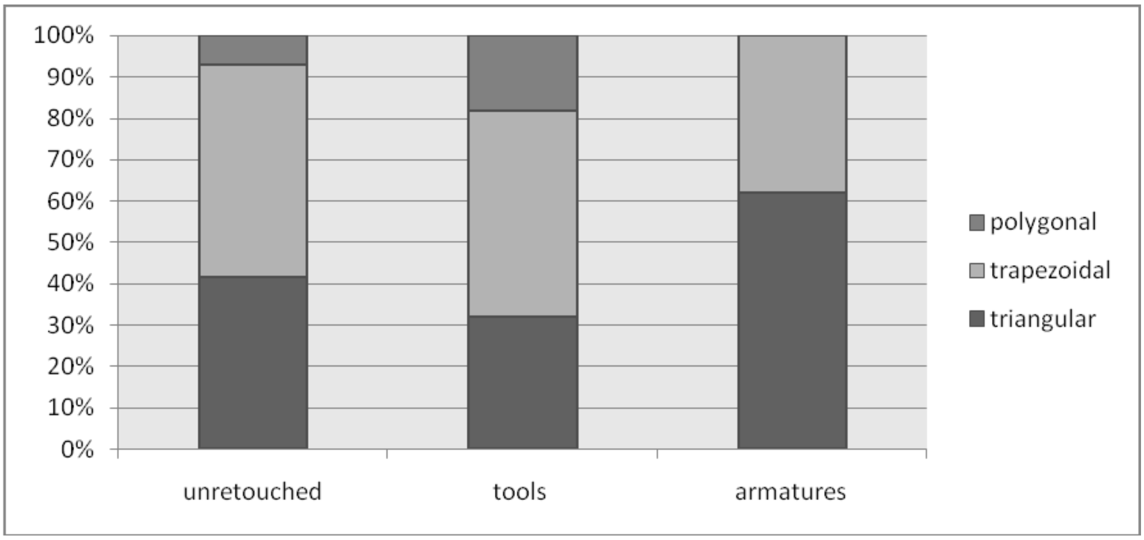
4.2.7.11. Morpho-technical comparisons

Graphs Graph 4.11, Graph 4.12, Graph 4.13, and Graph 4.14 present synthetic information about the main morpho-technical features recognized among unretouched and retouched blanks, in order to better ascertain cross comparisons. Except for transversal convexity (Graph 4.14), which is substantially the same in both retouched and unretouched blanks, the other parameters show differences which is worth to stress.

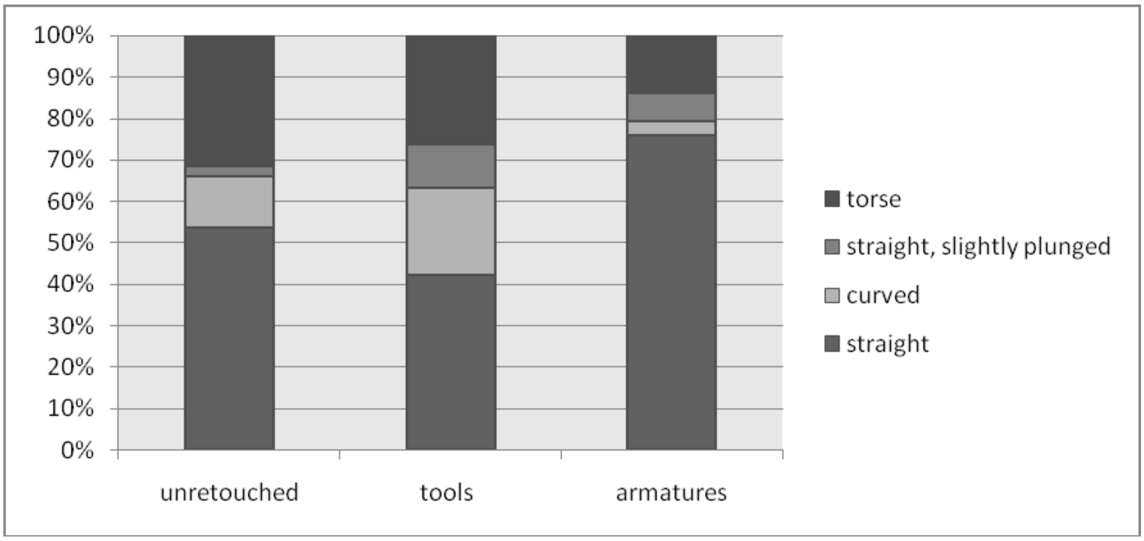
As regards the dorsal scars direction (Graph 4.11), the pattern shown by armatures is slightly more similar, respect to the tools, with the one of the unretouched blanks. Conversely, while armatures blanks section is mainly triangular and trapezoidal, tools show also polygonal sections. The armatures pattern is partially the result of the removal of a substantial portion of the blanks edges by the abrupt retouch. In the case of tools, conversely, a certain difference with the unretouched blanks is observable, in particular in the more frequent occurrence of polygonal sections. Finally, when considering the blanks ventral profile, high variability is recognizable through the three sets of artefacts. Armatures, as easily conceivable, show the main frequent occurrence of straight profiles, while tools are more equally distributed across the possible profile curvatures. These observation lead to reinforce the idea, above advanced according to blank size, of a slightly more congruity of the set of unretouched blanks with armatures rather than with tools.



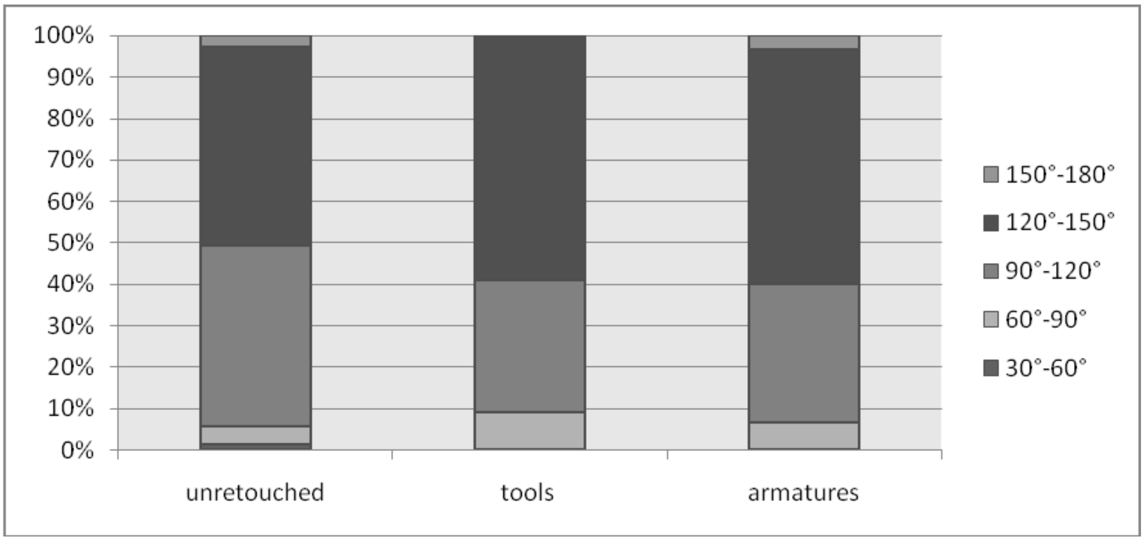
Graph 4.11: Dorsal scars direction, comparison between unretouched blanks, tools and armatures



Graph 4.12 Section, comparison between unretouched blanks, tools and armatures



Graph 4.13 Ventral profile, comparison between unretouched blanks, tools and armatures



Graph 4.14 Transversal convexity, comparison between unretouched blanks, tools and armature

4.2.7.12. <u>Transformation residues</u>

Diagnostic transformation residues (*Fig. 4.11*) are represented by few artefacts, highly informative of some of the activities occurred at the site (Tab. 4.22). Half of the residues assemblage is composed by burin spalls, both primary and secondary ones (resharpening burin spalls). The other three residues, a notch adjacent to fracture, a Krukowsky microburin and a microburin, are conversely directly related to armatures manufacture. In particular, while the notches adjacent to fracture are, possibly, technologically approachable to microburins, Krukowsky microburins are the direct outcome of processing accidents occurred while performing the abrupt retouch. Finally, the microburin is not associated to geometric armatures, not recovered. In this regard, it's worth to stress that the presence of microburins and geometric armatures is signaled within shouldered points early Epigravettian assemblages in Apulia, in the southernmost end of Italy (BIETTI and CANCELLIERI 2007).

Type of residue	N
Burin spall	2
Secondary burin spall	2
Notch adjacent to fracture	1
Krukowsky microburin	1
Microburin	1

Tab. 4.22: Diagnostic transformation residues

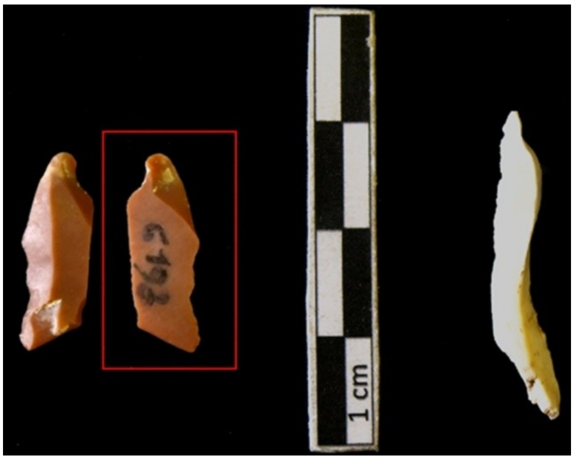
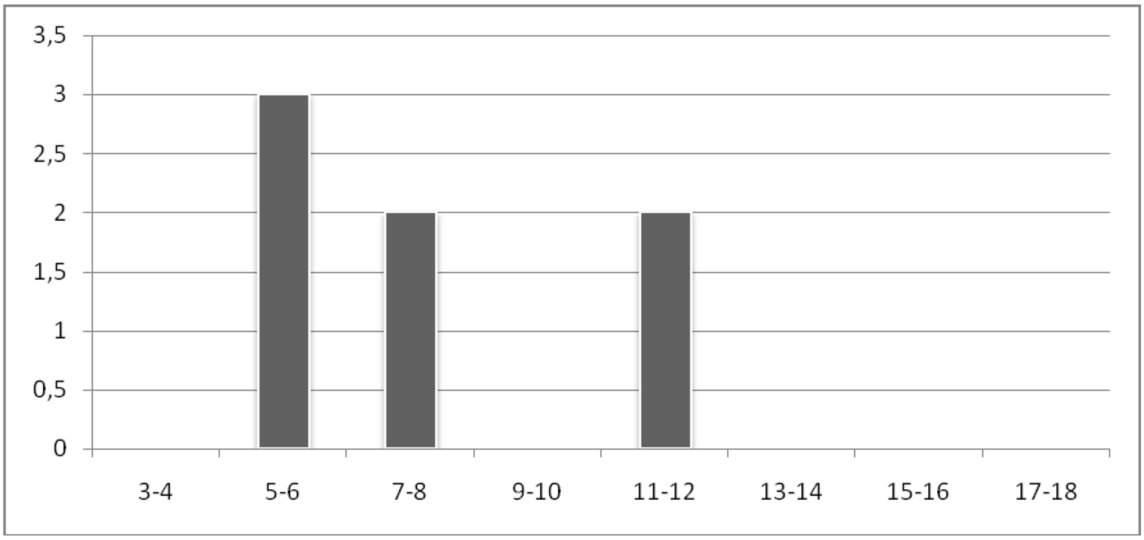


Fig. 4.11: Transformation residues: microburin (left), burin spall (right)

4.2.8. Deactivation of production

Cores are represented by three specimens, obtained by respectively a flint nodule, a pebble and a flake (*Fig. 4.12*). The production is strongly lamellar, as highlighted, also, by the last readable laminar scars measured on the extraction surfaces (*Graph 4.15*). Their abandon is due to both the occurrence of flaking accidents and loss of suitable convexities, not managed, but also to independent reasons. Inizialization, recognizable in one case, is by means of crest extraction. The exploitation of the volume is from one or two poles. The reduction progress, carried out on a single or on two surfaces, either independent or overlapping, is *frontale* or *semi-tournante*. The longitudinal convexity is from very low to low, while the transversal one from low to very high. Back and flanks are generally not prepared.



Graph 4.15: Laminar scars width, cores

Fig. 4.12: Cores

4.3. Synthesis and discussion

The procurement of the raw material was within debris or alluvial deposits. It is arguable that it was embedded in broader logistical activities. Flint blocks could have been collected along the paths during the movements to or from the cave, where the presence, in a limited extent, of flaking products resulted by the processing of flint cores, is attested.

The initial phases of shaping and initialization result to be in deficit respect to interventions carried out on partially preformed blocks, as results by the extreme rarity of totally cortical flakes and crested blades and bladelets. Not cortical full production laminar blanks, very regular, testify, together with cores, of a strongly bladelet oriented production. The occurrence *in situ* of flaking activities is signaled by the presence of management flakes and neo-crests. Retouched blanks are abundant and count both tools and armatures. The comparison between blanks size lead to the conclusion that while the *corpus* of unretouched ones is perfectly consistent with the armatures size, this is not completely true for tools, which are supposed to have been imported, in a certain extent, as ready made implements. Shouldered points are generally small, rather robust, not particularly elaborated and obtained from full production laminar blanks. The deactivation of production is testified by some bladelet cores, abandoned at an advanced stage of reduction. The flaking technique recognized among the phases of shaping and management is in the most cases the hard hammer direct percussion, while during full production is mainly the soft organic hammer direct percussion.

Data about the investigated area, obtained thanks to the lithic assemblage analysis, suggest that the frequentation of the cave was mainly connected to hunting activities, about which no faunal remain has been so far recovered as to support this hypothesis. It is arguably that the hunters reached the site within logistical movements, during which, probably, the collection of flint blocks could eventually occur. The results of the technological analysis conducted on the lithic industry point to the hypothesis that cave visitors arrived at Grotta di Pozzo equipped with a personal gear made of tools, armatures, cores and ready made blanks, by which restore the hunting weapons by means of the substitution of broken armatures with new ones, obtained from ready blanks or produced *in situ* processing partially preformed and/or partially exploited cores.

5. THE EARLY EPIGRAVETTIAN OF THE NORTHERN ADRIATIC FRINGE: DISCUSSION

5.1. Introduction

The last glacial cycle in Europe was marked by extensive and rapid climatic variability. The Last Glacial Maximum was characterized by the maximum expansion of the glacial icecap in Scandinavia and northern Europe and by generally cold arid climatic conditions in North-western Europe. During this time period, the amount of ice of the glaciers and of the continental ice sheets reached its maximum. To the ice accumulation on the continents, corresponded an abrupt sea level drop up to about -120 m. When ice accumulation was at its highest peak, vast areas of the nowadays underwater continental shelves were exposed, causing the change of the course of many rivers, mainly at the end of their path, which flowed into the sea far from their present-day mouths (ANTONIOLI, et al. 2004; CORREGGIARI, et al. 1997; LAMBECK and CHAPPELL 2001; LAMBECK and PURCELL 2005; LAMBECK, et al. 2002; SHACKLETON, et al. 1984; URIARTE 2010)

Because of the lowering of the sea level, the conformation of the western Mediterranean was sensibly different from the current one (*Fig. 5.1*). Corse and Sardinia, i.e., formed a single island and the Elba island was part of a coastal plain linked to the continent. East of Spain and between Pyrenees and Maritime Alps there were wide coastal plains while central and southern tyrrenian coasts were almost similar to the current ones, because of their steepness. East of Tunisia and North of

Libya there was an over 200 km wide coastal plain (SHACKLETON, et al. 1984). As far as the study area is concerned, the northern fringe of the Adriatic, during the LGM undergone dramatic events which profoundly changed its extension, respect to our current view of it (*Fig. 5.2*). A wide coastal plain occupied the northern half of the current basin, which was crossed by rivers supplied by the water sourced from the alpine glaciers and from the Apennine chain. The eastern sector, conversely, the current Dalmatian coast, was characterized by the presence of steep hills facing the plain (ANTONIOLI, et al. 2004; SHACKLETON, et al. 1984).

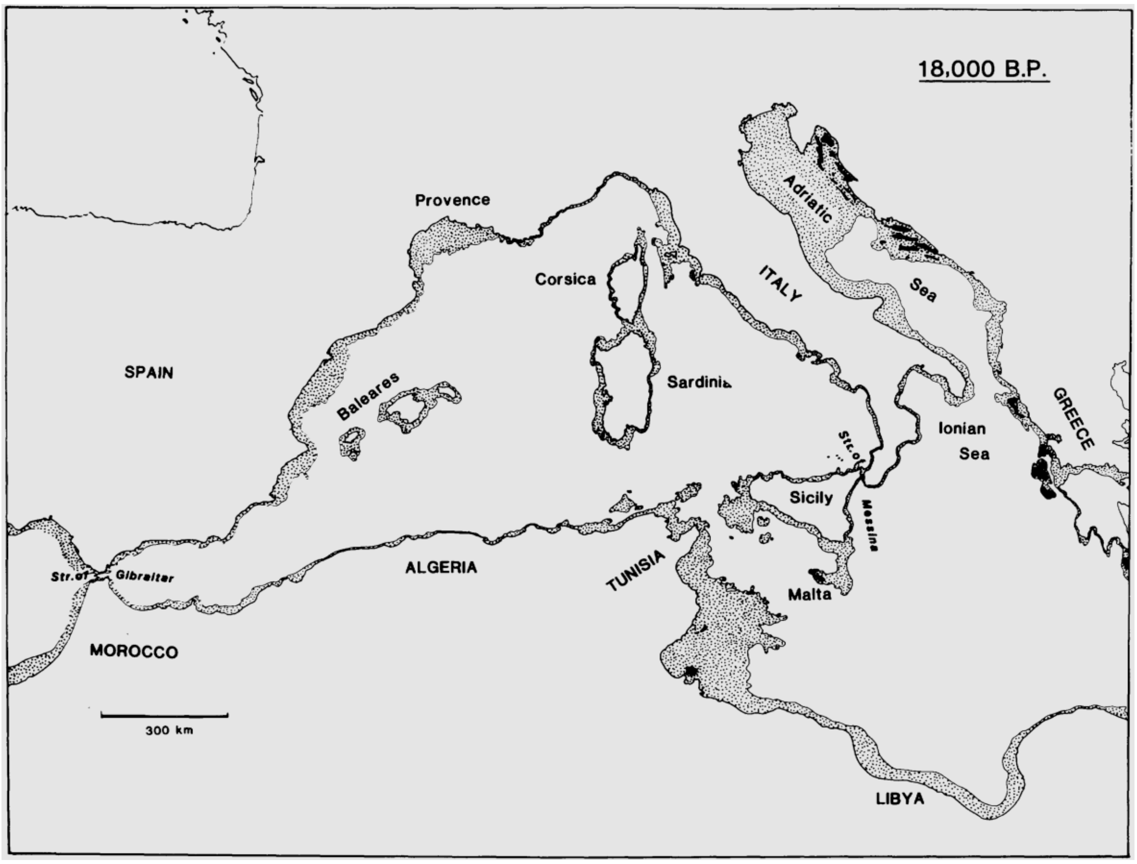


Fig. 5.1: Paleogeography of the Western Mediterranean at the LGM (SHACKLETON, et al. 1984)

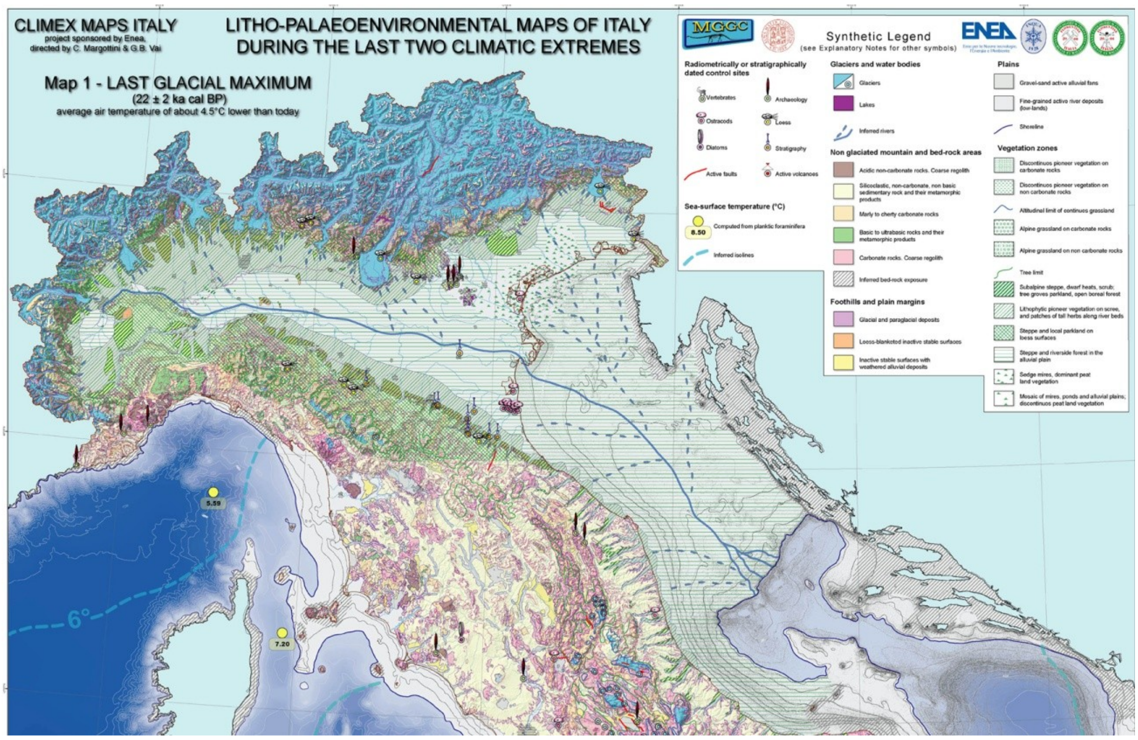


Fig. 5.2: The supposed extension of the Great Adriatic Plain at the LGM

The archaeological record is represented by a reduced number of sites and large gaps in several regions, interpreted as the result of the abandon of the northern regions and of the contraction of human presence in the southern ones, which worked as *refugia* (BAILEY and GAMBLE 1990; DJINDJIAN, et al. 1999; KOZLOWSKI 2005; STRAUS 1991a, b). While western Europe saw the onset of the Solutrean, characterized by very peculiar bifacially retouched projectile points, in southern and eastern Europe developed the Epigravettian, signaled, in its early phase, among other evidences, by shouldered projectile points. Contrary to the Solutrean, which is considered an innovative technocomplex, the Epigravettian is tied to the Gravettian tradition (BROGLIO 1997; BROGLIO and KOZLOWSKI 1987; DJINDJIAN, et al. 1999; OTTE 1990; PERESANI 2006).

Recently Banks et al. (BANKS, et al. 2008) have proposed a series of models, based on geographic projections of ecological niches defined by different environmental, climatic and archaeological variables, with the aim to constitute a set of predictions about the suitability of the territories which could have been potentially occupied by the populations of the two main technocomplexes, on the basis of the territories actually occupied by them. The results show how the "solutreans" were more likely adapted to, or preferred, areas with permanent permafrost, more humid and colder than the "epigravettians" territories, characterized by discontinuous permafrost and seasonal ice. While "solutreans" result to be almost perfectly inscribed within the predicted territories, "epigravettians" show to have been potentially adaptable also to more western territories, respect of their actual ones. The reasons why this didn't happen are traced, by the authors, in eco-cultural conditionings. The need to maintain strong links, also of linguistic nature, within the borders of well defined geographic barriers, prevented "epigravettians to expand beyond the Alps and the Pyrenees, toward environments similar to those habitually frequented.

The earliest evidences of the spread of the early Epigravettian in the Balkans (*Fig. 5.3*) are in Istria (Sandalija, 21.000 uncal BP), Slovenia (Ovca Jama, 19.500 uncal BP) and western Greece (Kastritsa, 20.000 uncal BP) while the youngest in Slovenia, Bosnia, southern Bulgary and eastern Greece (KOZLOWSKI 2008; MIHAILOVIC and MIHAILOVIC 2007; MONTET-WHITE 1996; MONTET-WHITE and KOSLOWSKI 1983). On the basis of chronological, typological, paleoenvironmental and paleoeconomic factors, Kozlowsky suggests that the first appearance of the technocomplexes with shouldered points in the Balkans should be traced in the occupation of the area as a *refugium* by late Gravettian groups coming from the middle Danube region. Furthermore he recognizes, on a morpho-stylistic basis, the origin of the shouldered points of this region in some similar eastern types, like the Kostienky and Willendorf ones (KOZLOWSKI 1999, 2008). In Italy, the early Epigravettian chronologically spans between ca. 24.000 and 19.000 calBP (ca. 20.000 – 16.000 uncalBP), and is traditionally subdivided into three phases: the initial phase, the foliates phase and the shouldered points phase (BARTOLOMEI, et al. 1979; BIETTI 1990, 1997; BROGLIO 1997; GIOIA, et al. 2003; MUSSI 1990, 2001; PALMA DI CESNOLA 1993; PALMA DI CESNOLA and BIETTI 1983), the latter being the best known and more precisely defined. It spans principally along the Adriatic (*Fig. 5.4*) side of the peninsula, showing an about 4.000

radiocarbon years chronological gap between the northern and the southern sites attributed to this phase, which suggests this technocomplex spread from North to South.

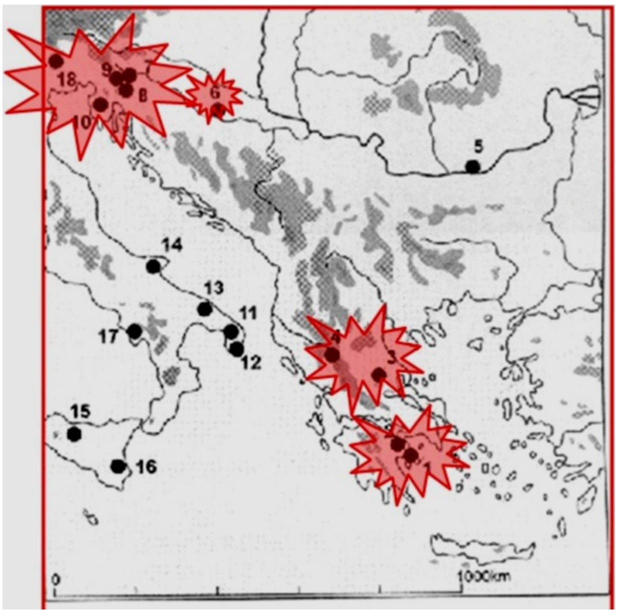


Fig. 5.3 Early Epigravettian sites with shouldered points on the Western Balkans (after KOZLOWSKI, 2008, modif.)

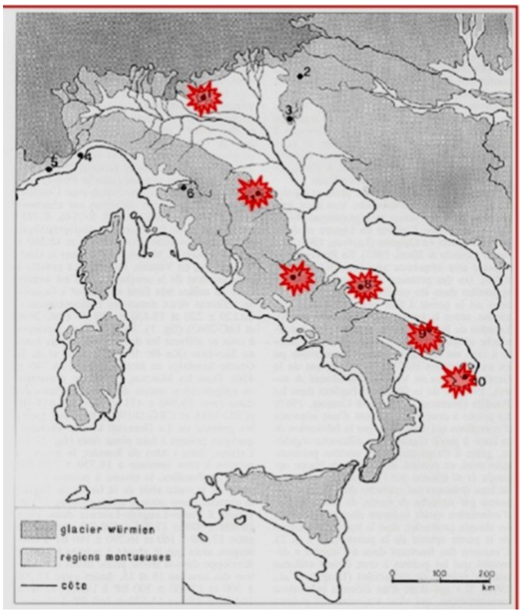


Fig. 5.4: Eastern early Epigravettian sites of Italy (after BROGLIO, 1997, modif.)

5.2. *The early Epigravettian of the northern Adriatic fringe*

In what follows, a synthesis of the available data on the considered time span will be provided, focusing on the geographic areas taken into consideration, which correspond to the Central Apennine and the Berici hills in Italy, the Istria peninsula in Croatia, the karst of Slovenia and the northern Bosnia (*Fig. 5.5*). The overview will start from the southernmost area, the central Italy Apennine. In this area are located the sites whose lithic assemblages have been the object of the present work, which aims to be a contribution to the knowledge provided by previous studies on the region.

Fig. 5.5: Localization of the sites discussed in the text

5.2.1. The Fucino Basin (Abruzzi Apennine)

The presence of a lake reaching about 700 m.a.s.l. and the presence of glaciers up to 1.500 m.a.s.l. (Mt. Velino and Mt. Vulture) could be related to the absence of archeological evidence in the Fucino basin around 20.000 uncalBP. It is probable that the fluvio-lacustrine layers recognizable at the base of the Paleolithic sequences of the area formed in this period, and is arguably, too, that the Fucino basin didn't allow prolonged human settlement. Between 18.000 and 16.500 uncalBP, the instauration of more temperate conditions, the slight lowering of lake level and the 100-200 m retirement of the glaciers, allowed human frequentation of a series of caves and shelters, like Grotta di Pozzo, Grotta Tronci and Riparo Maurizio, for mainly hunting purposes (AGOSTINI, et al. 2008; GIRAUDI 1989; GIRAUDI and FREZZOTTI 1997; MUSSI, et al. in press; MUSSI, et al. 2008). Surrounded by mountains, whose elevation often exceed 2000m, and set at about 715 m.a.s.l., the latter two sites are the highest ones both in Italy and Europe, and suggest an early recolonisation of the Apennine soon after the LGM (MUSSI and PERESANI 2004).

Recently, a model has been proposed by Agostini *et al.* (AGOSTINI, et al. 2008) about the exploitation of the area around 18.000 uncalBP, on the basis of the zooarchaeological record of Grotta Tronci and Riparo Maurizio. The authors created a DEM, elaborated in order to obtain a gradient map of the territory, where particular attention is given to the distinction between flat areas, reliefs and slopes. To the map has been correlated the hypothetical distribution of the habitats of the species recognized among the zooarchaeological record of the two sites (*Fig. 5.6*). Faunal remains testify of the predation of large size animals, in particular horse and *Equus Hydruntinus*, typical of flat open environments (ALHAIQUE and RECCHI 2003; WILKENS 1991). Cervids are also present, as are auroch and ibex (*Fig. 5.7*) (PHOCA-COSMETATU 2004), respectively typical of wooded environments and mid-high mountain open areas.

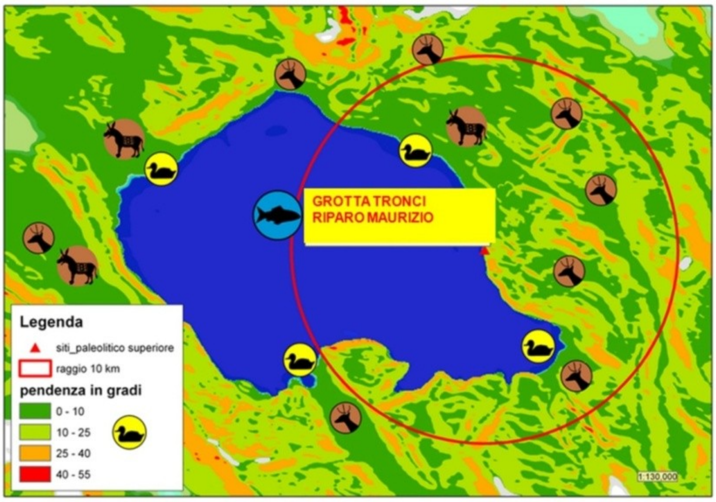


Fig. 5.6: Recostruction of the hunting area of Grotta Tronci and Riparo Maurizio (AGOSTINI, et al. 2008) modif.

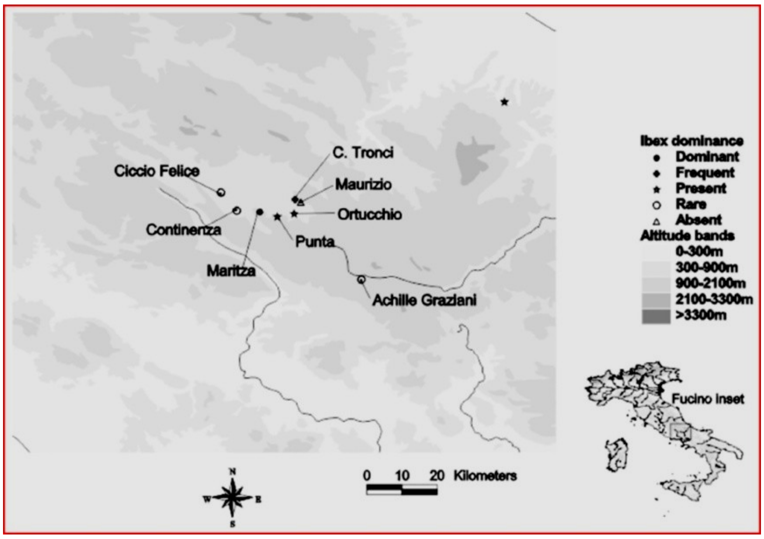


Fig. 5.7: Ibex remains presence in the upper Paleolithic sites of the Fucino basin (PHOCA-COSMETATU 2004)

Fishing, marsh birds hunting and mollusks harvesting are scarcely represented, despite of the presence of low water and marshy environments within a few kilometers from the sites.

According to the digital model proposed by the authors, which provides a map of the potential hunting areas, the whole *spectrum* of resources identified to have been exploited by the epigravettian hunters of Grotta Tronci and Riparo Maurizio, was available within a radius of 10 kilometers around the site, where open flat areas, shore belts, mountain slopes and river valleys are all present.

The other side of the coin, namely, the technological organization of the Epigravettian hunters who frequented the area at the end of the LGM, can be partially traced within the archaeological record of the lower levels of Grotta di Pozzo (*Fig. 5.8*). As presented in ch. 4, (MUSSI, et al. in press; MUSSI, et al. 2008) data about the lithic industry suggest the frequentation of the cave for hunting purposes. Unfortunately, no faunal remains have been so far recovered. Hunters probably reached the site partially equipped with an almost ready made tool kit, to be maintained by means of the substitution of broken armatures with new ones, eventually produced at the site from blanks introduced readymade or extracted from partially preformed or partially exploited cores.

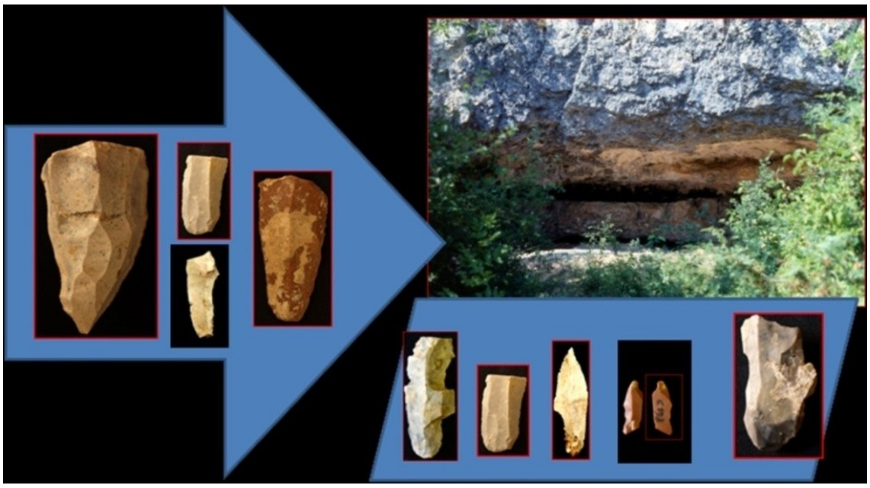


Fig. 5.8: Grotta di Pozzo, schematic representation of the technological cycle

5.2.2. The Esino and Misa river basins and the Cingoli ridge (Marche Apennine)

The record of the Marche Apennine for the time period considered is represented exclusively by three open air sites, Ponte di Pietra, Fosso Mergaoni and Madonna dell'Ospedale, which provide the evidence of extraction and production activities near good-quality flint outcrops. The sites are all located close to streams and rivers, in correspondence of rather wide open areas, set at the end of gorges. The set of available radiocarbon dates frames the first two sites between ca.20.000 and 18.000 Uncal BP (BROGLIO 1997; SILVESTRINI, et al. 2005). The chronological attribution of the latter, conversely, is based on the presence of shouldered points, which frame the assemblage within a large time interval ranging from ca. 20.000 to 15.000 Uncal BP (BIETTI 1990).

Ponte di Pietra (BROGLIO, et al. 2005; BROGLIO and LOLLINI 1981; LOLLINI, et al. 2005), dated to 19.940 ± 471 Uncal BP and 18.515 ± 618 Uncal BP, is close to Arcevia, in the province of Ancona, along the course of the Misa river (*Fig. 5.9*). Its sedimentary succession includes an eolic unit, superimposed to gravel deposits, containing the archeological evidences represented by thousands of flaked flint artefacts distributed in several clusters, rare faunal remains and some combustion areas.

Fig. 5.9: Ponte di Pietra (Courtesy of the Superintendence for Archeological Heritage of the Marche Region)

The lithic industry shows macrolithic laminar features, which are reflected on the corpus of retouched blanks, mainly composed of burins, endscrapers and pointed blades. Armatures include frequent *gravette* and *microgravette* points as well as backed truncated bladelets. By means of the analysis of selected clusters of lithic artefacts, of the refittings and of their technological composition, it has been possible to recognize that frequent workshop activities were carried out at the site, with subsequent withdrawal and transport of the predetermined artefacts, within the site or elsewhere (LOLLINI, et al. 2005).

At Fosso Mergaoni, lithic sets define the existence of workshops, well identifiable within the paleosurfaces. These include shaping flakes, cores, laminar products and different by-products resulted by the production of large blades, blades and bladelets from flint blocks provisioned very close to the site. Technological composition, quite rare retouched implements and the spatial pattern, are indicative of specialized tasks occurred, most probably, within a settlement system related to the fluvial basin and to its lithic resources.

Finally, the assemblage of Madonna dell'Ospedale shows a massive production of highly standardized blade and bladelet blanks. Paucity in retouched tools and absence of faunal remains suggest that the site function was rather specialized and mostly devoted to blank and hunting weapons production and, probably, maintenance.

In sum, during the end of the LGM and until at least the onset of the Lateglacial interstadial (BROGLIO, et al. 2005; PERESANI and SILVESTRINI 2007; PERESANI, et al. 2005) the Epigravettian frequentation of the Marche Apennine stops in correspondence of the first counterforts (*Fig. 5.11*) of the ridge. The archeological evidence indicates the exclusive presence of open-air sites, close to streams and major rivers, strongly devoted to extractive and productive activities, during, probably, short occupation visits (*Fig. 5.10*).

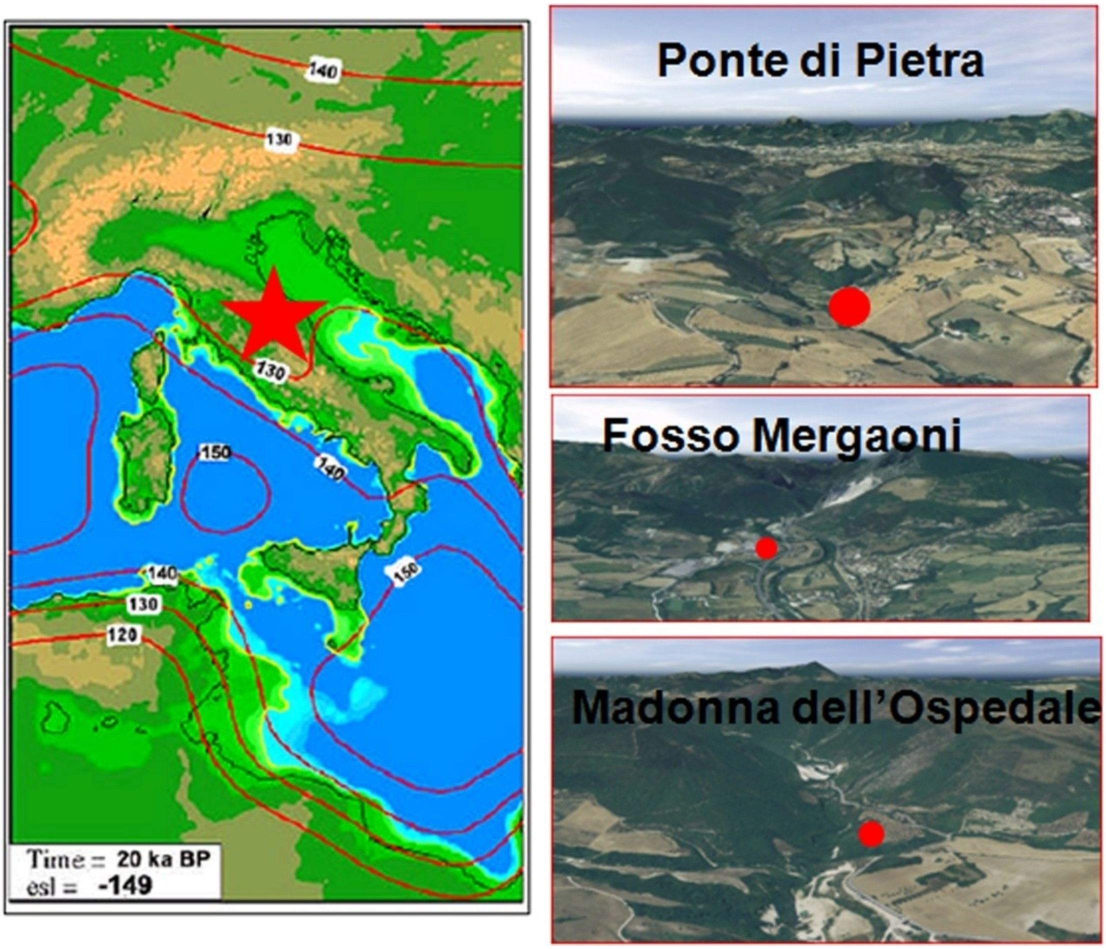


Fig. 5.10 Localization of Ponte di Pietra, Fosso Mergaoni and Madonna dell'Ospedale (ANTONIOLI, et al. 2004, modif.), (left) and panoramic view of the same sites, from East (Right).

Fig. 5.11: The central Apennine ridge

5.2.3. The Berici hills (Venetian region)

The Berici hills are made of a calcareous relief, interested by karstic phenomena, with a vaguely rhomboidal shaped base, emerging from the plain south of the town of Vicenza (Veneto region). They are about 25 x 20 km wide, and are separated by the Lessini mountains by a narrow plain strip. The early epigravettian sites of the area are all located along the eastern side of the relief (LEONARDI and BROGLIO 1962) (*Fig. 5.12*), at elevations comprised between 150 and 350 m.a.s.l., both in caves and shelters (Grotta di Paina, Grotta di Trene, Riparo del Broion).

The radiocarbon dates frame the occupation between 20.000 and 17.500 uncal BP (BROGLIO 1997; DE STEFANI, et al. 2005). These cultural evidences probably represent the residual of a complex insediative system, deeply extended toward the plain at the South, with diversified sites, probably set in a more central position but nowadays buried under massive alluvial deposits and currently out of reach (MUSSI and PERESANI 2004).

Lithic industries are dominated by armatures, which also include shouldered points. The latter show a very high similarity in typology, blank types and size, with the ones from the Croatian and Slovenian sites (BROGLIO 1997). As highlighted by very recent analyses on the material from the Broion shelter, the presence of armatures with impact scars and the absence, or rarity, of flaking activity, reinforces the hypothesis of their being short time occupation stations, used mainly during hunting activities.

Fig. 5.12: Panoramic view of the rocky slopes of the Berici hills

Technological and functional analyses on the shouldered points of Grotta di Paina (BROGLIO, et al. 1993), clarified some aspects related to manufacture and use of such implements. The shouldered points are the outcome of a production process which starts with the extraction of regular laminar blanks generally from cores with two opposed striking platforms, in order to manage and predetermine the distal convexity of the blade. Subsequently, the blank transformation is carried out by the creation of the shoulder, by means of abrupt retouch, and of the point, by means of a retouch that could vary, from marginal to abrupt, depending on the nature of the blanks. Finally, the analysis of the impact scars demonstrated that these armatures were actually used as projectile points.

Recent analyses and discoveries due to a reprise of the researches on the archaeological remains of Grotta di Paina (BERTOLA, et al. in press; BROGLIO, et al. 2009), while confirming previous statements about site function and land use, together with a refined assessment of the means of productions of the hunting weapons, shed new light on the broader question of the possible existence of transapennine networks, in particular, thanks to the recognition of a shouldered points phase characterized by the almost exclusive use of exogenous flint coming from the Apennine formations (*Fig. 5.13*), some 400 km South.

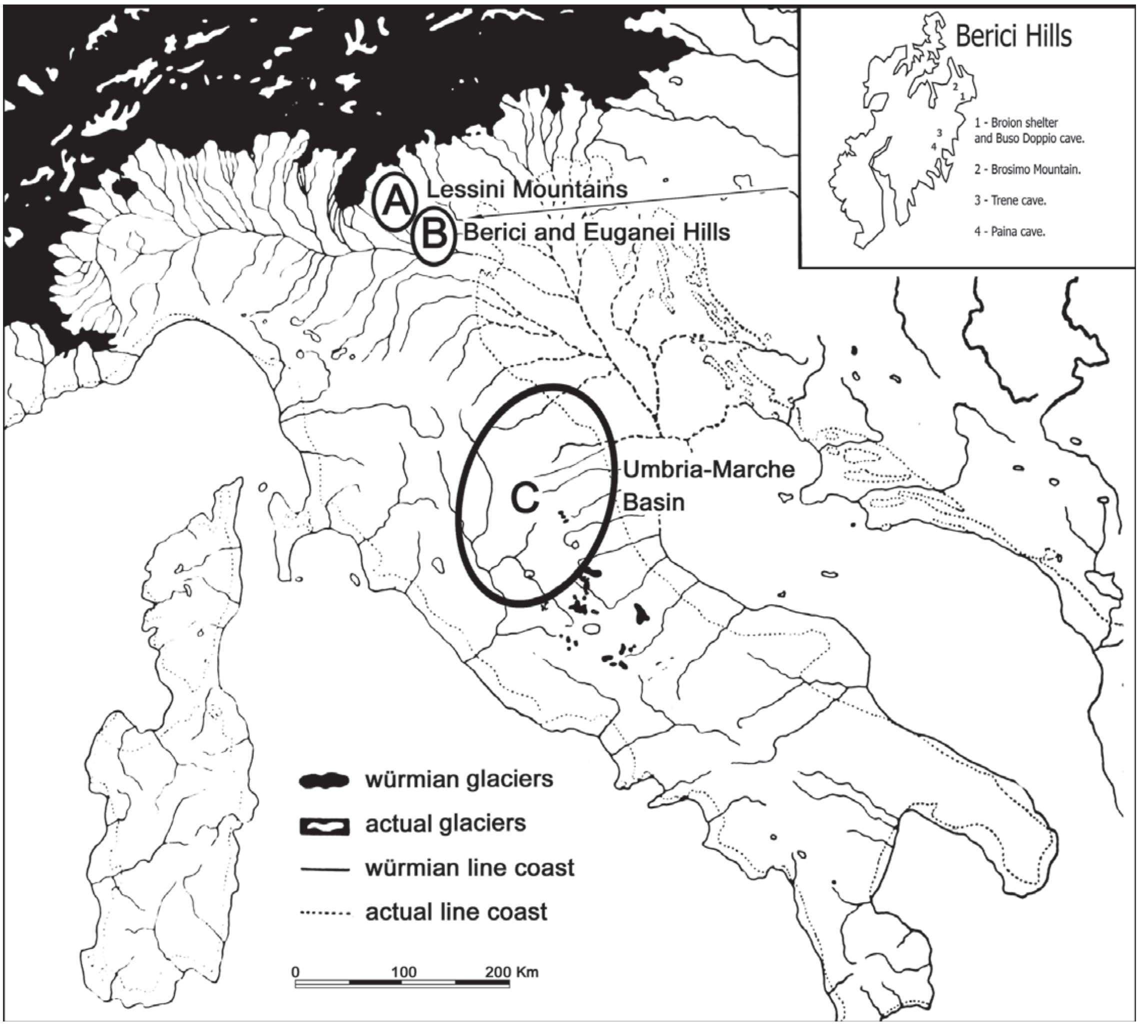


Fig. 5.13: Palaeogeography of the Italian peninsula during the LGM and flints provisioning areas exploited in the Palaeolithic of Berici Hills: Lessini Mountains (A); Berici and Euganei Hills (B); Umbria-Marche Basin (C) (BROGLIO, et al. 2009)

The north-western Balkans

The early Epigravettian of the north-western Balkans is documented in the deposits of caves, shelters and open air sites by lithic assemblages with shouldered points, spanning the period 20.000 - 17.000 uncal BP. In the Istria peninsula there is the important site of Šandalja II, while in the Slovenian karst the reference sites for this period are Zacajeni Spodmol, Ovce Jama, Zupanov Spodmol e Jama V Lozi. Finally, in northern Bosnia, the large open air settlement of Kadar (MONTET-WHITE 1996).

As far as the use of cave sites is concerned, these are generally interpreted as temporary encampments, set on passageways and only randomly used by small groups of hunters, which is suggested by the limited amount of tools and the general rarity of flaking activity. In some cases, like at Zupanov Spodmol, the epigravettian hunters reached the cave equipped with readymade tool kits as well as some cores, the exploitation of which is testified by a certain amount of flaking products. In the case of Ovca Jama, a more intensive use of the site is documented, along with a possible longer length of occupation (MONTET-WHITE 1996). Contrary to the cave and shelter sites record, one of the few sites interpreted as residential is Kadar (MONTET-WHITE and JOHNSON 1976), in northern Bosnia, where, together with several clusters of flaking products, formed after the processing of flint blocks recovered within a short distance from the site, are also present numerous tools and armatures. Within the same site, there are also the evidences of at least a possible windbreak structure, or tent.

It's worth to put a little more attention on the important site of Šandalja II, which, thanks to its archeological record and very recent analyses, largely contributes to clarify some aspects related to the peopling and frequentation of the northern sector of the Adriatic basin. The cave is set close to the town of Pula, in Croatia, within the Cenomanian limestone which constitute the southern end of the Istria peninsula. It elevates at about 70 m.a.s.l., overlooking the current narrow coastal strip. The cave is wholly filled with Pleistocene deposit, more than 8 meters thick, and was never occupied by Neolithic groups.

The stratigraphy (*Fig. 5.14*), identified during the Malez excavations, carried out from 1962 to 1989, includes eight layers, from layer H, at the base, to layer A, at the top. Layers E, F and G, dated between 28.000 e 23.000 uncalBP, contain Aurignacian lithic industries. The Epigravettian layers are C and B. The early Epigravettian is separated by the above recent Epigravettian by a long hiatus due to erosive events which have probably removed the sedimentary sequence of the first part of the Lateglacial. The layer attributed to the early Epigravettian is the one labeled C 'base', because the top of the same layer has been dated to the Lateglacial (MONTET-WHITE 1996).

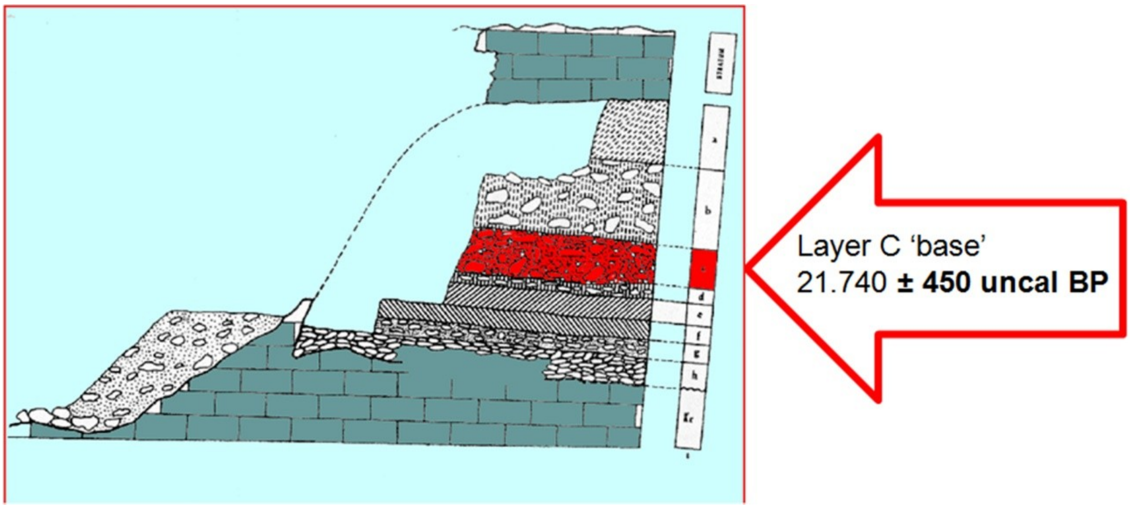


Fig. 5.14: Stratigraphic sequence of Šandalja II (MONTET-WHITE, 1996, modif.)

The faunal assemblage (MIRACLE 2007) of the late Aurignacian layers is made of species of diversified biomes, numerous enough to satisfy the necessities of a wide *spectrum* of carnivores. The data suggest that the Great Adriatic Plain was a highly productive environment both for large size herbivores and their predators, including humans. The early Epigravettian faunal assemblage is similar to the late Aurignacian one, even if with some differences in the frequencies. There are evidences of the use of the cave as bear den and of ephemeral and sporadic human frequentation.

As far as the lithic assemblage of the early Epigravettian is concerned (*Fig. 5.15*), only general information is available: among tools, a general paucity of burins and endscrapers is accompanied by a higher incidence of scrapers, retouched blades and pointed blades. Armatures include straight backed points, small marginally retouched points and a few shouldered points.

The artefacts lithic raw materials include both local lithotypes and a certain amount of exogenous materials. The procurement area is principally identified in southern end of the Istria peninsula, where it was probably possible to recover flint pebbles transported by the Isonzo river from the alpine and pre-alpine formations (KARAVANIC 2003; ZUPANIC 1975).

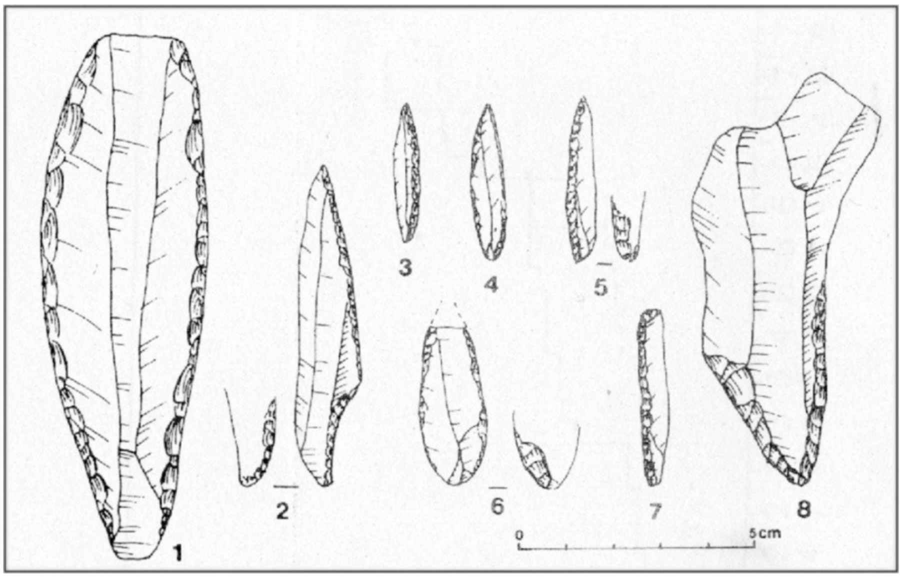


Fig. 5.15: Tools and armatures from layer C of Šandalja II (MONTET-WHITE 1996)

The presence of artefacts made on red and pinkish flints, very similar to the ones of the Lessini mounts and the Apennine Scaglia Rossa formation, suggests their acquisition after medium-long range movements. Thanks to the kind permission of dr. Dejana Brajcovic, director of the Institute for Quaternary Paleontology and Geology of the Croatian Academy of Sciences and Arts in Zaghreb, to the incomparable support provided by dr. Jandranka Mauch Lenardich from the same institute, and the financial support of the University of Ferrara, the author had the possibility to examine a sample of such artefacts, with the aim to detect, on a micropaleontological basis, some indications to confirm or to reject the hypothesis of a possible Apennine provenance of at least a part of them. Some preliminary indications in this direction, kindly provided by prof. Valeria Luciani of the University of Ferrara, are suggested by the recognition of Eocene planktic foraminifera within the micropaleontological assemblages observable on a series of artefacts. These data strongly point to an Apennine provenance because of the presence, in this area, of an Eocenic upper member of the Scaglia Rossa formation, which conversely lacks in the alpine and pre-alpine stratigraphic sequence (ARZARELLO, et al. 2007; BROGLIO, et al. 2009).

5.3. Over the hills and far away: on the traces of the late Upper Paleolithic settlement system around (and within?) the Great Adriatic Plain

Depending on the scientific and cultural framework, landscape is defined and perceived in very different ways, ranging from partitioned naturalistic (a neutral background to human activities) or culturalistic views (a particular cognitive or symbolic ordering of space) to more complex ones where the concepts of space and time, according to a "dwelling perspective" (INGOLD 1993), make landscape not definable without considering its temporality.

By the landscape ecology point of view, research aims to understand the causes and consequences of spatial heterogeneity, how they vary with scale and, ultimately, understand the reciprocal relations between spatial patterns and ecological processes (TURNER 1989, 2005a, b). While paleoecological methods of research alone are adopted to reconstruct past landscapes and their changes in time, when combined with geological, archaeological and historical data, it is possible to arrange short-term and long-term cultural and ecological processes on a progressive series of temporal and spatial scales. Particularly regarding this latter point, the present study case can be set at the boundary between the meso-scale and macro-scale (*Fig. 5.16*), where, theoretically speaking, species migrations, ecotone displacements and long-term changes on large stream watersheds, river basins and other large continental features can occur. Within this scale, human evolution can eventually lead to the transformation of the natural landscapes (DELCOURT and DELCOURT 1988).

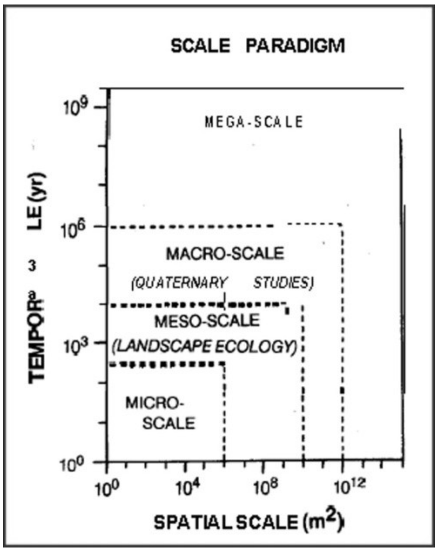


Fig. 5.16 Scale paradigm representation (DELCOURT and DELCOURT 1988)

Prehistoric human groups naturally dwelled their landscapes, following *"…a way of life now largely vanished from man's experience: mobile man pursuing food, shelter and satisfaction in different places in his environment*" (BINFORD 1980). Despite of the many refinements or criticisms (WIESSNER 1982), in his influential work, or "*the single most influential paper*" on hunter-gatherer settlement systems and site formation (DAVID and KRAMER 2001), L. Binford (1980) provides numerous significant considerations by suggesting that a similar basic organization is not shared by all hunter-gatherer societies and, what is important for archaeologists, major differences in organization can have an important and predictable effect on the archaeological record.

Archaeologists are not able to observe living systems. Even roughly reconstructed patterns are inferred from numbers, associations and spatial distributions of the residues produced by the activities performed at different times at different places in the landscape (DAVID and KRAMER 2001). With this in mind, it's worth to stress some points about the research context we are dealing with in the present work, before moving ahead with any attempts to synthesize and propose general patterns from the archeological record of the study area.

Speculating about the settlement system around a now submerged feature like the Great Adriatic Plain poses several problems of reliability of the propositions one is likely to give, mostly if that feature plays a primary role in the building of the theoretic scheme on which interpretation is based on. The evidence from the territories set all around the supposed borders of the Great Adriatic Plain provide bases to infer coherent stand-alone local settlement system patterns, which are, on the other side, a clearly incomplete picture of a conceivable broader one. When reasoning in terms of a larger scale, which the meso-scale can represent a good exemplification, a coarser speculative reasoning level has to be adopted, based on accordingly coarser assumptions. This is particularly valid in the present case, in which one tries to infer a largely unsustainable specific pattern about a currently not investigable area. These methodological and scientific concerns are mitigated by one basic statement according with which any suggested proposition has a relative value and is particularly aimed to explain and provide a coherent general framework for what is currently observable, rather than for what is definitely out of reach. In this perspective, information coming from the northern fringe of the current Adriatic basin will be used as a sort of proxy-data, indirect evidence produced by, and part of, a no longer observable element, chronologically and/or spatially separated by its material residues.

The reconstruction of the main environmental features of the Great Adriatic Plain, and their relations with human activity, record contrasting positions (BAILEY and GAMBLE 1990; MIRACLE 2007; MUSSI 1990, 2001; SHACKLETON, et al. 1984). The major discussion theme resides, of course, in the possibility of this geographic element to have represented, or not, a link between the opposite sides of the Adriatic, i.e., by holding the cyclic aggregation of bands and representing a fertile area of resources acquisition. The criticism of this view comes from scholars who conversely would see in the Great Adriatic Plain a largely avoided territory because of adverse climatic and environmental conditions, and paucity of resources. A series of palaeoecological, paleogeographical and palaeoethnological evidences would suggest a more reliability of the first of the two viewpoints, and what follows is an attempt to a synthesis.

Recent research carried out in Istria (BALBO, et al. 2006; MIRACLE 2005, 2007) pointed out, among the many results achieved about the Pleistocene/Holocene peopling of the area, a new or renewed view of the role that the Great Adriatic Plain could have played for the Late Upper Paleolithic human groups of the surrounding areas. Moving from a recent model proposed by Miracle (MIRACLE 2007), with LGM maximum lowering of the sea and climatic worsening, the principal and more stable settlement may have been on the plain, that was a highly productive environment both for animals and humans, and which could have worked as a *refugium*. In particular, the LGM human/carnivores occupation trend at Šandalja provides evidence of the role of the cave in being alternatively central or peripheral respect to the insediative choices and constraints. Support to this interpretation is further provided by the local settlement system patterns, above outlined, recognizable on the territories that once bordered the Great Adriatic Plain, in particular, the northernmost ones. The central Apennine, the Berici hills, the Istria peninsula and the Slovenian karst, all those regions testify of specialized activities carried out by special task oriented groups which frequented the sites for the procurement of lithic raw materials and alimentary resources. These evidences imply the existence of more stable settlement areas, probably, within the now submerged plain.

Further, a number of suggestions, proposed by different researchers, point to a net of links between the epigravettians of both sides of the northern Adriatic (DJINDJIAN, et al. 1999; KOSLOWSKI and OTTE 1997; PERESANI 2006), possibly following the LGM general trend characterized by the East West shifting of increasingly mobile human groups, moving between valley systems along networks of resources circulation (MONTET-WHITE 1994, 1996). Punctual comparisons can be established between the series of projectile points of the Venetian, Slovenian and Croatian sites (*Fig. 5.17*), in particular concerning blanks morphology and typological traits (BROGLIO 1994, 1997; MONTET-WHITE and KOSLOWSKI 1983). The shouldered points from Grotta di Paina, Šandalja II and Ovca Jama suggest in fact a techno-typological identity of the northern Adriatic findings (BROGLIO 1994).

The hypothesis of the existence of a large scale network of contacts between hunting bands and/or of their high mobility within the study area is definitely confirmed by the tracing of the lithic raw materials provenance. As above mentioned, in the early Epigravettian of both Šandalja II and Grotta di Paina, respectively in Istria and in the Berici hills, there is clear evidence of the introduction of flint artefacts made on exogenous material coming from the selciferous formations of the Umbria-Marche basin This raises anthropological questions about the means of procurement of such resources. The archaeological evidence from the Marche Apennine could provide a partial support to the subject, by suggesting that the provisioning was not embedded in a broad strategy of resource acquisition but, rather, the outcome of specialized planned activities.

Another important question deals with the possible routes followed by LGM people to reach the flint outcrops. One way to exemplify this problematic could be to draw straight lines between the inferred procurement areas and the archaeological sites *Fig. 5.17*). This would imply, in the particular case under analysis, movements from specialized sites to other specialized sites, or, in other words, between non-residential sites. It is here suggested, conversely, that exogenous flint artefacts probably reached the sites after at least a twofold transport, the first from the procurement area to the residential area, the second from this one to the hunting camps (*Fig. 5.18*). This finds partial support, at least at Paina, in the recognition that exogenous flints are represented exclusively in the form of ready made armatures, which indicates that their production was entirely carried out somewhere else (BROGLIO, et al. 2009).

Further, on the basis of the reconstructed paleogeographic features of the territory during the considered time span, the rivers that originate from the Apennine crossed the emerged plain toward its center, and it is arguable that part of the exogenous flints recovered within the assemblages of Šandalja and Paina could have been procured within the fluviatile deposits accumulated along the river courses. The reliability of this possibility is however subject to further investigations, in particular on the artefacts residual natural surfaces.

The series of considerations above proposed draw an overall picture of the northern Adriatic basin around 20.000 and 18.000 uncalBP as an area where highly, logistically mobile (*sensu* Binford) human groups, sharing a single cultural identity, built an archaeological landscape made of discrete areas and activities, both temporally and spatially partitioned: an inferable broad residential settlement area, currently inaccessible, which probably constituted also a node for cyclic human aggregation and cultural transmission, surrounded by a series of provisioning areas, target of short duration specialized expeditions. The Lateglacial interstadial climatic change, together with the progressive flooding of the Plain, led human groups to intensely occupy the more interior mountain? regions (MIRACLE 2007). Most probably, the onset of such a shift can be traced within the very end of the LGM, when one witnesses, along the Adriatic side of Italy, to a progressive diffusion toward both the interior and the South of the peninsula, of early Epigravettian assemblages with shouldered points (BARTOLOMEI, et al. 1979; BIETTI 1990; PALMA DI CESNOLA and BIETTI 1983). In the southernmost end, the Salento, these can be found until about 16.000 uncalBP (BIETTI 1979; GAMBASSINI 1970). What is worth to stress is that shouldered armatures often figure within lithic sets which show almost complete reduction sequences and large inventories of both tools and armatures (ALHAIQUE and BIETTI 2008; BIETTI and CANCELLIERI 2007), suggesting a relative "residentialization" and, accordingly, a progressive change in the settlement system pattern. In this perspective, the data from the Fucino basin could fit well the observed pattern, representing a feable *incipit* of the change observable in the settlement system pattern of the last phases of the early Epigravettian.

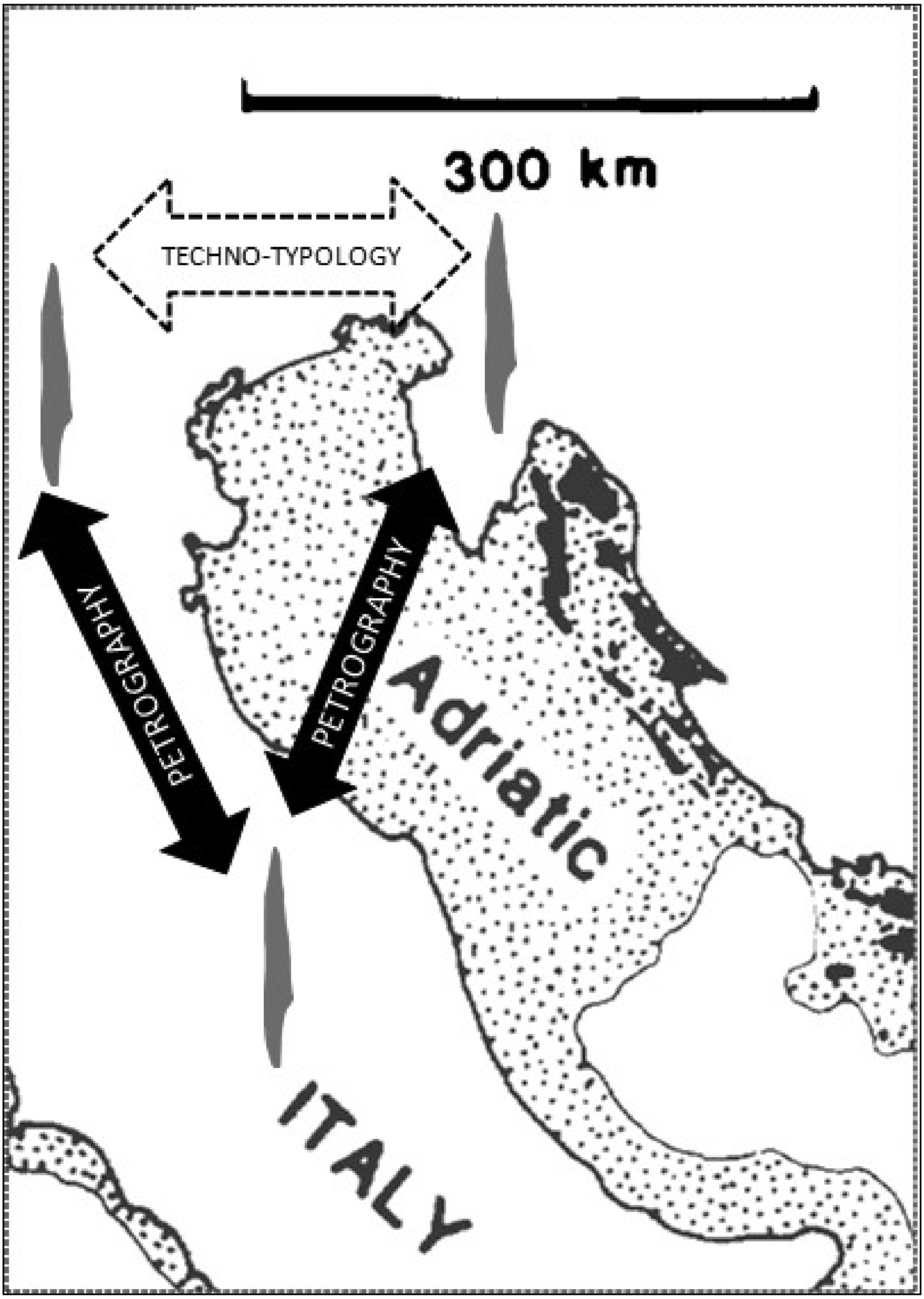


Fig. 5.17: Available data about late Upper Paleolithic connections

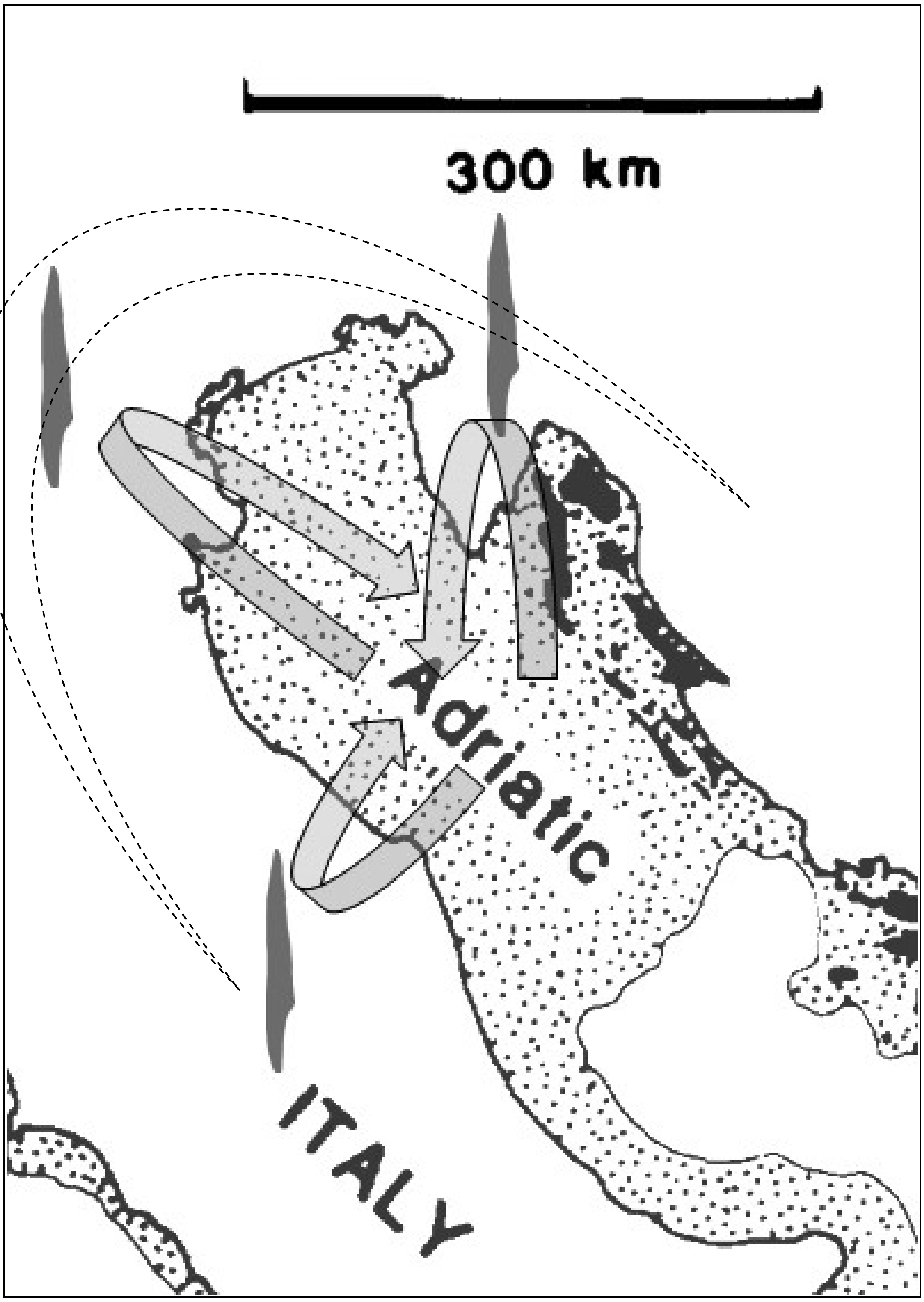


Fig. 5.18: Inferable logistical movements, responsible for techno-typological similarity and diffusion of lithic raw materials

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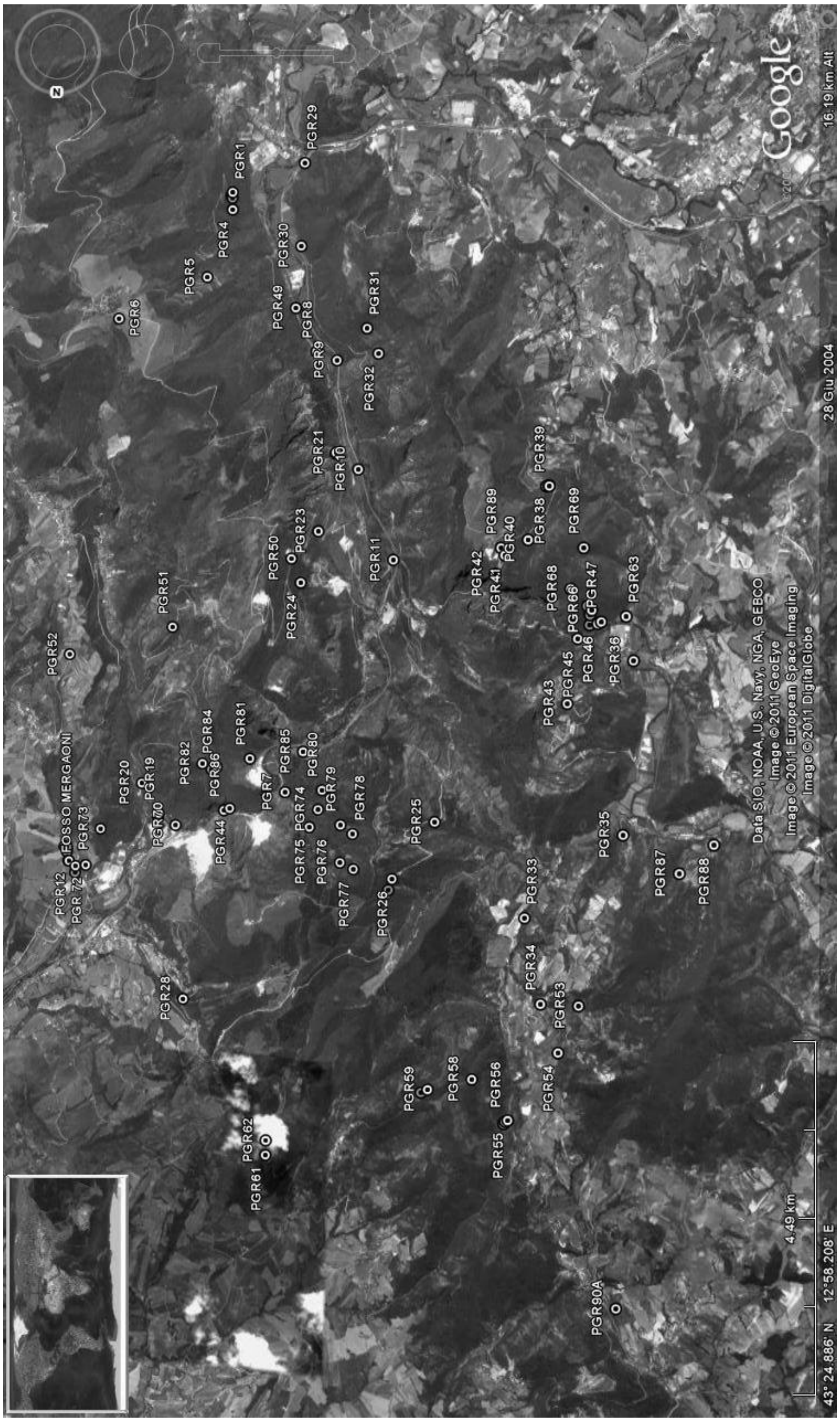
8. Annex. Flint sources of the upper Esino river basin: inventory


Google
28 Giu 2004
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image © 2011 GeoEye
Image © 2011 European Space Imaging
Image © 2011 DigitalGlobe
FOSSO MERGAONI

zone UTM 33T

EAST 338395

NORTH 4801752

m.a.s.l. 424

limestone outcrop

scaglia rossa

Cretaceous-Eocene

FLAKING ATTITUDE
PRIMARY OUTCROP

none

FLAKING ATTITUDE (%)
SECONDARY OUTCROP

none

microbladelets

large bladelets

blades

large blades

FLINT DOMINANT COLOURS

red

FREQUENCY ON 2 sq m

PGR01

detail

zone UTM 33T

EAST 338398

NORTH 4801829

m.a.s.l. 424

limestone outcrop

scaglia rossa

Cretaceous-Eocene

FLAKING ATTITUDE
PRIMARY OUTCROP

none

FLAKING ATTITUDE (%)
SECONDARY OUTCROP

none

microbladelets

large bladelets

blades

large blades

FLINT DOMINANT COLOURS

red

FREQUENCY ON 2 sq m

PGR02

detail

zone UTM 33T

EAST 338412

NORTH 4801796

m.a.s.l. 430

limestone outcrop

scaglia rossa

Cretaceous-Eocene

PGR03

FLAKING ATTITUDE
PRIMARY OUTCROP

none

FLAKING ATTITUDE (%)
SECONDARY OUTCROP

none

microbladelets

large bladelets

blades

large blades

FLINT DOMINANT COLOURS

red

FREQUENCY ON 2 sq m

detail

zone UTM 33T

EAST 338393

NORTH 4801991

m.a.s.l. 444

limestone outcrop

scaglia bianca

Cretaceous

PGR04

FLAKING ATTITUDE
PRIMARY OUTCROP

none

FLAKING ATTITUDE (%)
SECONDARY OUTCROP

none

microbladelets

large bladelets

blades

large blades

FLINT DOMINANT COLOURS

black

FREQUENCY ON 2 sq m

detail

zone UTM 33T

EAST 338752

NORTH 4802903

m.a.s.l. 656

limestone outcrop

maiolica

Jurassic-Cretaceous

FLAKING ATTITUDE
PRIMARY OUTCROP

none

FLAKING ATTITUDE (%)
SECONDARY OUTCROP

none

microbladelets

large bladelets

blades

large blades

FLINT DOMINANT COLOURS

grey

FREQUENCY ON 2 sq m

PGR05

detail

zone UTM 33T

EAST 340051

NORTH 4803419

m.a.s.l. 915

loose deposit

slope debris

FLAKING ATTITUDE
PRIMARY OUTCROP

FLAKING ATTITUDE (%)
SECONDARY OUTCROP

none

microbladelets

100

large bladelets

blades

large blades

FLINT DOMINANT COLOURS

grey

FREQUENCY ON 2 sq m

9

PGR06

detail

zone UTM 33T

EAST 337559

NORTH 4810015

m.a.s.l. 222

limestone outcrop

corniola

Jurassic

FLAKING ATTITUDE
PRIMARY OUTCROP

large blades

FLAKING ATTITUDE (%)
SECONDARY OUTCROP

none

microbladelets

large bladelets

blades

large blades

FLINT DOMINANT COLOURS

grey

FREQUENCY ON 2 sq m

zone UTM 33T

EAST 337173

NORTH 4804000

m.a.s.l. 229

limestone outcrop

scaglia rossa

Cretaceous-Eocene

FLAKING ATTITUDE
PRIMARY OUTCROP

micro bladelets

FLAKING ATTITUDE (%)
SECONDARY OUTCROP

none

microbladelets

large bladelets

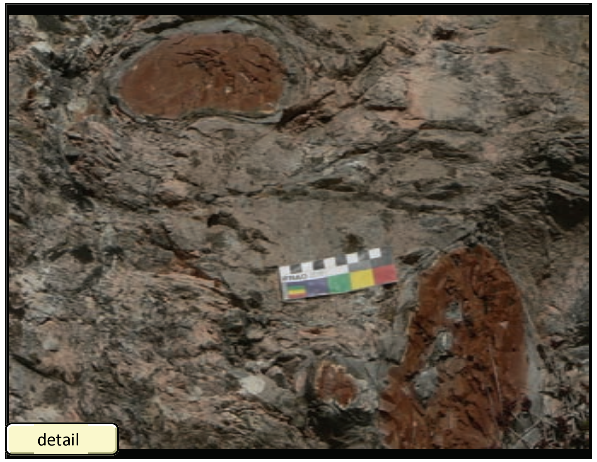
blades

large blades

FLINT DOMINANT COLOURS

red

FREQUENCY ON 2 sq m



zone UTM 33T

EAST	336885
NORTH	4804131
m.a.s.l.	212

loose deposit

current stream bed

FLAKING ATTITUDE
PRIMARY OUTCROP

FLAKING ATTITUDE (%)
SECONDARY OUTCROP

none	90
microbladelets	10
large bladelets	
blades	
large blades	

FLINT DOMINANT COLOURS

red, grey

FREQUENCY ON 2 sq m

6

PGR09

detail

zone UTM 33T

EAST	336571
NORTH	4805621
m.a.s.l.	234

limestone outcrop

scaglia rossa

Cretaceous-Eocene

FLAKING ATTITUDE
PRIMARY OUTCROP

blades

FLAKING ATTITUDE (%)
SECONDARY OUTCROP

none	
microbladelets	
large bladelets	
blades	
large blades	

FLINT DOMINANT COLOURS

red

FREQUENCY ON 2 sq m

PGR10

detail

PGR11

zone UTM 33T

EAST	336073
NORTH	4806853
m.a.s.l.	188

limestone outcrop
scaglia rossa
Cretaceous-Eocene

FLAKING ATTITUDE
PRIMARY OUTCROP

none

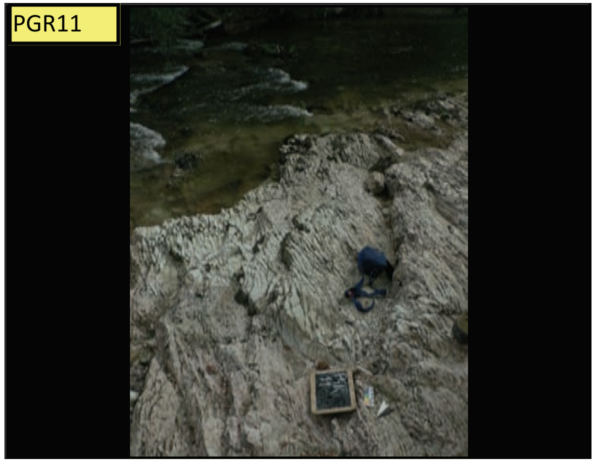
FLAKING ATTITUDE (%)
SECONDARY OUTCROP

none	
microbladelets	
large bladelets	
blades	
large blades	

FLINT DOMINANT COLOURS

red

FREQUENCY ON 2 sq m



detail

PGR14

zone UTM 33T

EAST	340760
NORTH	4810925
m.a.s.l.	180

loose deposit

alluvial deposit

FLAKING ATTITUDE
PRIMARY OUTCROP

FLAKING ATTITUDE (%)
SECONDARY OUTCROP

none	
microbladelets	50
large bladelets	
blades	
large blades	50

FLINT DOMINANT COLOURS

black

FREQUENCY ON 2 sq m

2

detail

zone UTM 33T

EAST	340760
NORTH	4810863
m.a.s.l.	182

loose deposit

alluvial deposit

FLAKING ATTITUDE PRIMARY OUTCROP

FLAKING ATTITUDE (%) SECONDARY OUTCROP

none	
microbladelets	70
large bladelets	30
blades	
large blades	

FLINT DOMINANT COLOURS

black, red

FREQUENCY ON 2 sq m

3

PGR16

detail

zone UTM 33T

EAST	340634
NORTH	4811216
m.a.s.l.	167

loose deposit

current soil

FLAKING ATTITUDE PRIMARY OUTCROP

FLAKING ATTITUDE (%) SECONDARY OUTCROP

none	
microbladelets	
large bladelets	50
blades	50
large blades	

FLINT DOMINANT COLOURS

black, red

FREQUENCY ON 2 sq m

4

PGR17

detail

PGR18

zone UTM 33T

EAST 339399

NORTH 4810390

m.a.s.l. 148

loose deposit

current stream bed

FLAKING ATTITUDE
PRIMARY OUTCROP

FLAKING ATTITUDE (%)
SECONDARY OUTCROP

none	80
microbladelets	10
large bladelets	
blades	10
large blades	

FLINT DOMINANT COLOURS

black, red

FREQUENCY ON 2 sq m

9

detail

PGR19

zone UTM 33T

EAST 339388

NORTH 4810352

m.a.s.l. 153

limestone outcrop

maiolica

Jurassic

FLAKING ATTITUDE
PRIMARY OUTCROP

micro bladelets

FLAKING ATTITUDE (%)
SECONDARY OUTCROP

none	
microbladelets	
large bladelets	
blades	
large blades	

FLINT DOMINANT COLOURS

grey

FREQUENCY ON 2 sq m

detail

PGR20

zone UTM 33T

EAST 339644

NORTH 4809932

m.a.s.l. 158

limestone outcrop

maiolica

Jurassic-Cretaceous

FLAKING ATTITUDE PRIMARY OUTCROP

blades

FLAKING ATTITUDE (%) SECONDARY OUTCROP

none

microbladelets

large bladelets

blades

large blades

FLINT DOMINANT COLOURS

grey

FREQUENCY ON 2 sq m

detail

PGR21

zone UTM 33T

EAST 336883

NORTH 4805383

m.a.s.l. 286

loose deposit

slope debris

FLAKING ATTITUDE PRIMARY OUTCROP

FLAKING ATTITUDE (%) SECONDARY OUTCROP

none

microbladelets

40

large bladelets

20

blades

20

large blades

20

FLINT DOMINANT COLOURS

grey

FREQUENCY ON 2 sq m

3

detail

PGR22

zone UTM 33T

EAST 336885

NORTH 4805397

m.a.s.l. 284

limestone outcrop

scaglia bianca

Cretaceous

FLAKING ATTITUDE PRIMARY OUTCROP

none

FLAKING ATTITUDE (%) SECONDARY OUTCROP

none:

microbladelets:

large bladelets:

blades:

large blades:

FLINT DOMINANT COLOURS

black

FREQUENCY ON 2 sq m

detail

PGR23

zone UTM 33T

EAST 337123

NORTH 4806451

m.a.s.l. 424

limestone outcrop

maiolica

Jurassic-Cretaceous

FLAKING ATTITUDE PRIMARY OUTCROP

none

FLAKING ATTITUDE (%) SECONDARY OUTCROP

none:

microbladelets:

large bladelets:

blades:

large blades:

FLINT DOMINANT COLOURS

grey

FREQUENCY ON 2 sq m

detail

zone UTM 33T

EAST 337365

NORTH 4807148

m.a.s.l. 485

limestone outcrop

calcari diasprigni umbro-

Jurassic

FLAKING ATTITUDE PRIMARY OUTCROP

micro bladelets

FLAKING ATTITUDE (%) SECONDARY OUTCROP

none

microbladelets

large bladelets

blades

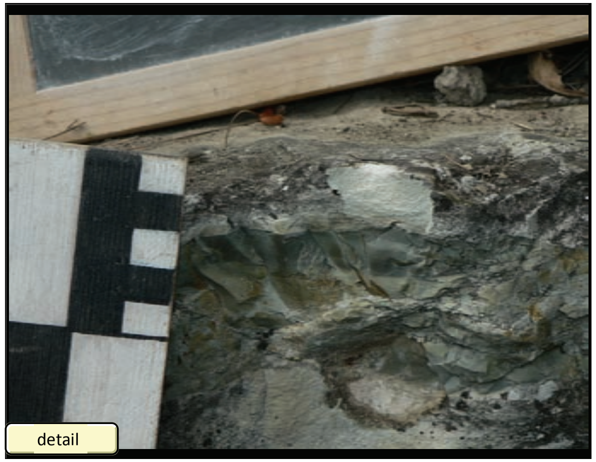
large blades

FLINT DOMINANT COLOURS

green

FREQUENCY ON 2 sq m

PGR24



detail

zone UTM 33T

EAST 335471

NORTH 4810371

m.a.s.l. 512

limestone outcrop

scaglia rossa

Cretaceous-Eocene

FLAKING ATTITUDE PRIMARY OUTCROP

none

FLAKING ATTITUDE (%) SECONDARY OUTCROP

none

microbladelets

large bladelets

blades

large blades

FLINT DOMINANT COLOURS

red

FREQUENCY ON 2 sq m

PGR25

detail

PGR26

zone UTM 33T

EAST	336048
NORTH	4811154
m.a.s.l.	635

limestone outcrop

maiolica

Jurassic-Cretaceous

FLAKING ATTITUDE
PRIMARY OUTCROP

large blades

FLAKING ATTITUDE (%)
SECONDARY OUTCROP

none

microbladelets

large bladelets

blades

large blades

FLINT DOMINANT COLOURS

grey

FREQUENCY ON 2 sq m

detail

PGR27

zone UTM 33T

EAST	336098
NORTH	4811304
m.a.s.l.	630

limestone outcrop

maiolica

Jurassic-Cretaceous

FLAKING ATTITUDE
PRIMARY OUTCROP

none

FLAKING ATTITUDE (%)
SECONDARY OUTCROP

none

microbladelets

large bladelets

blades

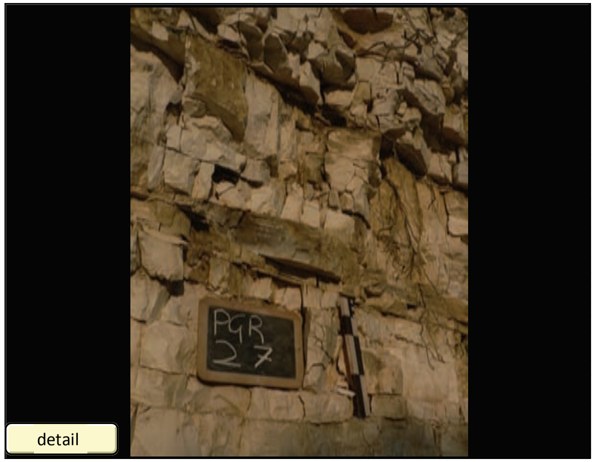
large blades

FLINT DOMINANT COLOURS

grey

FREQUENCY ON 2 sq m

detail



zone UTM 33T

EAST	339007
NORTH	4812922
m.a.s.l.	395

limestone outcrop

scaglia variegata

Eocene

FLAKING ATTITUDE
PRIMARY OUTCROP

large blades

FLAKING ATTITUDE (%)
SECONDARY OUTCROP

none

microbladelets

large bladelets

blades

large blades

FLINT DOMINANT COLOURS

black

FREQUENCY ON 2 sq m

PGR28

detail

zone UTM 33T

EAST	337366
NORTH	4801416
m.a.s.l.	240

limestone outcrop

scaglia rossa

Cretaceous-Eocene

FLAKING ATTITUDE
PRIMARY OUTCROP

none

FLAKING ATTITUDE (%)
SECONDARY OUTCROP

none

microbladelets

large bladelets

blades

large blades

FLINT DOMINANT COLOURS

red

FREQUENCY ON 2 sq m

PGR29

detail

PGR30

zone UTM 33T

EAST	337405
NORTH	4802549
m.a.s.l.	243

loose deposit

alluvial deposit

FLAKING ATTITUDE
PRIMARY OUTCROP

FLAKING ATTITUDE (%)
SECONDARY OUTCROP

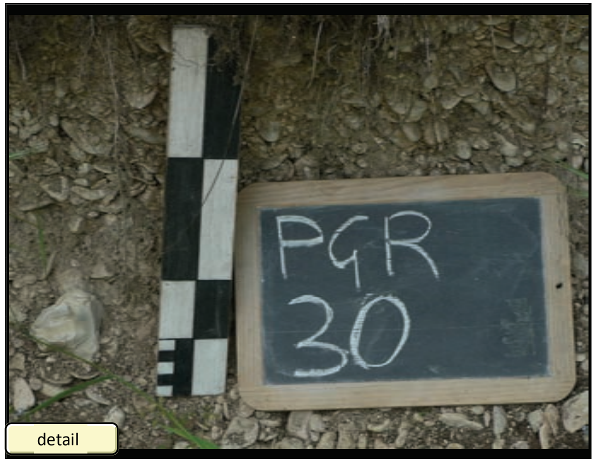
none	
microbladelets	
large bladelets	100
blades	
large blades	

FLINT DOMINANT COLOURS

grey

FREQUENCY ON 2 sq m

1



detail

PGR31

zone UTM 33T

EAST	336468
NORTH	4803713
m.a.s.l.	500

loose deposit

current soil

FLAKING ATTITUDE
PRIMARY OUTCROP

FLAKING ATTITUDE (%)
SECONDARY OUTCROP

none	40
microbladelets	
large bladelets	70
blades	
large blades	

FLINT DOMINANT COLOURS

green, red

FREQUENCY ON 2 sq m

4

detail

zone UTM 33T

EAST	336306
NORTH	4804061
m.a.s.l.	436

limestone outcrop

maiolica

Jurassic-Cretaceous

FLAKING ATTITUDE
PRIMARY OUTCROP

micro bladelets

FLAKING ATTITUDE (%)
SECONDARY OUTCROP

none

microbladelets

large bladelets

blades

large blades

FLINT DOMINANT COLOURS

grey

FREQUENCY ON 2 sq m

zone UTM 33T

EAST	334249
NORTH	4811610
m.a.s.l.	291

loose deposit

slope debris

FLAKING ATTITUDE
PRIMARY OUTCROP

FLAKING ATTITUDE (%)
SECONDARY OUTCROP

none

100

microbladelets

large bladelets

blades

large blades

FLINT DOMINANT COLOURS

grey, red

FREQUENCY ON 2 sq m

3

PGR34

zone UTM 33T

EAST 334026
NORTH 4812739
m.a.s.l. 339

loose deposit

current soil

FLAKING ATTITUDE
PRIMARY OUTCROP

FLAKING ATTITUDE (%)
SECONDARY OUTCROP

none: 20
microbladelets: 60
large bladelets: 20
blades:
large blades:

FLINT DOMINANT COLOURS: grey, red

FREQUENCY ON 2 sq m: 5

detail

PGR35

zone UTM 33T

EAST 332968
NORTH 4810478
m.a.s.l. 288

limestone outcrop
scaglia rossa
Cretaceous-Eocene

FLAKING ATTITUDE
PRIMARY OUTCROP: micro bladelets

FLAKING ATTITUDE (%)
SECONDARY OUTCROP

none:
microbladelets:
large bladelets:
blades:
large blades:

FLINT DOMINANT COLOURS: red

FREQUENCY ON 2 sq m:

detail

PGR36

zone UTM 33T

EAST	332856
NORTH	4808202
m.a.s.l.	252

loose deposit

current stream bed

FLAKING ATTITUDE
PRIMARY OUTCROP

FLAKING ATTITUDE (%)
SECONDARY OUTCROP

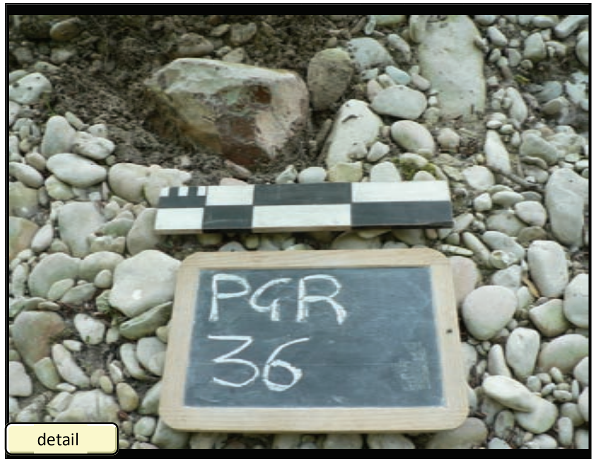
none	
microbladelets	
large bladelets	
blades	
large blades	100

FLINT DOMINANT COLOURS

green, red

FREQUENCY ON 2 sq m

3



detail

PGR37

zone UTM 33T

EAST	334015
NORTH	4805904
m.a.s.l.	657

limestone outcrop

scaglia rossa

Cretaceous-Eocene

FLAKING ATTITUDE
PRIMARY OUTCROP

none

FLAKING ATTITUDE (%)
SECONDARY OUTCROP

none	
microbladelets	
large bladelets	
blades	
large blades	

FLINT DOMINANT COLOURS

red

FREQUENCY ON 2 sq m

detail

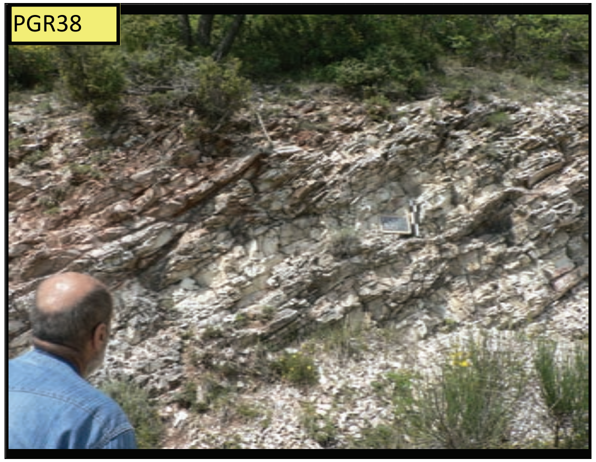
PGR38

zone UTM 33T	
EAST	333979
NORTH	4805893
m.a.s.l.	652

limestone outcrop

scaglia rossa

Cretaceous-Eocene



FLAKING ATTITUDE PRIMARY OUTCROP

micro bladelets

FLAKING ATTITUDE (%) SECONDARY OUTCROP

none	
microbladelets	
large bladelets	
blades	
large blades	

FLINT DOMINANT COLOURS

red

FREQUENCY ON 2 sq m

detail

PGR39

zone UTM 33T	
EAST	333978
NORTH	4805903
m.a.s.l.	650

limestone outcrop

scaglia bianca

Cretaceous

FLAKING ATTITUDE PRIMARY OUTCROP

none

FLAKING ATTITUDE (%) SECONDARY OUTCROP

none	
microbladelets	
large bladelets	
blades	
large blades	

FLINT DOMINANT COLOURS

black

FREQUENCY ON 2 sq m

detail

PGR40

zone UTM 33T

EAST 334250

NORTH 4806607

m.a.s.l. 676

limestone outcrop

maiolica

Jurassic-Cretaceous

FLAKING ATTITUDE
PRIMARY OUTCROP

large blades

FLAKING ATTITUDE (%)
SECONDARY OUTCROP

none

microbladelets

large bladelets

blades

large blades

FLINT DOMINANT COLOURS

grey

FREQUENCY ON 2 sq m

detail

PGR41

zone UTM 33T

EAST 334558

NORTH 4806809

m.a.s.l. 697

limestone outcrop

maiolica

Jurassic-Cretaceous

FLAKING ATTITUDE
PRIMARY OUTCROP

large blades

FLAKING ATTITUDE (%)
SECONDARY OUTCROP

none

microbladelets

large bladelets

blades

large blades

FLINT DOMINANT COLOURS

grey

FREQUENCY ON 2 sq m

detail

PGR42

zone UTM 33T

EAST	334685
NORTH	4807054
m.a.s.l.	719

loose deposit

current soil

FLAKING ATTITUDE PRIMARY OUTCROP

FLAKING ATTITUDE (%) SECONDARY OUTCROP

none	
microbladelets	
large bladelets	90
blades	10
large blades	

FLINT DOMINANT COLOURS: grey

FREQUENCY ON 2 sq m: 42

detail

PGR43

zone UTM 33T

EAST	333712
NORTH	4808770
m.a.s.l.	542

limestone outcrop

scaglia rossa

Cretaceous-Eocene

FLAKING ATTITUDE PRIMARY OUTCROP: none

FLAKING ATTITUDE (%) SECONDARY OUTCROP

none	
microbladelets	
large bladelets	
blades	
large blades	

FLINT DOMINANT COLOURS: red

FREQUENCY ON 2 sq m:

detail

PGR44

zone UTM 33T

EAST 338352

NORTH 4810256

m.a.s.l. 203

loose deposit

current stream bed

FLAKING ATTITUDE
PRIMARY OUTCROP

FLAKING ATTITUDE (%)
SECONDARY OUTCROP

none	70
microbladelets	
large bladelets	
blades	30
large blades	

FLINT DOMINANT COLOURS

red

FREQUENCY ON 2 sq m

3

detail

PGR45

zone UTM 33T

EAST 333584

NORTH 4807916

m.a.s.l. 225

loose deposit

current stream bed

FLAKING ATTITUDE
PRIMARY OUTCROP

FLAKING ATTITUDE (%)
SECONDARY OUTCROP

none	40
microbladelets	40
large bladelets	
blades	20
large blades	

FLINT DOMINANT COLOURS

black, red, grey

FREQUENCY ON 2 sq m

8

detail

zone UTM 33T

EAST	333323
NORTH	4807718
m.a.s.l.	210

loose deposit

current soil

FLAKING ATTITUDE
PRIMARY OUTCROP

FLAKING ATTITUDE (%)
SECONDARY OUTCROP

none	100
microbladelets	
large bladelets	
blades	
large blades	

FLINT DOMINANT COLOURS

green

FREQUENCY ON 2 sq m

1

PGR46

detail

zone UTM 33T

EAST	333278
NORTH	4807695
m.a.s.l.	239

loose deposit

current soil

FLAKING ATTITUDE
PRIMARY OUTCROP

FLAKING ATTITUDE (%)
SECONDARY OUTCROP

none	
microbladelets	10
large bladelets	60
blades	30
large blades	

FLINT DOMINANT COLOURS

green, grey, red

FREQUENCY ON 2 sq m

5

PGR47

detail

zone UTM 33T

EAST 333430

NORTH 4807734

m.a.s.l. 282

limestone outcrop

maiolica

Jurassic-Cretaceous

FLAKING ATTITUDE
PRIMARY OUTCROP

blades

FLAKING ATTITUDE (%)
SECONDARY OUTCROP

none

microbladelets

large bladelets

blades

large blades

FLINT DOMINANT COLOURS

grey

FREQUENCY ON 2 sq m

PGR48

detail

zone UTM 33T

EAST 337473

NORTH 4803392

m.a.s.l. 228

limestone outcrop

scaglia rossa

Cretaceous-Eocene

FLAKING ATTITUDE
PRIMARY OUTCROP

none

FLAKING ATTITUDE (%)
SECONDARY OUTCROP

none

microbladelets

large bladelets

blades

large blades

FLINT DOMINANT COLOURS

red

FREQUENCY ON 2 sq m

PGR49

detail

zone UTM 33T

EAST	337500
NORTH	4806817
m.a.s.l.	509

limestone outcrop

maiolica

Jurassic-Cretaceous

FLAKING ATTITUDE
PRIMARY OUTCROP

none

FLAKING ATTITUDE (%)
SECONDARY OUTCROP

none

microbladelets

large bladelets

blades

large blades

FLINT DOMINANT COLOURS

grey

FREQUENCY ON 2 sq m

zone UTM 33T

EAST	339211
NORTH	4807750
m.a.s.l.	505

limestone outcrop

scaglia rossa

Cretaceous-Eocene

FLAKING ATTITUDE
PRIMARY OUTCROP

blades

FLAKING ATTITUDE (%)
SECONDARY OUTCROP

none

microbladelets

large bladelets

blades

large blades

FLINT DOMINANT COLOURS

red

FREQUENCY ON 2 sq m

PGR52

zone UTM 33T

EAST	340746
NORTH	4808132
m.a.s.l.	502

loose deposit

current soil

FLAKING ATTITUDE
PRIMARY OUTCROP

FLAKING ATTITUDE (%)
SECONDARY OUTCROP

none	
microbladelets	70
large bladelets	
blades	30
large blades	

FLINT DOMINANT COLOURS: grey, red

FREQUENCY ON 2 sq m: 3

detail

PGR53

zone UTM 33T

EAST	333524
NORTH	4812737
m.a.s.l.	374

limestone outcrop

scaglia variegata

Eocene

FLAKING ATTITUDE
PRIMARY OUTCROP

none

FLAKING ATTITUDE (%)
SECONDARY OUTCROP

none	
microbladelets	
large bladelets	
blades	
large blades	

FLINT DOMINANT COLOURS: red

FREQUENCY ON 2 sq m:

detail

PGR54

zone UTM 33T

EAST	333787
NORTH	4813369
m.a.s.l.	424

loose deposit

slope debris

FLAKING ATTITUDE PRIMARY OUTCROP

FLAKING ATTITUDE (%) SECONDARY OUTCROP

none	100
microbladelets	
large bladelets	
blades	
large blades	

FLINT DOMINANT COLOURS: red

FREQUENCY ON 2 sq m: 2

detail

PGR55

zone UTM 33T

EAST	334445
NORTH	4814303
m.a.s.l.	499

limestone outcrop

scaglia variegata

Eocene

FLAKING ATTITUDE PRIMARY OUTCROP: none

FLAKING ATTITUDE (%) SECONDARY OUTCROP

none	
microbladelets	
large bladelets	
blades	
large blades	

FLINT DOMINANT COLOURS: red

FREQUENCY ON 2 sq m

detail

zone UTM 33T

EAST	334477
NORTH	4814318
m.a.s.l.	502

limestone outcrop

scaglia rossa

Cretaceous-Eocene

FLAKING ATTITUDE
PRIMARY OUTCROP

large blades

FLAKING ATTITUDE (%)
SECONDARY OUTCROP

none

microbladelets

large bladelets

blades

large blades

FLINT DOMINANT COLOURS

red

FREQUENCY ON 2 sq m

PGR56

detail

zone UTM 33T

EAST	334498
NORTH	4814352
m.a.s.l.	508

limestone outcrop

scaglia rossa

Eocene

FLAKING ATTITUDE
PRIMARY OUTCROP

blades

FLAKING ATTITUDE (%)
SECONDARY OUTCROP

none

microbladelets

large bladelets

blades

large blades

FLINT DOMINANT COLOURS

red

FREQUENCY ON 2 sq m

PGR57

detail

zone UTM 33T

EAST	334932
NORTH	4813788
m.a.s.l.	573

limestone outcrop

scaglia rossa

Cretaceous-Eocene

FLAKING ATTITUDE PRIMARY OUTCROP

none

FLAKING ATTITUDE (%) SECONDARY OUTCROP

none

microbladelets

large bladelets

blades

large blades

FLINT DOMINANT COLOURS

red

FREQUENCY ON 2 sq m

PGR58

detail

zone UTM 33T

EAST	335531
NORTH	4813963
m.a.s.l.	570

limestone outcrop

scaglia bianca

Cretaceous

FLAKING ATTITUDE PRIMARY OUTCROP

none

FLAKING ATTITUDE (%) SECONDARY OUTCROP

none

microbladelets

large bladelets

blades

large blades

FLINT DOMINANT COLOURS

black

FREQUENCY ON 2 sq m

PGR59

detail

PGR60

zone UTM 33T

EAST	335622
NORTH	4814008
m.a.s.l.	561

limestone outcrop

marne a fucoidi

Cretaceous

FLAKING ATTITUDE
PRIMARY OUTCROP

bladelets and large

FLAKING ATTITUDE (%)
SECONDARY OUTCROP

none

microbladelets

large bladelets

blades

large blades

FLINT DOMINANT COLOURS

red

FREQUENCY ON 2 sq m

detail

PGR61

zone UTM 33T

EAST	337791
NORTH	4815006
m.a.s.l.	397

limestone outcrop

scaglia variegata

Eocene

FLAKING ATTITUDE
PRIMARY OUTCROP

large blades

FLAKING ATTITUDE (%)
SECONDARY OUTCROP

none

microbladelets

large bladelets

blades

large blades

FLINT DOMINANT COLOURS

black

FREQUENCY ON 2 sq m

detail

zone UTM 33T

EAST 337789

NORTH 4814805

m.a.s.l. 405

limestone outcrop

scaglia variegata

Eocene

FLAKING ATTITUDE
PRIMARY OUTCROP

large blades

FLAKING ATTITUDE (%)
SECONDARY OUTCROP

none

microbladelets

large bladelets

blades

large blades

FLINT DOMINANT COLOURS

black

FREQUENCY ON 2 sq m

zone UTM 33T

EAST 332957

NORTH 4807625

m.a.s.l. 232

loose deposit

current soil

FLAKING ATTITUDE
PRIMARY OUTCROP

FLAKING ATTITUDE (%)
SECONDARY OUTCROP

none

microbladelets

100

large bladelets

blades

large blades

FLINT DOMINANT COLOURS

red

FREQUENCY ON 2 sq m

1

PGR65

zone UTM 33T

EAST	333425
NORTH	4807602
m.a.s.l.	326

loose deposit

slope debris

FLAKING ATTITUDE
PRIMARY OUTCROP

FLAKING ATTITUDE (%)
SECONDARY OUTCROP

none	
microbladelets	
large bladelets	100
blades	
large blades	

FLINT DOMINANT COLOURS

grey

FREQUENCY ON 2 sq m

1

detail

PGR66

zone UTM 33T

EAST	333404
NORTH	4807542
m.a.s.l.	324

loose deposit

slope debris

FLAKING ATTITUDE
PRIMARY OUTCROP

FLAKING ATTITUDE (%)
SECONDARY OUTCROP

none	
microbladelets	100
large bladelets	
blades	
large blades	

FLINT DOMINANT COLOURS

grey, red

FREQUENCY ON 2 sq m

3

detail

zone UTM 33T

EAST 333683

NORTH 4807259

m.a.s.l. 465

loose deposit

slope debris

FLAKING ATTITUDE
PRIMARY OUTCROP

FLAKING ATTITUDE (%)
SECONDARY OUTCROP

none

microbladelets

large bladelets

30

blades

70

large blades

FLINT DOMINANT COLOURS

green

FREQUENCY ON 2 sq m

3

PGR68

zone UTM 33T

EAST 333517

NORTH 4806723

m.a.s.l. 605

loose deposit

current soil

FLAKING ATTITUDE
PRIMARY OUTCROP

FLAKING ATTITUDE (%)
SECONDARY OUTCROP

none

microbladelets

large bladelets

blades

large blades

100

FLINT DOMINANT COLOURS

grey

FREQUENCY ON 2 sq m

1

PGR69

PGR70

zone UTM 33T

EAST	339141
NORTH	4810506
m.a.s.l.	183

loose deposit

current stream bed

FLAKING ATTITUDE
PRIMARY OUTCROP

FLAKING ATTITUDE (%)
SECONDARY OUTCROP

none	
microbladelets	
large bladelets	100
blades	
large blades	

FLINT DOMINANT COLOURS

grey, red

FREQUENCY ON 2 sq m

3

detail

PGR71

zone UTM 33T

EAST	330009
NORTH	4812679
m.a.s.l.	350

loose deposit

current soil

FLAKING ATTITUDE
PRIMARY OUTCROP

FLAKING ATTITUDE (%)
SECONDARY OUTCROP

none	
microbladelets	
large bladelets	70
blades	30
large blades	

FLINT DOMINANT COLOURS

red

FREQUENCY ON 2 sq m

10

detail

PGR72

zone UTM 33T

EAST 340474

NORTH 4811104

m.a.s.l. 196

limestone outcrop

scaglia variegata

Eocene

FLAKING ATTITUDE
PRIMARY OUTCROP

large bladelets

FLAKING ATTITUDE (%)
SECONDARY OUTCROP

none

microbladelets

large bladelets

blades

large blades

FLINT DOMINANT COLOURS

black

FREQUENCY ON 2 sq m

detail

PGR73

zone UTM 33T

EAST 340255

NORTH 4810588

m.a.s.l. 319

limestone outcrop

scaglia rossa

Cretaceous-Eocene

FLAKING ATTITUDE
PRIMARY OUTCROP

large bladelets

FLAKING ATTITUDE (%)
SECONDARY OUTCROP

none

microbladelets

large bladelets

blades

large blades

FLINT DOMINANT COLOURS

red

FREQUENCY ON 2 sq m

detail

zone UTM 33T

EAST 337090

NORTH 4810242

m.a.s.l. 307

loose deposit

slope debris

FLAKING ATTITUDE
PRIMARY OUTCROP

FLAKING ATTITUDE (%)
SECONDARY OUTCROP

none

microbladelets: 100

large bladelets

blades

large blades

FLINT DOMINANT COLOURS: grey

FREQUENCY ON 2 sq m: 2

PGR74

zone UTM 33T

EAST 337210

NORTH 4810486

m.a.s.l. 337

loose deposit

slope debris

FLAKING ATTITUDE
PRIMARY OUTCROP

FLAKING ATTITUDE (%)
SECONDARY OUTCROP

none

microbladelets

large bladelets: 100

blades

large blades

FLINT DOMINANT COLOURS: grey

FREQUENCY ON 2 sq m: 1

PGR75

zone UTM 33T

EAST 336775

NORTH 4810955

m.a.s.l. 570

loose deposit

slope debris

FLAKING ATTITUDE
PRIMARY OUTCROP

FLAKING ATTITUDE (%)
SECONDARY OUTCROP

none

microbladelets

large bladelets

60

blades

40

large blades

FLINT DOMINANT COLOURS

grey

FREQUENCY ON 2 sq m

4

PGR76

detail

zone UTM 33T

EAST 336586

NORTH 4811040

m.a.s.l. 595

loose deposit

slope debris

FLAKING ATTITUDE
PRIMARY OUTCROP

FLAKING ATTITUDE (%)
SECONDARY OUTCROP

none

microbladelets

large bladelets

100

blades

large blades

FLINT DOMINANT COLOURS

grey

FREQUENCY ON 2 sq m

2

PGR77

detail

PGR78

zone UTM 33T

EAST	336602
NORTH	4810562
m.a.s.l.	515

loose deposit

slope debris

FLAKING ATTITUDE
PRIMARY OUTCROP

FLAKING ATTITUDE (%)
SECONDARY OUTCROP

none	
microbladelets	
large bladelets	100
blades	
large blades	

FLINT DOMINANT COLOURS

grey

FREQUENCY ON 2 sq m

1

detail

PGR79

zone UTM 33T

EAST	336772
NORTH	4810445
m.a.s.l.	389

loose deposit

slope debris

FLAKING ATTITUDE
PRIMARY OUTCROP

FLAKING ATTITUDE (%)
SECONDARY OUTCROP

none	100
microbladelets	
large bladelets	
blades	
large blades	

FLINT DOMINANT COLOURS

green

FREQUENCY ON 2 sq m

1

detail

PGR80

zone UTM 33T

EAST 337036

NORTH 4809979

m.a.s.l. 374

limestone outcrop

calcari diasprigni umbro-

Jurassic

FLAKING ATTITUDE
PRIMARY OUTCROP

micro bladelets

FLAKING ATTITUDE (%)
SECONDARY OUTCROP

none

microbladelets

large bladelets

blades

large blades

FLINT DOMINANT COLOURS

green

FREQUENCY ON 2 sq m

detail

PGR81

zone UTM 33T

EAST 338066

NORTH 4809564

m.a.s.l. 228

loose deposit

slope debris

FLAKING ATTITUDE
PRIMARY OUTCROP

FLAKING ATTITUDE (%)
SECONDARY OUTCROP

none

microbladelets

large bladelets

blades

large blades

100

FLINT DOMINANT COLOURS

grey

FREQUENCY ON 2 sq m

1

detail

PGR82

zone UTM 33T

EAST 338754

NORTH 4809643

m.a.s.l. 496

loose deposit

current soil

FLAKING ATTITUDE
PRIMARY OUTCROP

FLAKING ATTITUDE (%)
SECONDARY OUTCROP

none: 100

microbladelets:

large bladelets:

blades:

large blades:

FLINT DOMINANT COLOURS: green

FREQUENCY ON 2 sq m: 1

detail

PGR83

zone UTM 33T

EAST 338623

NORTH 4809722

m.a.s.l. 450

limestone outcrop

bugarone

Jurassic

FLAKING ATTITUDE
PRIMARY OUTCROP: large bladelets

FLAKING ATTITUDE (%)
SECONDARY OUTCROP

none:

microbladelets:

large bladelets:

blades:

large blades:

FLINT DOMINANT COLOURS: grey

FREQUENCY ON 2 sq m:

detail

zone UTM 33T	
EAST	338548
NORTH	4809685
m.a.s.l.	431
	loose deposit
	slope debris
FLAKING ATTITUDE PRIMARY OUTCROP	
FLAKING ATTITUDE (%) SECONDARY OUTCROP none	
microbladelets	
large bladelets	100
blades	
large blades	
FLINT DOMINANT COLOURS	grey
FREQUENCY ON 2 sq m	1

PGR84

detail

zone UTM 33T	
EAST	337309
NORTH	4809458
m.a.s.l.	142
	loose deposit
	current stream bed
FLAKING ATTITUDE PRIMARY OUTCROP	
FLAKING ATTITUDE (%) SECONDARY OUTCROP none	50
microbladelets	
large bladelets	50
blades	
large blades	
FLINT DOMINANT COLOURS	grey, red
FREQUENCY ON 2 sq m	2

PGR85

detail

PGR86

zone UTM 33T

EAST	338434
NORTH	4810285
m.a.s.l.	164

loose deposit

current stream bed

FLAKING ATTITUDE PRIMARY OUTCROP

FLAKING ATTITUDE (%) SECONDARY OUTCROP

none	
microbladelets	40
large bladelets	40
blades	
large blades	20

FLINT DOMINANT COLOURS: black, red

FREQUENCY ON 2 sq m: 2

detail

PGR87

zone UTM 33T

EAST	332242
NORTH	4810956
m.a.s.l.	349

limestone outcrop

maiolica

Jurassic-Cretaceous

FLAKING ATTITUDE PRIMARY OUTCROP: large bladelets

FLAKING ATTITUDE (%) SECONDARY OUTCROP

none	
microbladelets	
large bladelets	
blades	
large blades	

FLINT DOMINANT COLOURS: grey

FREQUENCY ON 2 sq m:

detail

PGR88

zone UTM 33T

EAST	331807
NORTH	4810573
m.a.s.l.	297

loose deposit

slope debris

FLAKING ATTITUDE
PRIMARY OUTCROP

FLAKING ATTITUDE (%)
SECONDARY OUTCROP

none	10
microbladelets	30
large bladelets	60
blades	
large blades	

FLINT DOMINANT COLOURS

grey, red

FREQUENCY ON 2 sq m

22

detail

PGR89

zone UTM 33T

EAST	334611
NORTH	4806708
m.a.s.l.	740

limestone outcrop

bugarone

Jurassic

FLAKING ATTITUDE
PRIMARY OUTCROP

large blades

FLAKING ATTITUDE (%)
SECONDARY OUTCROP

none	
microbladelets	
large bladelets	
blades	
large blades	

FLINT DOMINANT COLOURS

grey

FREQUENCY ON 2 sq m

detail

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