

LOWER PALEOLITHIC INDUSTRY OF BRECHA DAS LASCAS, LEVEL 7 (PORTUGAL)

Victor P. Chabai*, Valéry I. Sitlivy**, Anthony E. Marks***

INTRODUCTION

Although Lower Paleolithic occupation of Portugal is well attested by numerous open-air sites (Freeman 1975, Raposo and Santonja 1995, Cunha-Ribeiro 1996), until very recently not a single cave occurrence with largely *in situ* materials had been documented. The discovery of largely intact Lower Paleolithic cave deposits resulted from a joint archaeological and spelunker effort to map the existing galleries in the faulted cliff face at Almonda, in central Portugal (fig. 1). This work took place over some years, with emphasis on existing cave galleries and the artifacts found on their surfaces (Zilhão, Maurico, and Souto 1993). This resulted in the discovery of the deeply stratified, collapsed but intact Middle Paleolithic cave of Gruta da Oliviera, as well as the Lower Paleolithic cave of Galeria Pesada (Marks, Monigal and Chabai 1999). Additionally, survey of the cliff face by J. Mauricio located two areas of surface materials that, technologically, might have been either Lower or Middle Paleolithic. One of these, the Brecha das Lascas, was tested in 1997 with additional limited excavations in 1998 through 2000. This preliminary paper describes the technological patterns of flake production found there.

Far from being a surface concentration, the Brecha das Lascas proved to be part of a sediment filled cave gallery that had been exposed by a back cutting of the cliff face. While excavations have been limited to fewer than 5 sq. m, they have provided both a clear profile of the gallery fill and a large sample of artifacts from the lowest geological layers (Photos 1, 2). As will be noted, these materials are not in primary context but it is likely that movement has been minimal and that the excavated materials belong to a single assemblage.

STRATIGRAPHY

The stratigraphy of the gallery consists of mainly eboulis in a matrix of sandy silt, but seven geological layers were noted. These are, as follows (fig. 2): 1) a heavily brecciated eboulis in a sandy matrix; 2) flowstone; 3) a light-

ly brecciated sandy fill with only small fragments of unweathered limestone; 4) a complex of laterally and vertically limited pockets of differentially dense eboulis in a silty matrix with differential degrees of cementation. (Some artifacts and faunal remains were recovered from sub-units 4b and 4d but the samples, as yet, are too small to characterize with confidence); 5) partly brecciated silt with variable amounts of eboulis; 6) moderately brecciated sandy/silt with eboulis and a good number of artifacts. (Sample is still somewhat small for publication but additional excavations are planned to acquire more); and, 7) unbrecciated sandy/silt grading down to mainly sand. While eboulis is dense at the top of this layer, it becomes smaller and scarce in the lower part of the layer where there are large, heavily water worn limestone boulders. These, combined with the sandy fill between them, clearly represent the results of marked fluvial activity and, probably, the bottom of the gallery. This layer contains a large number of artifacts, mainly concentrated in the eboulis rich upper portion but many additional artifacts were recovered around the water worn boulders. These artifacts often were on edge and it is likely that they migrated downward into the loose sand from the concentration at the top of the layer.

In addition to the artifacts, a small sample of faunal material, including microfauna, was recovered. While these are still being studied, the presence of numerous bat remains from Level 7, confirms that the excavations are from a gallery, rather than a remnant rockshelter.

Preliminary ESR dating of *Equus* teeth from both a heavily brecciated, artifact and faunal rich sediment stratigraphically equivalent to Level 7 and from Level 4 directly above the materials described below indicate the youngest likely date (assuming an EU uptake model) is ca. 200,000BP but may be as old as ca. 280,000 BP (assuming a LU uptake model). Which is correct will be resolved soon (J. Rink and D. Richter, personal communication). In either case, it is certain that the Level 7 assemblage dates to the mid- to late Middle Pleistocene.

Given the sizable artifact sample recovered from Level 7, from only ca. 5.5 sq. m. of excavations, it was

* Crimean Branch of the Institute of Archaeology, Simferopol, Ukraine.

** Royal Museums of Art and History, Brussels, Belgium.

*** Southern Methodist University, Dallas, Texas, USA.

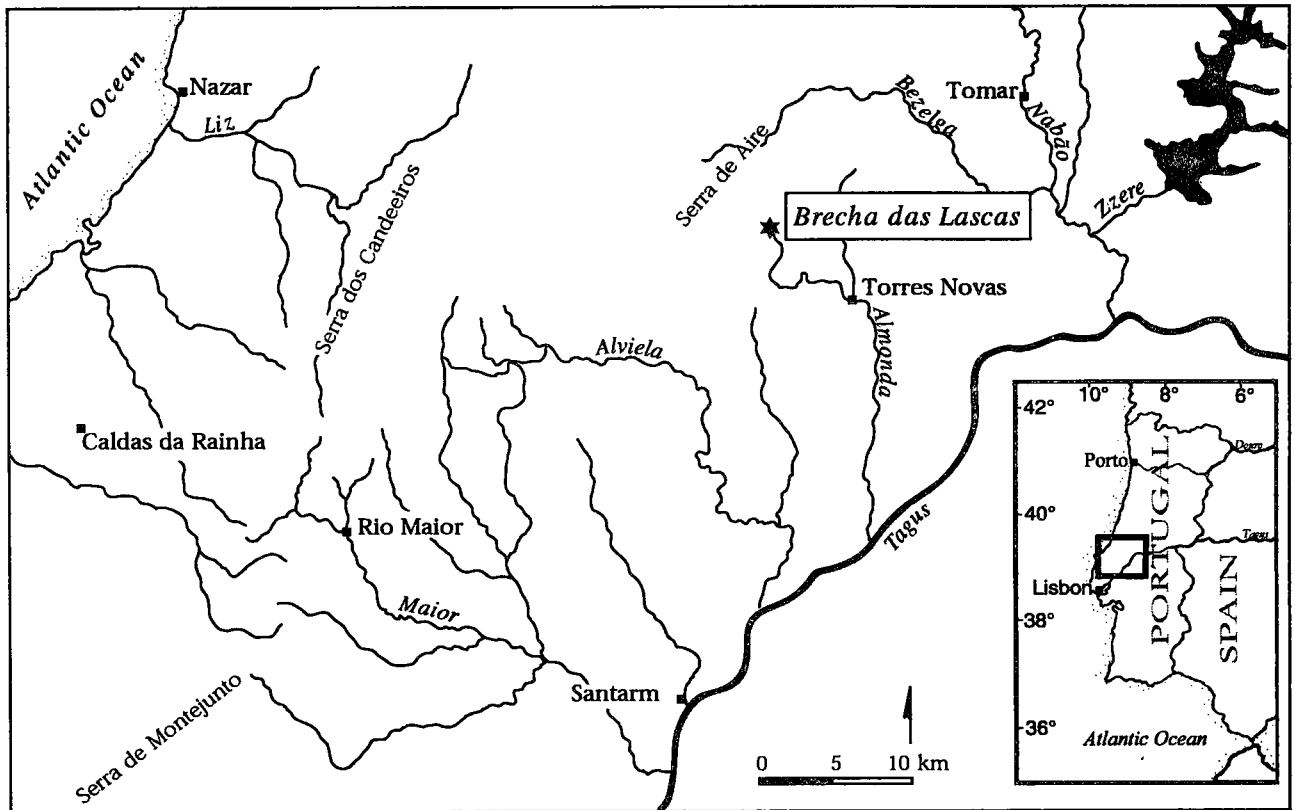


Figure 1 : Localisation of Brecha das Lascas site.

decided that a preliminary report was appropriate, since the material represents an, as yet, undescribed aspect of the Portuguese Lower Paleolithic: a locus of flake production.

Artifacts edges are mainly fresh, with few traces of natural damage. Only one handaxe on limestone was heavily abraded. Also, flint artifacts have a deep white patina and are strongly decalcified. The majority of artifacts, being made of either quartz or quartzite do not tend to exhibit chemical weathering under any conditions. Given the stratigraphic position of the artifacts, the fluvial sediment in which some occurred, the high density of artifact accumulation, the only moderate number of chips, and a number of artifacts on edge in the fluvial sediments, it is clear that this sample was not in primary context. Some movement is highly probable, as is some compaction. In spite of this (how many Lower Paleolithic sites are truly in primary context?), it appears that artifact movement was relatively limited and took place under rather low energy conditions, as testified by the pristine, undamaged edges of the vast majority of even the most delicate of artifacts.

ARTIFACTS

Artifact assemblage structure. The assemblage reported here was recovered from Level 7 of Squares I/K, rows 5 and 6, although in K6 the layer was largely eroded (fig. 3). While additional artifacts and the ESR dated tooth came from Square D6, these were not included, in order to limit, as much as possible, the possible effects of spatial dispersion. The following report is based on an assemblage of 736 artifacts (Table 1).

This assemblage is characterized by a striking predominance of debitage products. Combined, flakes, blades and chips account for 78.5 % of the total number of artifacts. Also, there are a significant number of cores, pre-forms, tested and unmodified raw material - 16.2 %. Thus, artifacts that are directly connected with intensive core reduction process comprise 94.7 % of total number of artifacts recovered. The tool-kit is proportionately limited: only slightly more than 4 % of the assemblage. In general, the composition of the artifacts displays a workshop character for the excavated area. The characteristic artifacts, such as the numerous unmodified voluminous cobbles of quartz and quartzite, the tested cobbles, the cores

in different stages of exploitation, the abandoned flakes, chips, and the paucity of bifacial shaping/retouching flakes, as well as of bifacial pre-forms, all point to an emphasis on the production of flakes through normal core reduction processes.

In spite of the presence of suitable raw material (cobble), there are no choppers or chopping tools. Heavy-duty (macro) artifacts are represented by numerous clear cores and a few handaxes.

Raw material. The raw materials used in Level 7 include quartzite, quartz, flint and limestone (Photo 3-12). The quartzite and quartz are present in the form of cobbles and large pebbles. Some were tested by single blows (Table 1). The dimensions of quartzite and quartz cobbles are: maximum 113 mm in diameter and 666.3g in weight; minimum 51 mm in diameter and weight 77 g in weight. The average diameter is 65.5 mm. The original shape of flint and limestone blocks cannot be discerned. Quartzite and quartz cobbles vary both in color and quality and were available on the plateau, immediately above the cave and, perhaps, even on the floor of the cave gallery. Presently known sources of flint are some 3 km from the cave to the northwest and some 10 km to the east. Limestone, of the quality permitting flaking, is present about 1 km north of the site.

On average, artifacts made on quartz and quartzite are present in similar frequencies (51.3% and 43.7% respectively), while artifacts made on flint and limestone are rare (3.3% and 1.4% respectively).

Cores

A total of 104 cores were found in Level 7, although only 44 were typologically classifiable. These cores include 23 on quartzite, 21 on quartz and 1 on limestone. Core dimensions can be summarized as follows :

Dimensions		maximum	minimum	average
Material	n	(l, w, th in mm)	(l, w, th in mm)	(l, w, th in mm)
quartzite	23	44, 76, 73	40, 50, 28	52, 52.9, 43.3
quartz	21	90, 74, 53	71, 22, 9	52.2, 45, 25.8
limestone	1			84.5, 79.6, 32.4

The identifiable cores were mainly on cobbles (41 pieces), with only 3 on flakes. All cores have been subdivided into two main groups: those with prepared platform (10 pieces) and those without prepared platform (31 pieces). The three multi-platform cores have both prepared and unprepared platforms. None of the cores shows any preliminary preparation of the flaking surface. They usually have a single flaking surface, or, more rarely, two flaking surfaces.

Quartzite cores. Cores with unprepared platform made on cobbles (13) predominate, while those with prepared platform are less numerous - 8 pieces. Among the unprepared platform cores, those with unidirectional (longitudinal and transversal) removals are most common (Table 2). There are a few examples of an extension of the flaking surface onto a lateral cobble side. Bidirectional, orthogonal and semi-discoidal cores occur in about the same proportions (Table 2). Semi-discoidal cores are

those with one sharply convex flaking surface and an opposed surface which is unprepared and covered by cortex. On the other hand, discoidal cores have two flaking surfaces on opposite sides of the cores. The characteristic feature of the Brecha das Lascas discoidal cores is the presence of cortex on a lateral side (Fig 7: 4, 6). Prepared platform cores are represented by about the same types and in about the same proportions.

Quartz cores. The characteristic features of this group include an abundance of semi-discoidal cores of different sizes (especially "micro" cores), a predominance of core fragments and a paucity of irregular cores (Table 2) (Fig.6:1-2). Cores made on quartz always have some cortex surface, even when the core has been extensively reduced. However, there is no clear impact of raw material constraints on core typology. Nearly all types of cores are equally represented on both quartz and quartzite.

Pre-forms

These are represented by one elongated piece on quartzite, shaped bilaterally, as well as on the base (>72, 44, 22). The distal end is broken. The dorsal surface retains cortex only along one lateral edge. The cross-section is triangular (Fig. 10: 1). This pre-form is morphologically similar to the "Barrenförmige Kerne" trifacial pieces and could have served as a pre-form for a bifacial tool and/or use as a core (Bosinski, Sytlivy 1990).

Debitage products

Flakes are most numerous - 49.7 %. Those on quartzite account for 63.3 %, those on quartz, 27.1 %, on flint, 6.4 %, and those on limestone, 3 %. Blades are obviously accidental, accounting for only 1.6 %. Chips are mainly represented by quartz (Table 1).

Quartzite flakes. The flakes with centripetal, unidirectional and crossed scars are the most representative (Table 3) (Fig. 4: 4-6; 8; 9). Also, among unidirectional, crossed, convergent and centripetal were found 9 débordant pieces. There are no Levallois flakes. Flakes are strikingly corticated, as only 27.3 % are without some cortex (Table 4). Cortex occurs most commonly on the proximal and proximal-lateral positions on the dorsal surface (Table 4). Also, a large number of flakes have cortex covered platforms (Table 5), although unfaceted platforms are important, as well. Faceted platforms are completely absent. Obtuse interior flaking angles dominate, with the majority ranging between 111° and 120° (Table 6). Medium-sized flakes (average dimensions 40.8, 38.4, 12.2) are the most common (Table 7). Large pieces are rare: their average dimensions are as follows: longitudinal type (108, 82, 22) and transversal (71, 103, 32). In sum, the Elongation Index (L/W% ratio) is 106.2 (Table 8), although flakes are rather massive, short, and often transversal (i.e. L<W), as indicated by the Mass Index (Th/L% ratio) of 29.9.

Quartz flakes. Flakes with unidirectional, centripetal and crossed scars dominate. (Table 3) (Fig.6 : 7, 9). Also, among those with unidirectional,

crossed scar patterns are two débordant pieces. There are no Levallois flakes. Flakes are usually partially covered by cortex; only 17.5% of flakes are without cortex (Table 4). At the same time, only 6.3% of flakes are completely corticated. As with the quartzite flakes, cortex is most often proximal end and proximal-lateral; together, they comprise more than half of the flakes (Table 4). More than two-thirds of the platforms are also cortical (more than on quartzite flakes) (Table 5). Plain platforms occur only one third as often. The remaining platform types are presented only by a few pieces each. Obtuse flaking angles prevail, with about one-third between 111° and 120° (Table 6). Medium-sized quartz flakes are rather small: average dimensions 32.5, 29.4, 11.5 (Table 6). Big pieces, again, are rare. Dimensions are as follows: length (90, 59, 19) and width (35, 61, 16). The Elongation Index (L/W% ratio) is 110.5 and the Mass Index (Th/L% ratio) is 35.3, indicating that quartz flakes are massive but not elongated (Table 8).

Flint flakes. There are only 21 flakes made on flint. About half have centripetal dorsal scars and lateral dorsal scars appear to be important (Fig. 11). Other types of dorsal scar patterns are represented by rare examples (Table 3). There are 4 débordant pieces (lateral, convergent, centripetal). There are no Levallois flakes or primary decortication flakes. Most flint flakes are without cortical (Table 4) but, when present is typically found on the proximal, distal-lateral, or lateral positions (Table 4). Two types of platform preparation dominate - plain and dihedral (Table 5). There are no faceted platforms. Obtuse interior flaking angles are common, but are slightly greater than for quartzite and quartz: about two-thirds are between 115° and 125°. Medium-sized flint flakes are quite similar in size to those on quartzite: average dimensions are: length, 40.1mm, width, 37.3mm, and thickness 12.5mm (Table 7). The same is true for the indexes: the Elongation Index (L/W% ratio) is 107.5 and the Mass Index (Th/L% ratio) is 31.1 (Table 8). The maximum dimensions of flint flakes are as follows: length (80, 77, 20) and width (46, 58, 20).

Limestone flakes. There are only 9 limestone flakes. Dorsal scars include Levallois-centripetal (Fig. 10: 3), crossed, centripetal and unidirectional (Table 3). There is one flake débordant with centripetal scars. There are no primary flakes. The majority of limestone flakes have no traces of cortex or natural surface (Table 4). Plain, polyhedral and dihedral platform preparations dominate (Table 5). There are no faceted or cortical platforms. Obtuse interior flaking angles, again, dominate, but from 91° to 116°. Medium-sized limestone flakes differ from quartzite, quartz, and flint (Table 7). The average dimensions of limestone flakes are 52.3mm, 43.4mm, and 10.4mm. The Elongation Index (L/W% ratio) is 120.5; Mass Index (Th/L% ratio) is 23.9 (Table 8). The maximum dimensions of flint flakes are: length (77mm, 63mm, and 13mm). Transversal limestone flakes are not present.

Debitage Patterning

The character of the dorsal scar patterns of the most representative blank groups, made both on quartz and quartzite, are similar: that is, there is a dominance of radial or unidirectional patterns, following by those with crossed patterns. Only the small sample of flint debitage has a significant number of flakes with lateral scar patterns. Although limestone flakes are rare, they include examples with clear radial and crossed dorsal patterns of both Levallois and non-Levallois character. The débordant flakes occurred on all different types of raw material. Cortex pattern attributes divide the industry into two groups: a) a major group made up of quartzite and quartz with a high degree of dorsal and backing cortex; and, b) a minor group comprised of the flint and limestone materials with few cortical pieces. This might be explained by both the small number of flint and limestone pieces, as well as by their production either off-site or, at least, outside the excavation area.

Platforms of quartzite and quartz pieces both show a predominance of cortical and unfaceted forms. Flint and limestone blanks, however, are somewhat different, having unfaceted or dihedral / polyhedral platforms. In sum, this industry is not faceted and has a low level of crude preparation and numerous cortical platforms.

Interior flaking angles tend to be obtuse for all kinds of raw material. The most common angles are between 110-120°.

Most blanks made on flint, quartz and quartzite tend to be short. Blades are rare and accidental. Even short flakes were broken during flaking - false burins compose about 11 % of total number of quartzite blanks. At the same time, limestone blanks are more elongated. The most massive blanks were made on quartz, rather than on flint or quartzite. The more "elegant" blanks were manufactured on limestone, seen mainly due to the presence of Levallois flakes. In sum, blank dimensions show a high level of flake mass and short proportions for all kinds of raw material.

Numerous debitage products display inter-relationships among morphologically different core and blank groups made on both quartzite and quartz that provide a reliable base for technological studies.

Tools

Only 31 tools were found in Level 7, which account for about 4% of the total assemblage. Tools are clearly rare and do not represent morphologically distinct series.

Tools on quartzite. These comprise 38.7% of the tool assemblage. One-third of them are denticulates; distal or lateral, made by obverse or inverse retouch (Table 9) (Fig. 5: 4, 5; 8: 7). A quarter of the tools were typed as single blow notches, distal or lateral. A single straight sidescraper on flake has flat obverse scalar retouch. Handaxes are represented by tip fragments and one complete amygdaloid piece (Fig. 12). The complete piece was made on a somewhat flat cobble, has a cortical base, and unretouched edges. It was shaped on both sides by sever-

al flake-like removals. Cortex covers more than two-thirds of the tool, including the base and both surfaces. It is longitudinally asymmetrical, particularly at the distal end. The profile is asymmetrical: Z-like. The general impression is that this tool is either crude or unfinished. It is relatively large: length, 128mm; width, 87mm; and thickness 36mm.

Tools on quartz. About half of the tools were produced on quartz. Most are retouched flakes. Other tool classes are represented only by a few pieces each (Table 9). The most prominent quartz tools are two bifacial semi-crescent scrapers. Both were made on flakes in a plano-convex manner.

Tools on flint. There are only three tools made on flint: a canted-like sidescraper, a lateral notch, and a laterally retouched flake (Fig. 11: 6-8). All were produced by obverse retouch. The sidescraper, however, does not correspond well to canted types, because of the very obtuse angle between the conjoining edges (Fig 11: 6).

Tool on limestone. The single limestone tool is a crudely prepared, lanceolate handaxe with abruptly trimmed base and asymmetrical profile (length, 77mm, width, 43mm, and thickness, 26mm). This tool is heavily eroded (Photo 11-12).

Thus, the Brecha das Lascas, Level 7, tool-kit is characterized by rare handaxes and sidescrapers, some bifacial tools on cobbles and flakes, denticulates, notches and various morphologically non-standardized retouched pieces. The relationship between tool-types and raw material is difficult to discern, given the small tool sample.

Technology

As it was described above, the debitage products made both on quartzite and quartz show similar technologically important attributes, such as: dorsal scar patterns, position of dorsal cortex, platform preparation, and platform angles. Also, the similarity of shape, volume, and dimensions of initial blocks of raw material, as well as a high level of morphological similarity of core assemblages, all must be noted. In spite of the different physical properties of quartz and quartzite, the end products (cores and blanks) are very similar. There are not even any shatter pieces, which are usually a common part of quartz reduction. Kombewa flakes are absent. Neither flint nor limestone artifacts are well represented in artifact assemblage. Yet, their end products and their characteristics are different (Levallois blanks, absence of cortical blanks, Indexes of Mass and Elongation for limestone) from those made on quartz and quartzite.

Reduction of quartzite and quartz cobbles

The technology for quartz and quartzite reduction is represented by four main reduction sequences: "sausage slice", discoidal, semi-discoidal and bifacial. Bipolar-on-anvil and centripetal on flake methods are rare.

"Sausage slice" - "tranches de saucisson" method. The sausage slice method is characterized by the successive production of one or several flakes per unprepared flaking

surface, on egg-shape cobbles/pebbles, following the natural shape of the raw material. Depending upon the shape of the cobble/pebble, one or more striking platforms may have been used as single flaking surface exploitation. The usual products of the "sausage slice method," that are abundant in this assemblage, are "citron flakes" with natural lateral side and/or proximal, proximal-lateral, proximal-lateral-distal cortex. Lateral cortex has two orientation variants: left and right. Analyses of the quartz (21 pieces) and quartzite blanks (50 pieces) show a similar pattern for both variants of cortex orientation: left position 48% and 57.1% for quartz and quartzite, respectively; right position - 52% and 42.8% respectively. Thus, dominance of one or other cortex position, (which might give some idea about specific habits of the knappers) was not observed.

In this assemblage, the "sausage slice" method is represented by two different reduction sequences. The first was based on cores with unprepared platforms, while the second was characterized by cores with single blow, prepared platform. Both are characterized by longitudinal and transverse oriented cores on cobbles, with either prepared or unprepared platforms, with mainly unidirectional, and rarely bi-directional, scars.

Sausage method variants. Depending on platform preparation of the cores, the "sausage slice" method was subdivided into two variants.

Variant I.1: unprepared platform sausage method (Fig. 4). This includes unidirectional, unidirectional-transversal, bi-directional and bi-directional-transversal cores on cobbles with unprepared platform, 13 cores in all. The blanks obtained from these cores (22 quartzite and 8 quartz) have the following combinations of attributes: unidirectional and bi-directional scar patterns; proximal, lateral, distal, proximal-lateral, proximal-lateral-distal cortex; and, in all cases, cortical platforms (Table 10).

Unprepared platform orthogonal (2 on quartzite) and orthogonal-alternative (1 on quartzite) cores on cobbles are a deviation of the "sausage" variant I.1 flaking, caused by the need to change the striking platform, as a result of hinge fractures on the flaking surface. Blanks with the following combination of attributes are characteristic of these cores: crossed dorsal scar pattern; proximal-lateral position of cortex; and, cortical platform. This combination was found on 6 quartz flakes.

Variant I.2: prepared platform sausage method (Fig. 5). Two cores are associated with this variant - both are unidirectional-transversal. The dorsal scar pattern and position of cortex of the blanks obtained by this variant are the same as for variant I.1. Platforms were prepared by a single blow. The total number of such blanks is 12 (10 quartzite and 2 quartz).

Discoidal method (Fig. 7-9). The discoidal method is characterized by recurrent, alternating, centripetal exploitation of a voluminous initial block without preliminary preparation and decortication of two large opposite surfaces. The peripheral striking platform is represented by a large, flat and dihedral/polyhedral ridge. Flaking surfaces were used alternatively, both as flaking

surfaces and striking platforms. Based on the flaking surfaces, which tend to be bi-pyramidal, the angle of percussion was always secant, which produced the sharply convex core profiles. This also explains why debitage products are short, wide, and thick flakes (often débordant), with flat and crudely prepared platforms.

This method is attested to by a variety of quartzite and quartz cores and numerous characteristic flakes produced at different reduction stages. The sequence of cores includes initial and tested cobbles, probable initial cores, full debitage, and exhausted cores.

Two discoidal cores, two orthogonal, and one orthogonal-adjacent, reflect the different exploitation stages of this method, as well as attempts to avoid hinge fractures on flaking surfaces. All of these cores were made on quartzite.

In addition, the different exploitation stages are associated with two main kinds of blank platform preparation. The blanks of "initial" stage have different positions of dorsal cortex, with cortical platforms and centripetal, centripetal-débordant dorsal scar patterns. There are 20 quartzite and 12 quartz blanks with such attribute combinations.

The "full debitage" stage of discoidal method is characterized by blanks with the following combinations of attributes: centripetal, centripetal-débordant dorsal scar pattern; either without dorsal cortex or with lateral, lateral-distal and distal remnants of cortex; and, with plain, dihedral and polyhedral variations of platform preparation. Blanks with such attributes combination comprise 32 pieces (27 on quartzite and 5 on quartz). The second blank group has the same pattern of cortex position and platform preparation attributes, but with crossed dorsal scar pattern (21 blanks: 15 on quartzite and 6 on quartz). The third blank group shows identical platform preparation, but has a unidirectional dorsal scar pattern and no dorsal cortex. The number of blanks of the third group is 9 (5 quartzite and 4 quartz). The fourth group of blanks is similar to the third group, but some dorsal cortex is present (2 quartzite flakes). In sum, 96 blanks are associated with discoidal reduction sequences.

In addition to these debitage types, both discoidal and sausage prepared platform (variant I.2) methods could have produced blanks with convergent dorsal scar pattern, with lateral-distal position of cortex or without cortex at all and plain platform (4 pieces on quartzite and 1 piece on quartz).

Semi-discoidal method (Fig. 6). This method differs from the discoidal method by exploitation of only a single flaking surface. The face opposite to the flaking surface of the cobble was used as an unprepared striking platform. Some of the semi-discoidal cores were likely produced on broken cobbles or massive primary flakes. The number of quartz cores of different dimensions, probably discarded at different stage of exploitation, show the possible reduction tendency: from initial core with semi-peripheral (convergent) exploitation of the flaking surface, with completely cortical striking platform (on the opposite side of the core), to the centripetal or orthogonal flaking surface cores of full debitage, fin-

ishing as small exhausted cores with the same kinds of negatives (Fig. 6: 1-4). Throughout the reduction sequence, the system of flaking (e.g. directions and angles of percussion) was not changed.

There are 9 semi-discoidal cores (2 quartzite and 7 quartz). The blanks associated with this method have crossed dorsal scar pattern, completely cortical platforms and no dorsal cortex. There are 14 blanks (11 on quartzite and 3 on quartz).

There are also a number of blanks associated with both semi-discoidal and the unprepared platforms variant of the sausage method (variant I.1). These blanks have a unidirectional dorsal scar pattern, cortical platforms and lack dorsal cortex (10 pieces on quartzite and 6 on quartz). The blanks with convergent dorsal scar pattern and with similar dorsal cortex and platform preparation might have resulted from core exploitation by either semi-discoidal and variant I.1 of the sausage methods (6 quartzite and 9 quartz flakes).

Bifacial method. The sample of artifacts associated with bifacial treatment is too small to draw conclusions about shaping methods. It appears that different methods were used to produce different bifaces: handaxes on quartzite and limestone, small fragments of bifacial pieces (all on quartz cobbles) and bifacial scrapers on quartz flakes. A single Pre-form on quartzite probably attests to the trifacial method, as discussed above (Fig. 10: 1). A large quartzite handaxe and small fragments of biface pieces on cobbles seem to be close to a system of initial discoidal core reduction: alternating peripheral flaking by means of hard hammerstones which resulted in an asymmetric crude profile. Bifacial scrapers on quartz were partially reduced from both sides in a manner resembling plano-convex bifacial flaking. One has proximal and distal cortex.

This method is seen in bifacial tools (3 quartzite, 3 quartz and 1 limestone) and in a single bifacial tool Pre-form made on quartzite. Six flakes on quartzite were identified as bifacial shaping flakes (Fig. 12).

Other methods. A number of blanks could not attributed to methods discussed above. These include broken blanks (30 quartzite and 7 quartz pieces), completely cortical primary blanks (2 on quartzite and 5 on quartz) and primary blanks with prepared platform (6 on quartzite and 1 on quartz). The last could be associated with the initial reduction stage of one of the methods based on the same kind of core platform preparation, either the sausage prepared platform method (variant I.2) or the discoidal method.

A single centripetal core made on a quartzite preliminary flake reflects "flat" recurrent flaking with prepared platform (Fig. 10: 2). This core is not associated with the semi-discoidal method because of the preliminary platform preparation and the "flat" concept" of core exploitation.

A single quartz core shows use of bipolar-on-anvil methods as the cobble was small and too thick. Some flakes with proximal cortex and parallel sides could have resulted from this method.

Reduction tendency of quartzite and quartz cobbles. Different flaking methods show varying degrees of core exploitation. The "sausage slice" method, which was based on the same raw material and primary blocks as the discoidal method, is characterized by cores with important reduction potential. These cores were discarded because of numerous knapping accidents (e.g. deep hinge fractures).

Difficulties in longitudinal exploitation of hard raw material are indicated by a single *outré-passé* quartzite blade. In contrast, semi-discoidal and discoidal methods display long and more intensive core reduction from big initial cores to small, reduced cores showing alternating bifacial or partly bifacial reduction as well as medium-size cores with reduced mass (thickness).

Reduction of limestone and flint. While small, these two materials show evidence of debitage activity which probably took place outside of the excavated area. Initial core blanks, tested blocks of flint and limestone are absent. Cortical pieces, chips and cores are very rare. The reduction sequence is thus not complete. Nevertheless, rare final debitage products made on limestone attest to use of the Levallois flaking method. Levallois debitage is represented by three short, rather massive, large flakes with regular centripetal dorsal scar pattern and polyhedral platforms (Fig. 10: 3). These flakes have medium size and could have been obtained from a lineal Levallois core - Levallois "tortoise" core. Other debitage products, that is, bigger flakes, blade with irregular, centripetal, crossed and unidirectional dorsal scars, could have been the result of preparation of Levallois flake reduction and/or other non-Levallois centripetal methods.

Flint debitage products attest to non-Levallois method (s). There are no large or medium sized deliberate blanks. Short, massive flakes - with lateral, convergent, irregular centripetal negatives, often *débordant*, with plain and polyhedral platforms and sharply convex profile - probably resulted from discoidal and/or centripetal non-Levallois recurrent method (s) (Fig. 11).

Summary of Technological Observations

Briefly, all reduction methods of the lithic industry from Brecha das Lascas, Level 7 demonstrate direct percussion by means of hard hammerstones. The bulbs of percussion are pronounced, platforms are wide, long, proximal flake parts are massive and platform angles are obtuse. However, no hard hammerstones with traces of percussion were recovered. Abundant and suitable quartzite and quartz cobbles were probably changed often and did not leave specific percussion marks. Numerous false burin fractures (Siret, accidental break) indicate the use of hard and heavy hammerstones.

Preliminary technological study of Brecha das Lascas lithic assemblage shows the existence of several production systems which were applied to different types of raw material in order to exclusively obtain flakes, rarely to produce bifacially shaped tools. The following core reduction models can be proposed :

- 1) "Sausage slice" method, with two variants applied to quartzite and quartz cobbles, in order to obtain a series of non-elongated, massive flakes with cortical remnants (dorsal cortex common, plus various combinations of cortex position), obtuse flaking angles and wide butts.
- 2) Discoidal (bifacial) and semi-discoidal (unifacial) methods resulting in numerous short, wide and massive flakes (often *débordant*) with little or no cortex, applied to quartzite, quartz cobbles and probably flint blocks.
- 3) Rare core reduction methods (for this assemblage) are represented by:
 - a) bipolar method, applied only to quartz cobbles, with use of anvil;
 - b) centripetal recurrent non-Levallois "flat" method;
 - c) Levallois lineal method for medium-sized single preferential flakes (exclusive use of limestone).

Only a small number of the products from all of these debitage methods were transformed into tools. These were typically denticulates, notches and retouched pieces, rarely sidescrapers. All other products remained unretouched.

Bifacial reduction, as well as core reduction, was applied to different raw materials. These materials did not cause differences either during the technological processes or in final results.

Discussion

As for other comparisons, it is interesting to note that the "sausage slice" method with unprepared platform is quite similar to the method applied at the Late Middle Paleolithic complex of Makarovo IV, separated in both time and space from the site considered here (Sitlivy-Escutenaire, Sitlivy, 1996), and at the Upper Paleolithic site of Malta in Baikal, Siberia (Sitlivy *et al.*, 1997). The main common feature is the rarity or absence of real choppers and chopping-tools and the use of a pure "sausage slice" method. In the Iberian Peninsula and on the Mediterranean coast, chopper/chopping morphology often occurred, which could be linked to this or other methods (e.g. "débitage discoïde unifacial" based on pebble quartz core with choppers typology in Coudoulous I, Garonne Basin; Jaubert, Mourre 1996).

We can find numerous examples of morphologically similar artifacts (e.g. discoidal cores or bifaces) on non-flint material throughout the Iberian Peninsula (e.g. Raposo *et al.*, 1996). However, problems of dating and homogeneity of this record (see for example "Non-Flint Stone Tools and the Paleolithic Occupation of the Iberian Peninsula", edited by N. Moloney, L. Raposo, M. Santonja, 1996) lead to some preliminary technological comparisons with well-studied core reduction sequences in South-Western France.

Both bifacial secant debitage based on discoidal core with bi-pyramidal section (discoidal conception with alternating exploitation) and partial discoidal bifacial debitage with characteristic preservation of cortex (as at Brecha das Lascas) are well represented in the Lower Paleolithic (Acheulean) sandstone workshop of Cazalège

in Armagnac (Millet *et al.*, 1999).

Caudoulois I, layer 4, in the Garonne Basin (> 130 ka, stage 6) is characterized by discoidal unifacial and bifacial quartz cores with pyramidal and bipyramidal sections ("concept discoïde") and by secant direction of the breaking surface ("direction du plan de fracturation"), as well as by the bipolar-on-anvil method ("débitage sur enclume") (Jaubert, 1995; Jaubert, Mauran, 1996). It is interesting to note that Levallois flake debitage was done on flint cores. The dominance of quartz discoidal methods yielded particular blanks (wider than they are long) with obtuse to very obtuse flaking angle, numerous knapping accidents, rare Kombewa flakes and general "debitage monotonie". Layers 7 and 8 (stage 8-7) contained numerous manuports, pebble tools/cores, flakes with natural (unretouched) working edge and rare partial bifaces. Tools are not well developed.

The Middle Paleolithic site of La Borde (Livernon, Lot), eastern border of the Aquitaine Basin (temperate period: isotopic stage 5 or more likely stage 7) has a quartz lithic industry (96.2 %) with debitage flaked from discoidal unifacial or bifacial cores (with pronounced convex section), pebble component (tested cobbles, hammerstones, choppers/chopping-tools, unidirectional cores with peripheral exploitation). Denticulates and notches are present among the retouched tools. Levallois products and good scrapers are also present; however, they are rare and were made on flint (Jaubert *et al.*, 1990).

A lithic assemblage made on quartz pebbles (hammerstones, pebble cores/tools), which is compared to the local Early Paleolithic or beginning of Middle Paleolithic (with no Levallois evidence), associated with a rich faunal assemblage (mainly equids), was found at the "L'igüe des Rameaux" site (Tarn-et-Garonne, South-Western France) (Rouzaud *et al.*, 1990).

Quartz and quartzite pebbles were widely used in later periods: e.g. the Late Middle Paleolithic site of Mauran in the Pyrenean Piedmont area (Farizy *et al.*, 1994; Jaubert, 1993). Discoidal debitage based on discoidal/pyramidal cores (mostly unifacial with cortical or semi-cortical sides, opposite to the working surface) was accompanied by non-modified quartz pebbles (manuports and hammerstones), broken tested pebbles and choppers. Short, massive flakes (often "pseudo-Levallois points") and asymmetrical or backed blanks were transformed into notched and denticulated tools or remained unretouched. As a whole, the Lower and Middle Paleolithic of southwestern France, especially in Pyrenees region, is characterized by the dominance of quartzite and quartz industries with discoidal reduction, often the bipolar-on-anvil method, and the absence or rarity of Levallois methods (Jaubert, Bismuth, 1993). Typologically, Lower and Middle Paleolithic complexes of Southwestern Europe vary from Acheulean (with numerous or rare bifaces and cleavers) and Micoquian industries to industries without bifacial tools and with a high number of non-modified blanks, denticulates, notches and general poverty of the small tool-kit. The same features were mentioned by different authors, e.g. N. Moloney (1996): presence of cortex

on unifacial/bifacial tools or on flakes, cortical butts, centripetal core exploitation, simple retouch techniques, a general similar flake tool-kit (scrapers, denticulates, notches).

Hardness of the local raw material (e.g. quartzite) and natural good quality of working edges of flake tools could be responsible for typological homogeneity and the absence of flake tool modification (retouching, resharpening), as was proposed for regions neighboring Portugal (Jaubert, 1996).

Conclusions

Sausage slice and discoidal methods occurred during the Lower Paleolithic in different regions of Africa and Eurasia rich in cobbles/pebbles sources. These methods persisted in the Middle and Upper Paleolithic, and even later (especially sausage slice), in the Iberian Peninsula, the Mediterranean coast of France, Italy, Central and Northern Asia. Thus, this flaking method has no chronological significance. Discoidal methods are more common for Lower and Middle Paleolithic industries, often accompanying "Meridional Acheulian" and/or Micoquian technocomplexes. "Flat" centripetal core exploitation, both Levallois and non-Levallois are evidence of Middle Paleolithic technologies. However, in the Brecha das Lascas, Level 7 lithic assemblage, these methods occurred only rarely.

The tool-kit of Brecha das Lascas, Level 7 also has an "archaic" character, based on the non-standardization of tools on flakes, the minor modification of blanks and the crude manner of shaping. Based on technological analysis of this assemblage, site function can be interpreted as being a workshop or debitage area of a larger site. It can be placed chronologically not earlier than the Late Lower Paleolithic with some traces of Levallois technology. This assemblage, from a Lower Paleolithic context, is the first to document a specific locus of flake production from true core reduction. Given the limited area exposed, it is not clear just how large an area this might have been. It is likely, however, that the area sampled was only a part of a larger site with other spatially defined activity areas.

This assemblage, from a Lower Paleolithic context, documents a specific locus of flake production from true core reduction. Given the limited area exposed, it is not clear just how large an area this might have been. It is likely, however, that the area sampled was only a part of a larger site with other spatially defined activity areas. Certainly, the extremely low ratio of retouched tools to debitage is uncharacteristic of known Lower Paleolithic Iberian sites located away from immediate sources of raw material.

Acknowledgements

The work reported here was part of a larger research project into the Paleolithic of the Almonda karst system headed by Dr. João Zilhão, University of Lisbon. We wish to thank him for his invitation to participate. Our work, on the Lower Paleolithic of the Brecha das Lascas and the Galeria

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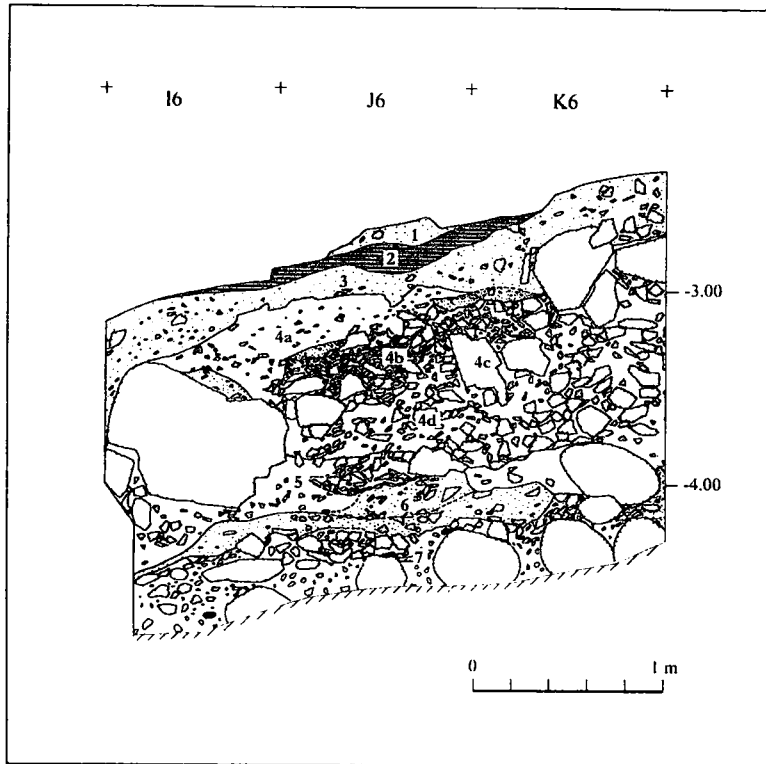


Figure 2 : Brecha das Lascas, profile N

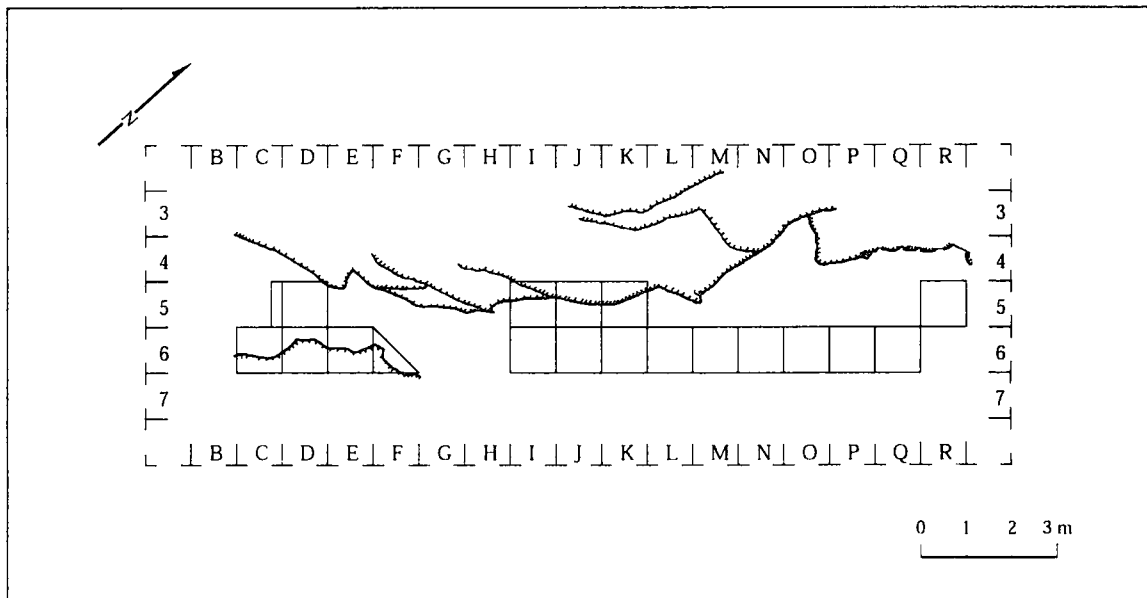


Figure 3 : Plan of the excavations zone on the Brecha das Lascas site.

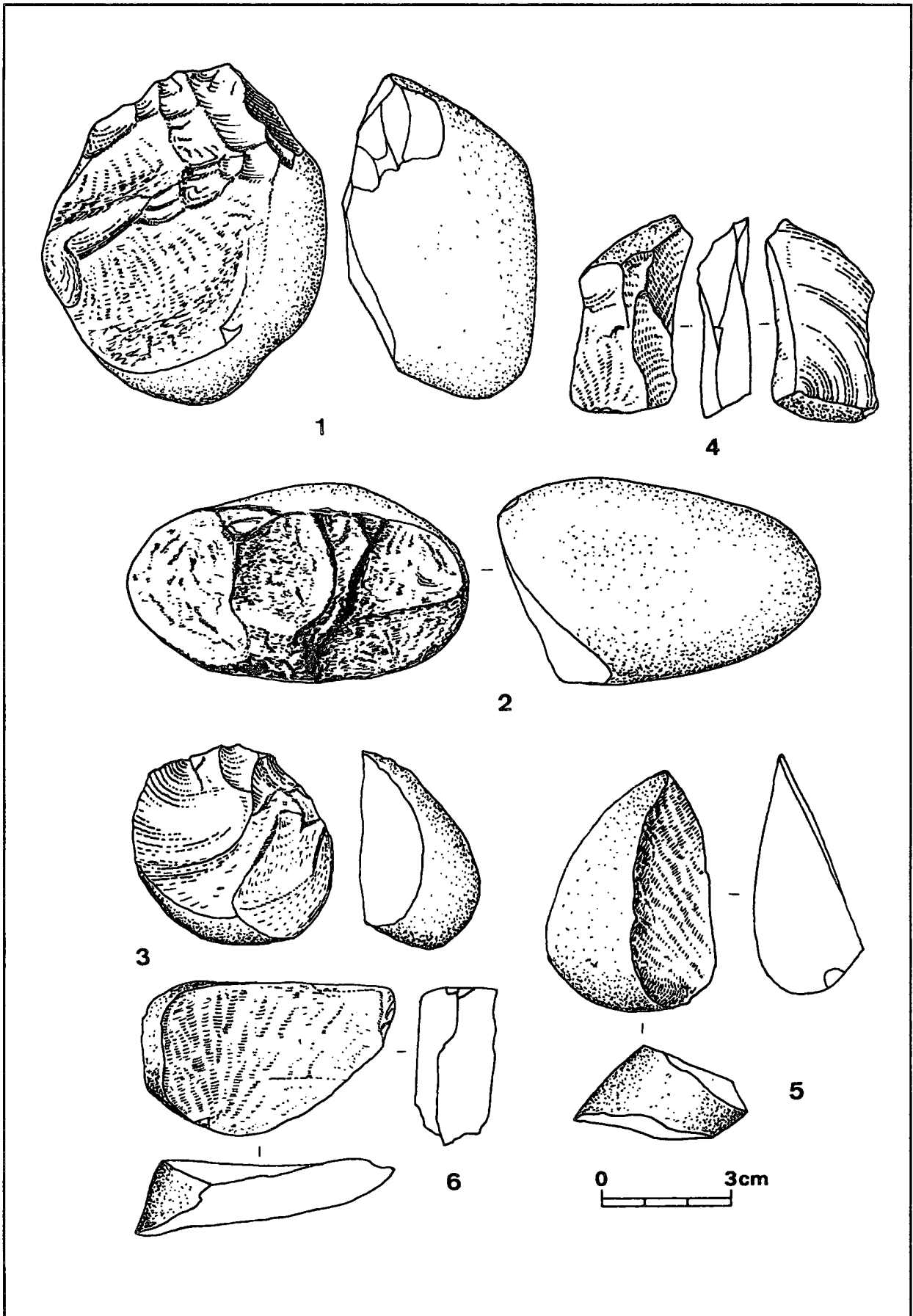


Figure 4 : Brecha das Lascas, layer 7. Unprepared platform "sausage" method (1, 2: quartz; 3-6: quartzite): cores and flakes.

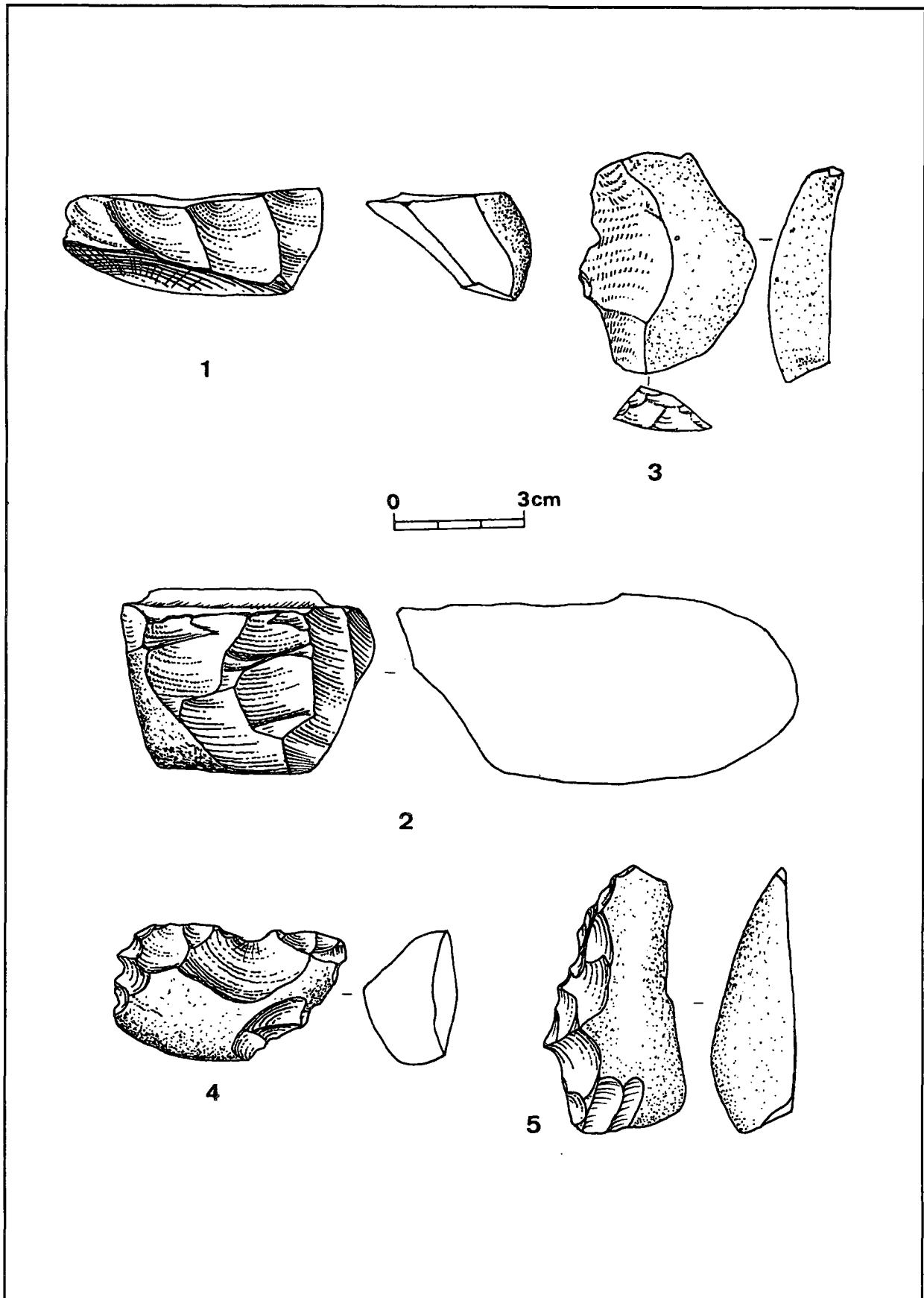


Figure 5 : Brecha das Lascas, layer 7. Prepared platform "sausage" method. Quartzite: cores, flake, denticulated tools.

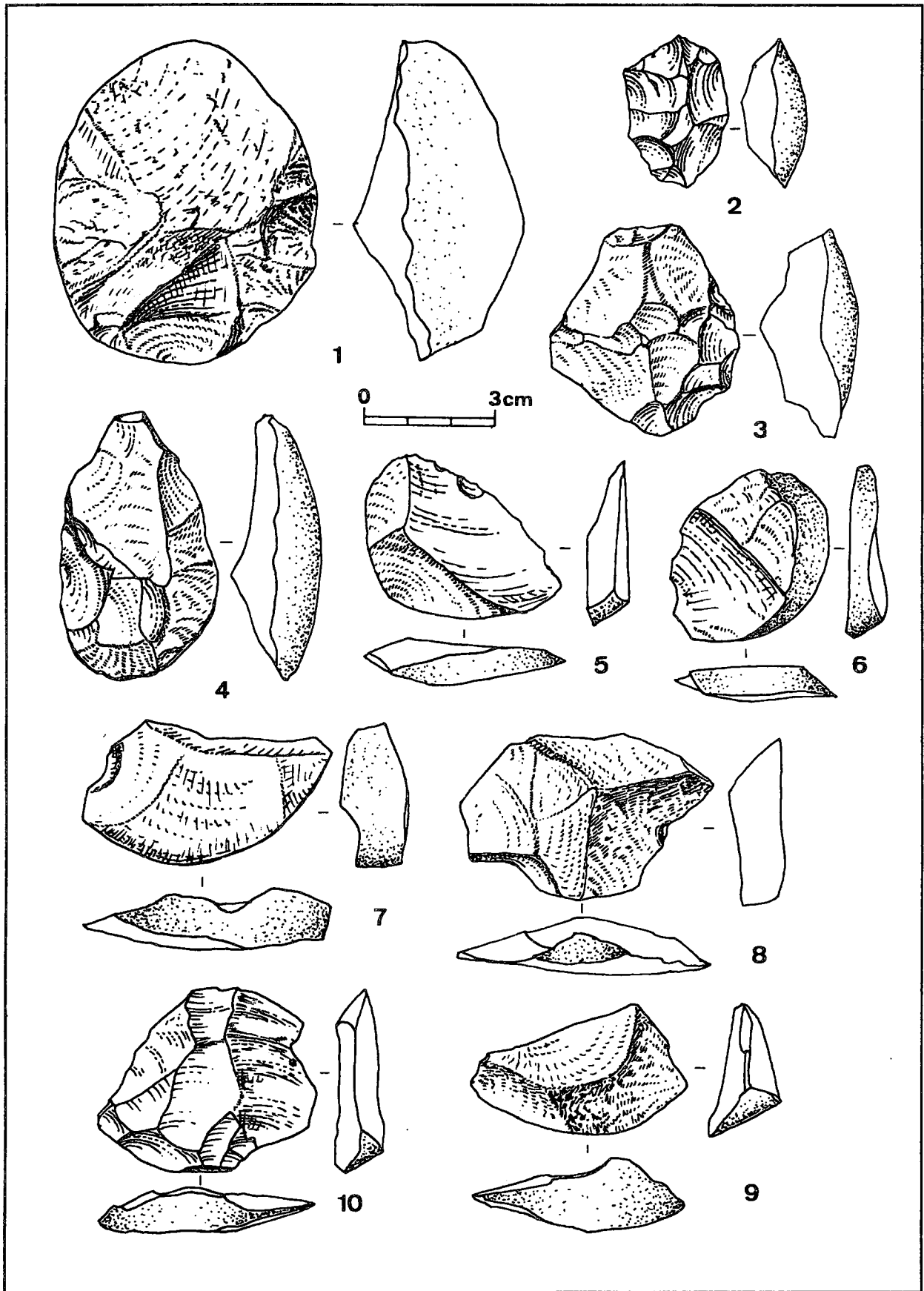


Figure 6 : Brecha das Lascas, layer 7. Semi-discoidal method. Quartzite and quartz (1-2, 7): cores and flake.

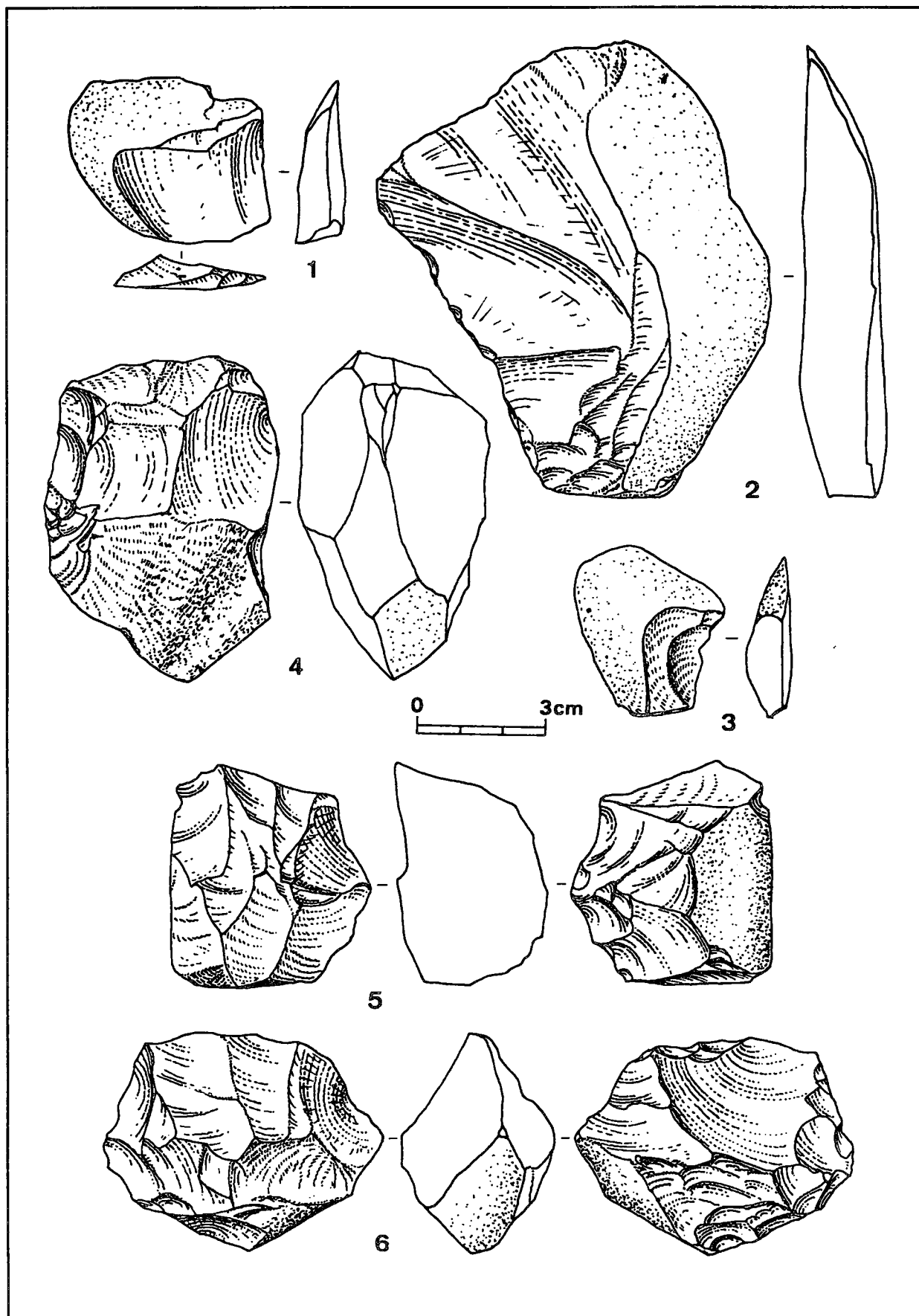


Figure 7 : Brecha das Lascas, layer 7. Discoidal method. Quartzite: cores and flakes.

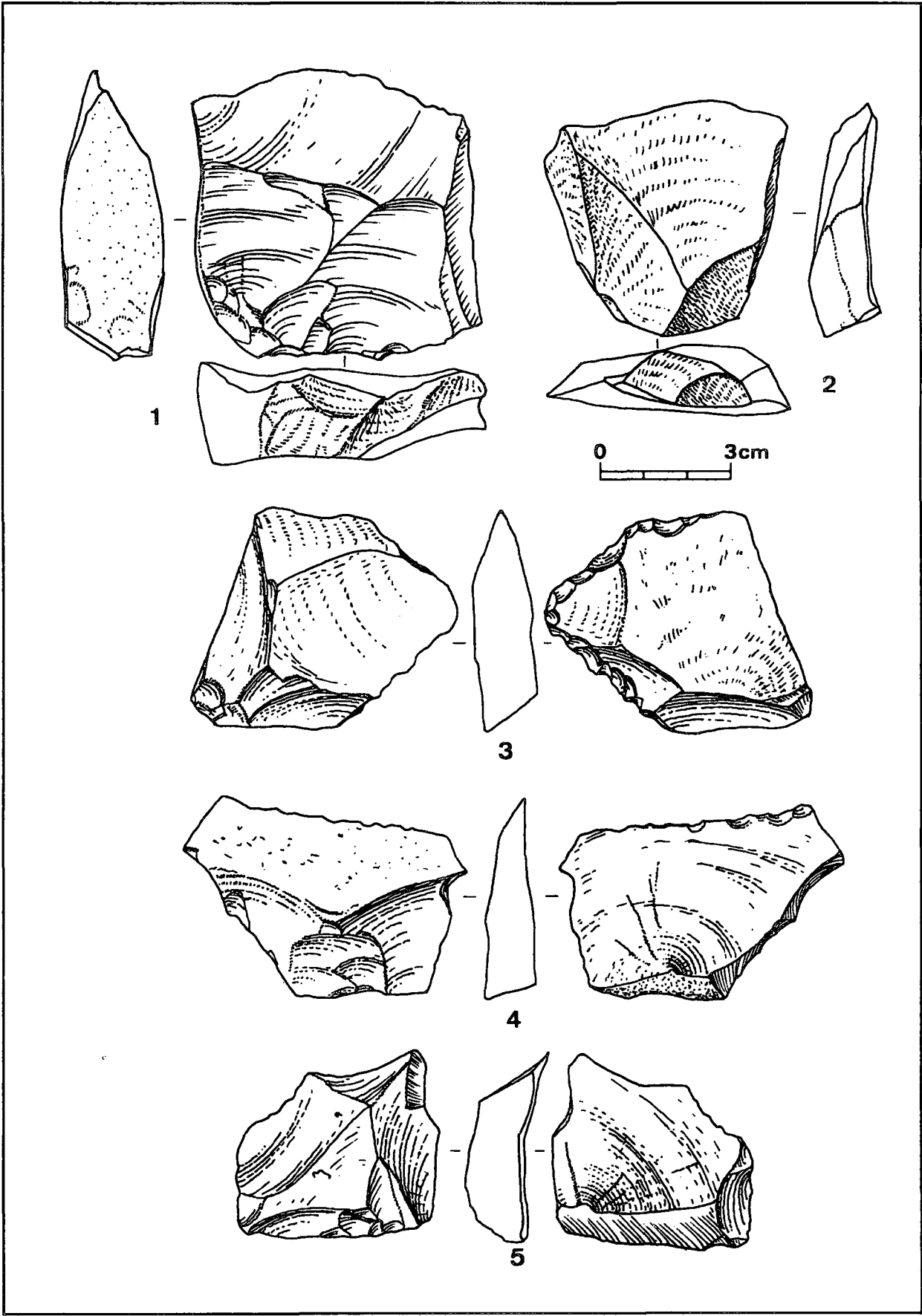


Figure 8 : Brecha das Lascas, layer 7. Discoidal method. Quartzite: "debordant" flakes.

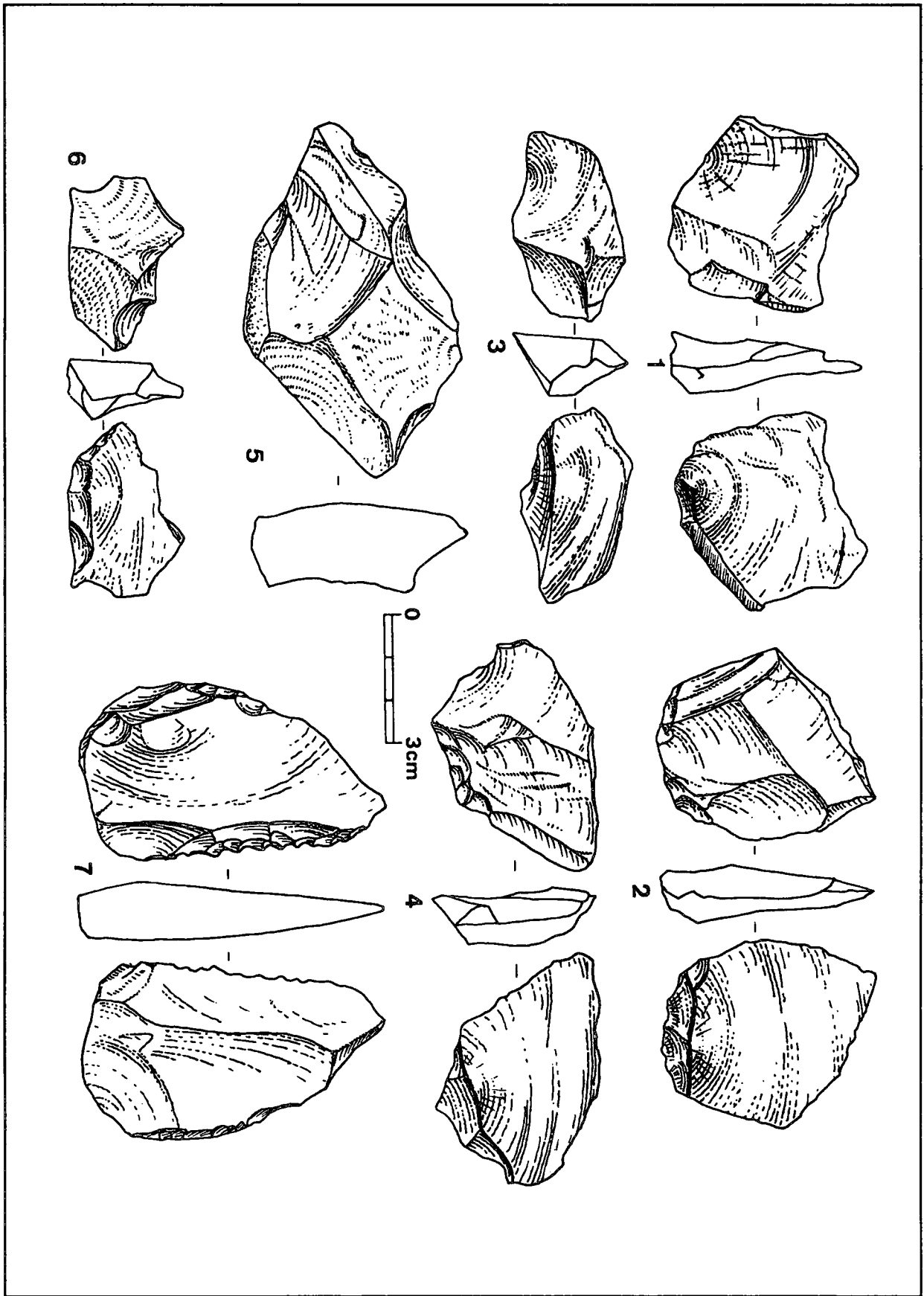


Figure 9 : Brecha das Lascas, layer 7. Discoidal method. Quartzite: "debordant" flakes. Denticulated tool (7).

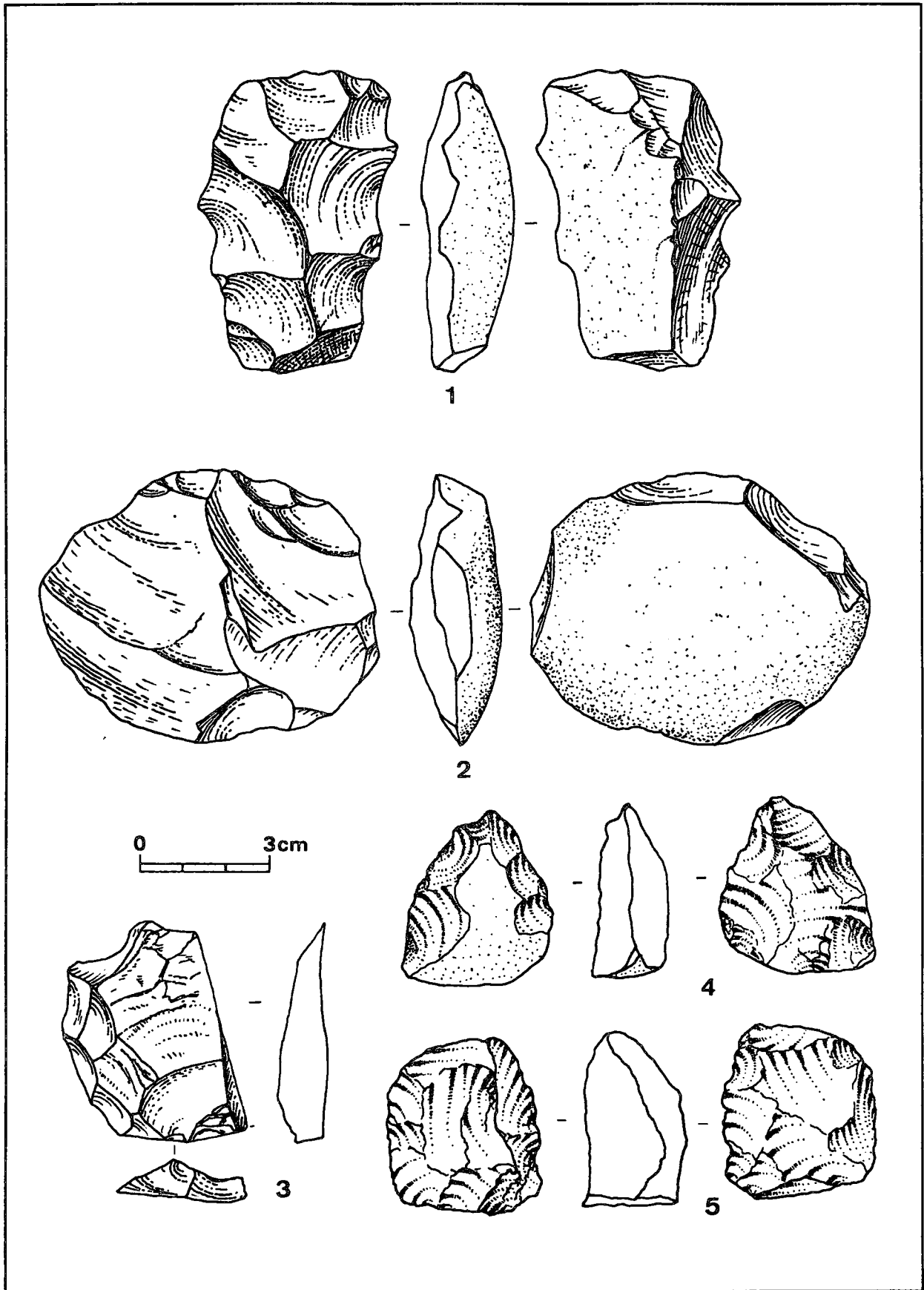


Figure 10 : Brecha das Lascas, layer 7. 1- trifacial Pre-form ("barrenförmige Kerne"), quartzite; 2- centripetal core, quartzite; 3- Levallois flake, limestone; 4, 5- bifacial scrapers, quartz.

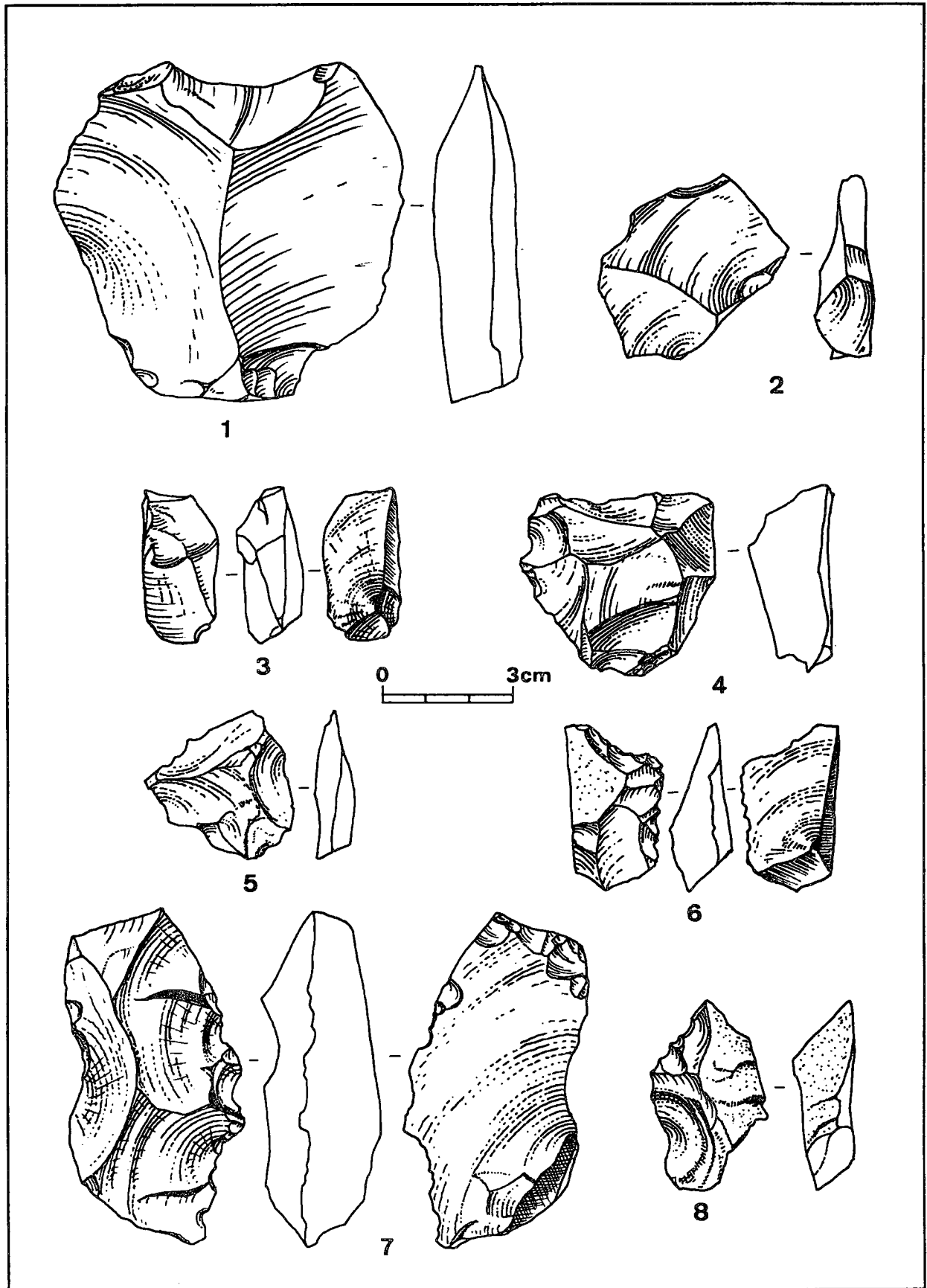


Figure 11 : Brecha das Lascas, layer 7. Limestone discoidal and/or centripetal non-Levallois recurrent debitage: flakes and tools.

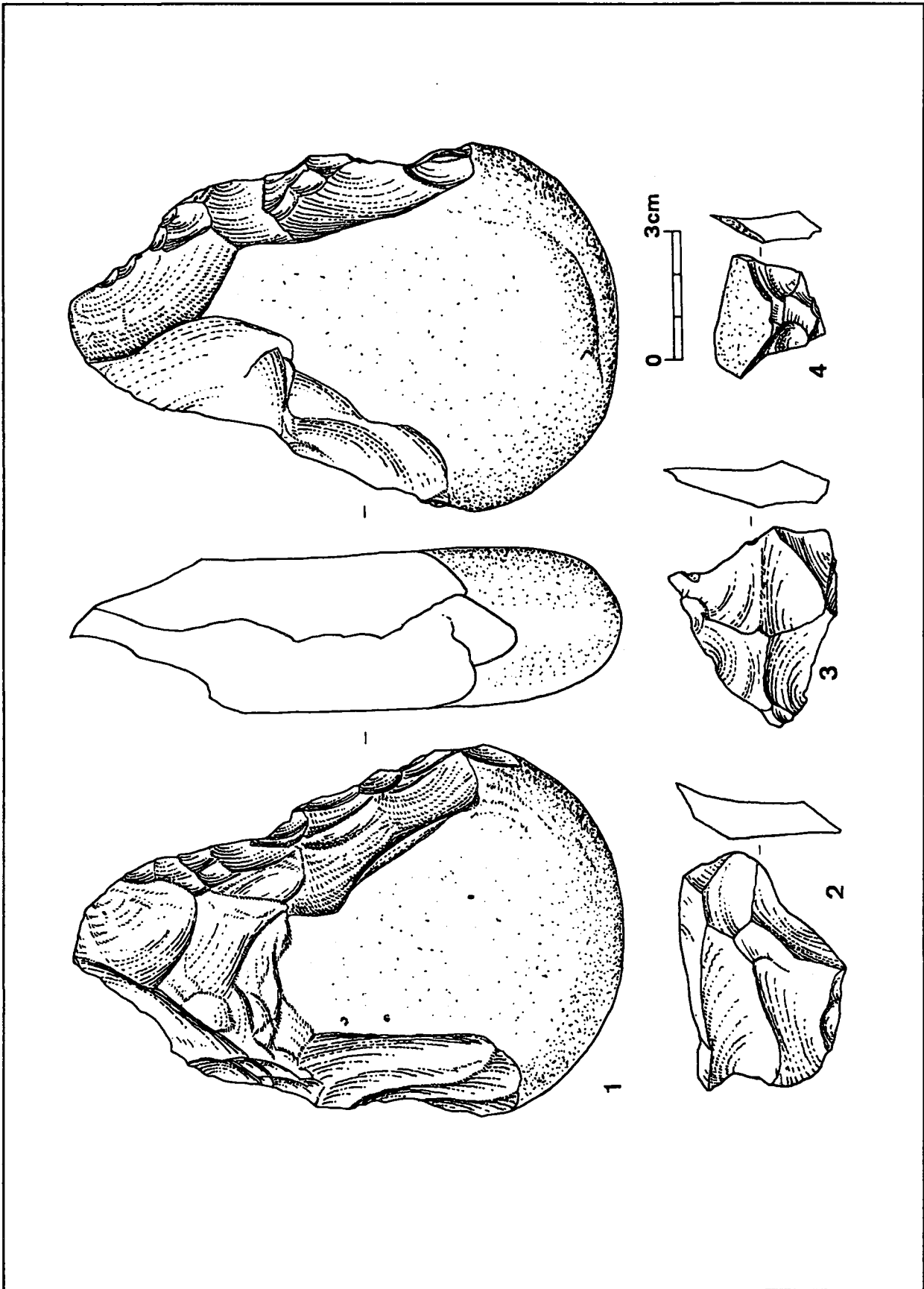


Figure 12 : Brecha das Lascas, layer 7. Quartzite. 1- handaxe; 2-4- bifacial shaping flakes.

TABLE 1. Brecha das Lascas, level 7. ARTIFACTS

	Quartzite		Quartz		Flint		Limestone		Total:	
	N	%	N	%	N	%	N	%	N	%
Tools	12	3,7	15	4,0	3	12,0	1	9,1	31	4,2
Flakes	196	60,9	140	37,0	21	84,0	9	81,8	366	49,7
Blades	11	3,4	1	0,3	0	0,0	0	0,0	12	1,6
Cores	34	10,6	69	18,3	0	0,0	1	9,1	104	14,1
Preforms	1	0,3	0	0,0	0	0,0	0	0,0	1	0,1
Bifacial Shaping Flakes	7	2,2	0	0,0	0	0,0	0	0,0	7	1,0
Chips	47	14,6	152	40,2	1	4,0	0	0,0	200	27,2
Tested Cobbles	5	1,6	1	0,3	0	0,0	0	0,0	6	0,8
Cobbles	9	2,8	0	0,0	0	0,0	0	0,0	9	1,2
TOTAL:	322	100,0	378	100,0	25	100,0	11	100,0	736	100,0

TABLE 2. Brecha das Lascas, level 7. CORES

	Quartzite		Quartz		Total:	
	#	%	#	%	#	%
ON COBBLES						
Unprepared Platforms						
unidirectional-transversal	3	13,0	1	4,8	4	9,1
unidirectional	3	13,0	1	4,8	4	9,1
bidirectional	2	8,7	2	9,5	4	9,1
bidirectional-transversal			1	4,8	1	2,3
orthogonal	2	8,7			2	4,5
orthogonal-alternative	1	4,3			1	2,3
converging-transversal			1	4,8	1	2,3
semi-discoidal	2	8,7	7	33,3	9	20,5
irregular			4	19,0	4	9,1
Prepared / Unprepared Platforms						
bidirectional			1	4,8	1	2,3
bidirectional-adjacent			1	4,8	1	2,3
orthogonal			1	4,8	1	2,3
Prepared Platforms						
unidirectional-transversal	2	8,7			2	4,5
orthogonal	2	8,7			2	4,5
orthogonal-adjacent	1	4,3			1	2,3
discoidal	2	8,7			2	4,5
polyhedral	1	4,3			1	2,3
ON FLAKES						
Unprepared Platforms						
unidirectional-transversal	1	4,3			1	2,3
Prepared Platforms						
unidirectional			1	4,8	1	2,3
radial	1	4,3			1	2,3
CORE FRAGMENTS						
TOTAL:	34	100%	69	100%	103	100%

TABLE 3. Brecha das Lascas, level 7. BLANKS: DORSAL SCAR PATTERN

	Quartzite		Quartz		Flint		Limestone		Total:	
	N	%	N	%	N	%	N	%	N	%
cortex	17	9,8	6	7,6	0	0,0	0	0	23	8,2
lateral	12	6,9	3	3,8	5	26,3	0	0	20	7,1
bilateral	0	0,0	1	1,3	1	5,3	0	0	1	0,4
unidirectional	42	24,1	23	29,1	2	10,5	1	11,1	68	24,2
bidirectional	8	4,6	0	0,0	0	0,0	0	0,0	8	2,8
convergent	14	8,0	10	12,7	2	10,5	0	0,0	26	9,3
crossed	27	15,5	17	21,5	0	0,0	3	33,3	47	16,7
radial	54	31,0	19	24,1	9	47,4	2	22,2	84	29,9
Levallois	0	0,0	0	0,0	0	0,0	3	33,3	3	1,1
unidentifiable	13		1		0		0		14	
TOTAL:	187	100,0	80	100,0	19	100,0	9	100,0	295	99,6

TABLE 4. Brecha das Lascas, level 7. BLANKS: CORTEX POSITION

	Quartzite		Quartz		Flint		Limestone		Total:	
	N	%	N	%	N	%	N	%	N	%
cortex 100%	14	7,5	5	6,3	0	0	0	0	19	6,4
proximal	34	18,2	27	33,8	1	5,3	0	0	62	21,0
proximal-lateral	27	14,4	17	21,3	0	0,0	0	0	44	14,9
proximal-bilateral	3	1,6	1	1,3	0	0,0	0	0	4	1,4
proximal-distal	4	2,1	1	1,3	0	0,0	0	0	5	1,7
proximal-lateral-distal	18	9,6	6	7,5	0	0,0	0	0	24	8,1
distal	8	4,3	3	3,8	0	0,0	0	0	11	3,7
distal-lateral	14	7,5	3	3,8	2	10,5	0	0	19	6,4
distal-bilateral	1	0,5	1	1,3	0	0,0	0	0	2	0,7
lateral	13	7,0	2	2,5	2	10,5	2	22,2	19	6,4
without cortex	51	27,3	14	17,5	14	73,7	7	77,8	86	29,2
TOTAL:	187	100,0	80	100,0	19	100,0	9	100,0	295	100,0

TABLE 5. Brecha das Lascas, level 7. BLANKS: PLATFORMS PREPARATION

	Quartzite		Quartz		Flint		Limestone		Total:	
	N	%	N	%	N	%	N	%	N	%
cortical	81	47,9	53	68,8	1	5,9	0	0	135	49,6
plain	56	33,1	17	22,1	11	64,7	4	44,4	88	32,4
punctiform	8	4,7	1	1,3	0	0,0	0	0,0	9	3,3
dihedral	15	8,9	3	3,9	3	17,6	1	11,1	22	8,1
polyhedral	8	4,7	1	1,3	0	0,0	3	33,3	12	4,4
crushed	1	0,6	2	2,6	2	11,8	1	11,1	6	2,2
unidentifiable	18		3		2		0		23	
TOTAL:	187	100,0	80	100,0	19	100,0	9	100,0	295	100,0

TABLE 6. Brecha das Lascas, level 7. BLANKS: INTERIOR FLAKING ANGLES BY RAW MATERIAL

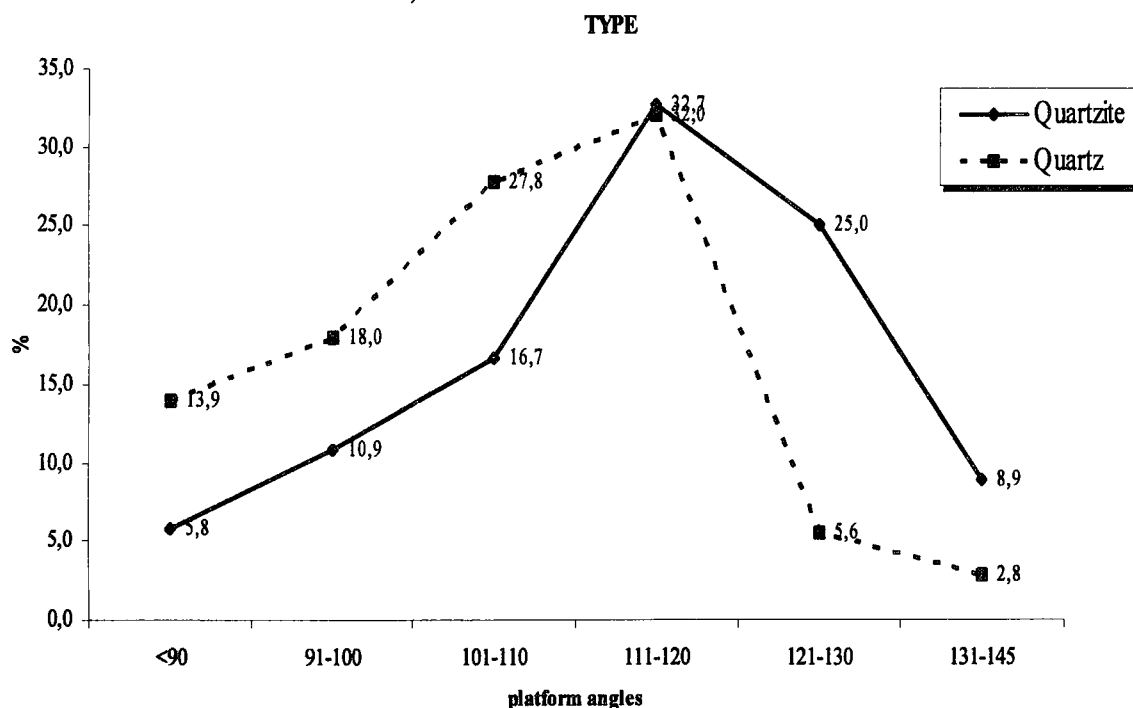


TABLE 7. Brecha das Lascas, level 7. BLANKS: LENGTH TO WIDTH RATIO BY RAW MATERIAL TYPE

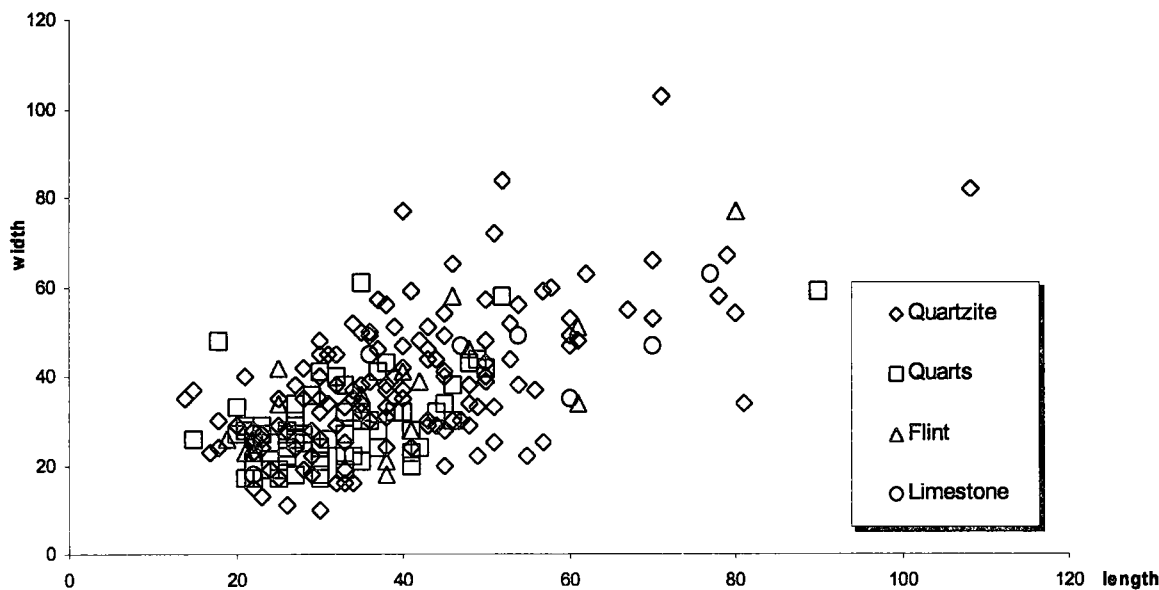


TABLE 8. Brecha das Lascas, level 7. BLANKS: INDEXES OF MASS AND ELONGATION BY RAW MATERIAL TYPE

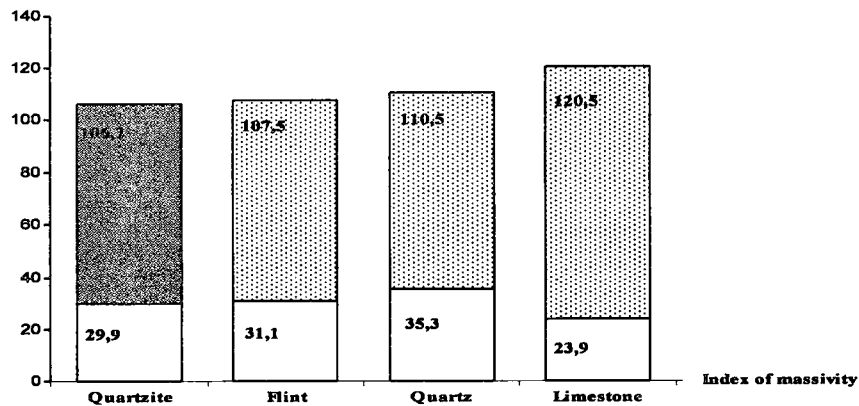


TABLE 9. Brecha das Lascas, level 7. TOOLS

	Quartzite	Quartz	Flint	Limestone	Total:
Sidescrapers					
straight, obverse	1				1
canted, obverse			1		1
Denticulates					
transverse, obverse	1	1			2
transverse, inverse	1				1
lateral, obverse	2	1			3
Notches					
distal, obverse	3	1			4
lateral, obverse			1		1
lateral, inverse		1			1
Handaxes					
semi-amygdaloid	1				1
lanceolate				1	1
tip fragments	2	1			3
Bifacial Scrapers					
semi-crescent		2			2
Retouched Pieces					
on chunk	1				1
on flake, lateral obverse		2	1		3
on flake, alternating		1			1
on flake, distal obverse		1			1
Unidentifiable		4			4
TOTAL:	12	15	3	1	31

TABLE 10. Brecha das Lascas, level 7: CORRELATION OF FLAKING METHODS AND FLAKING PRODUCTS

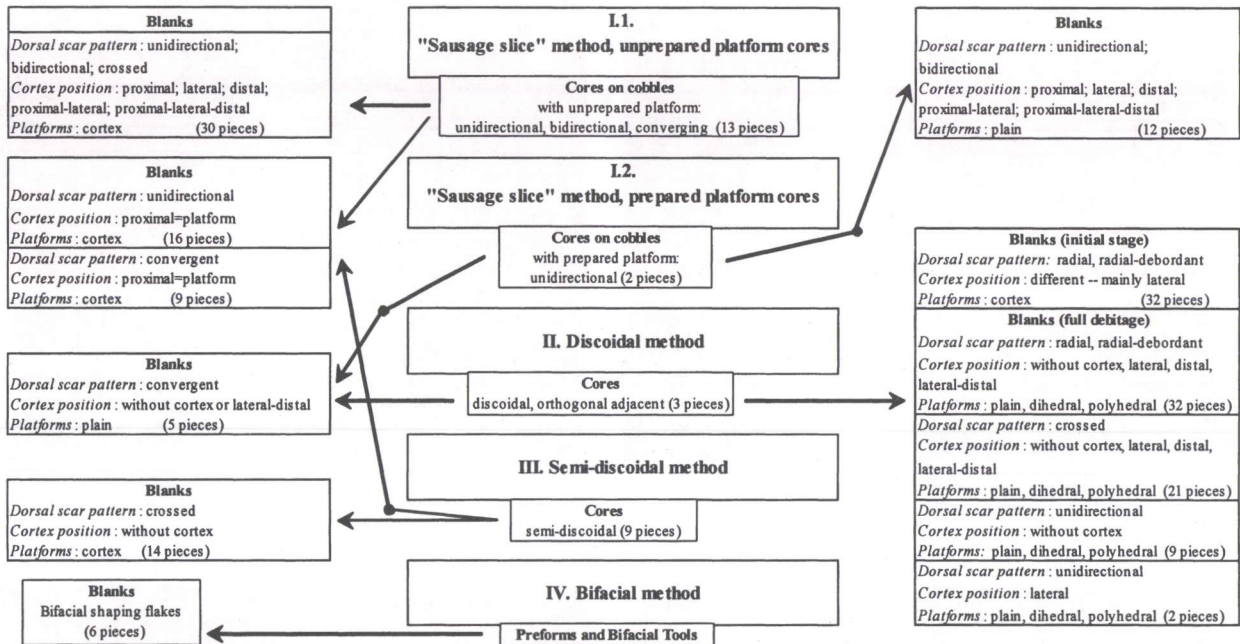


Photo 1 : Brecha das Lascas. Profile N (2000).



Photo 2 : Brecha das Lascas. Surface of the level 7.



*Photo 3 : Brecha das Lascas. Quartzite, handaxe.
(Photo RMAH / R. Mommaerts).*



*Photo 4 : Brecha das Lascas. Quartzite, trifacial pre-form.
(Photo RMAH / R. Mommaerts).*



*Photo 5 : Brecha das Lascas. Quartzite, core.
(Photo RMAH / R. Mommaerts).*



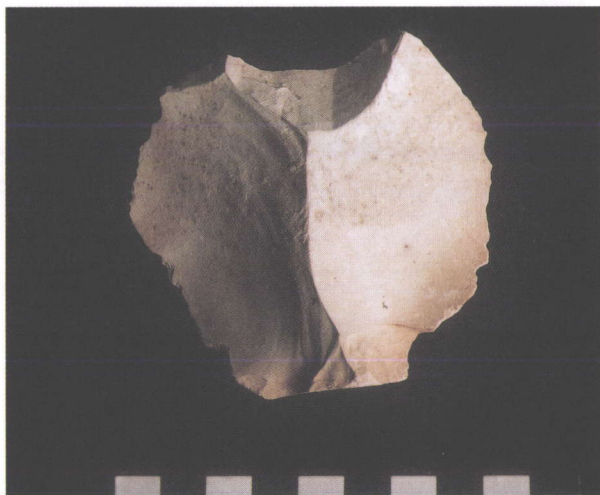
*Photo 6 : Brecha das Lascas. Quartzite, core.
(Photo RMAH / R. Mommaerts).*



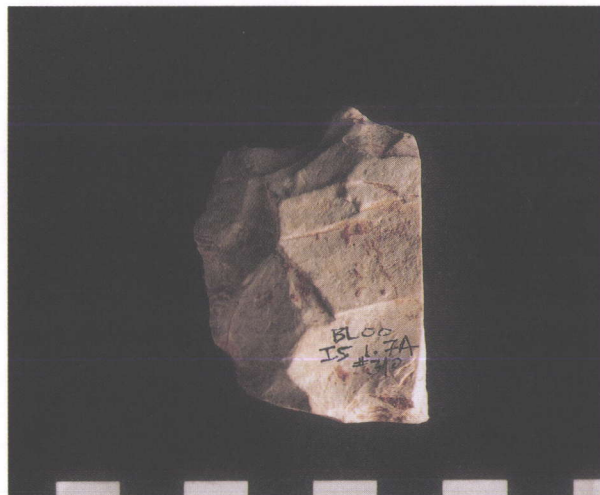
*Photo 7 : Brecha das Lascas. Quartz, core.
(Photo RMAH / R. Mommaerts).*



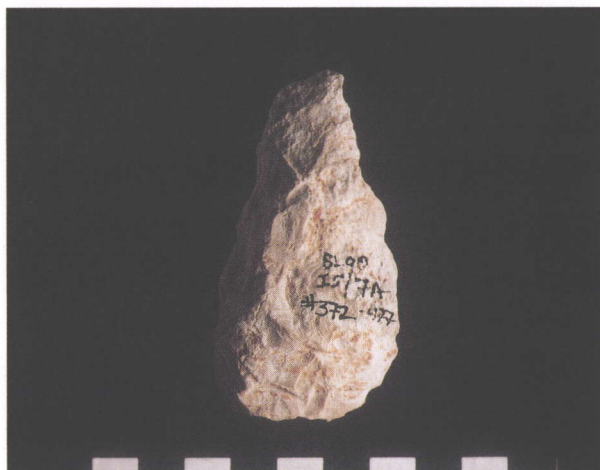
*Photo 8 : Brecha das Lascas. Quartz, core.
(Photo RMAH / R. Mommaerts).*



*Photo 9 : Brecha das Lascas. Flint, flake.
(Photo RMAH / R. Mommaerts).*



*Photo 10 : Brecha das Lascas. Limestone, flake.
(Photo RMAH / R. Mommaerts).*



*Photo 11: Brecha das Lascas. Limestone, handaxe.
(Photo RMAH / R. Mommaerts).*



*Photo 12 : Brecha das Lascas. Limestone, handaxe.
(Photo RMAH / R. Mommaerts).*