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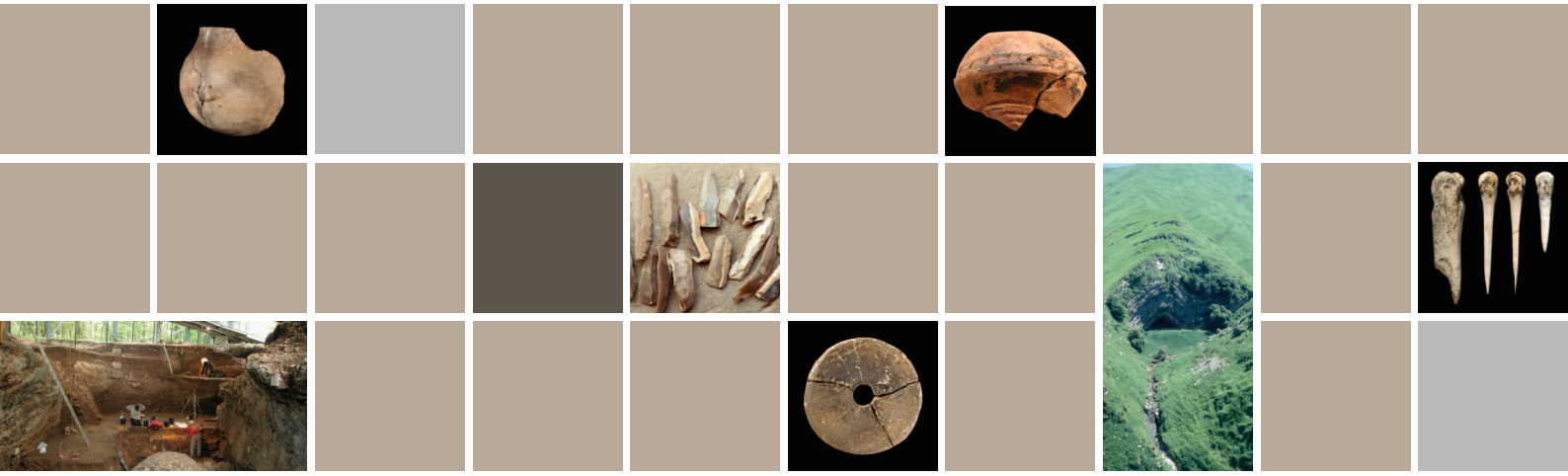

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# Plan of the article

# THE RECYCLING AND REUSE OF CORES AND BIFACES DURING THE MIDDLE PALEOLITHIC IN WESTERN EUROPE:

## functional and cultural interpretations

**Céline THIÉBAUT, Émilie CLAUD, Vincent MOURRE, Maria-Gema CHACÓN, Guillaume ASSELIN, Michel BRENET, Benoît PARAVEL**

**Abstract**

*In several Middle Paleolithic assemblages in Western Europe, cores and bifaces with percussion zones that are not related to their usual mode of functioning have been observed. We used experimental cores and bifaces as percussion tools on different materials. The stigmata produced during percussion on stone materials closely resemble those observed on archaeological objects. Though the use of these pieces as hammerstones or retouchers is difficult to firmly demonstrate, this is the most probable hypothesis. The characteristics of the traces observed are similar to those observed on classic hammerstones. While the recycling of bifaces and cores into hammerstones, sometimes followed by their reuse, depending on their original function, is infrequently observed in Middle Paleolithic assemblages, it appears to be a recurrent characteristic that is independent of environmental constraints or economic or technical contexts. This practice thus seems to be associated with cultural choices, perhaps of a universal nature.*

**Keywords**

*recycling, core, biface, Middle Paleolithic, Western Europe, cultural behavior*

## 1 - Introduction

Lithic artifacts, including bifaces and cores, with percussion marks on their surfaces or edges have long been observed by several researchers (Smith, 1894, cited by Roe 1981, 273; Wymer, 1964; Keeley, 1980). These type of stigmata, described as "impact traces" (Boëda *et al,.* 2004), "percussion and crushing traces" (Moncel, 1995, 1999), "incipient cones of percussion" (Keeley, 1993; Mitchell, 1998) and "battered areas" (Keeley, 1993 ; Mitchell 1998), have since been recorded in other assemblages on Middle Paleolithic cores at Caours and in sites in the Vanne Valley, and on Lower Paleolithic bifaces from Hoxne, Boxgrove, South Woodford and La Grande Vallée, as well as on Middle Paleolithic bifaces from Orgnac and Barbas (table 1).

There may be a correlation between this type of object and that which has been called a "flake with a pecked bulb" (Tixier 2000), which is a flake with traces located on or near the bulb of percussion. Depending on the author, these traces are described as "short, parallel striations and rounded grooves with jagged edges" (Shchelinskii, 1983 in Plisson, 1988, 131) or "very small,

punctiform impact traces, micro-craters or delimited incipient cones, around 0.5 mm, often forming miniscule dotted lines oriented more or less perpendicular to the morphological axis of the tool" (Tixier, 2000, 129). While for V. E. Shchelinskii these are definitely retouchers, J. Tixier and S. Beyries propose the alternative hypotheses that these marks could have been made to improve the adherence of adhesive to the tool, or they could have been created during the "dehafting" of tools (Tixier, 2000, 129). Other than flakes with pecked bulbs, the stigmata present on the lithic remains in question are rarely described or photographed and the interpretations proposed are seldom based on experimental comparisons (see, however, Mitchell, 1998, p. 226-239). Various hypotheses have nonetheless been proposed to explain their origin: use as a hammerstone for flaking or retouching stone materials, as a hammerstone for bone fracturing, as a hammerstone or anvil, as a hammerstone on an intermediate piece, as a hammerstone or anvil to make noise or as an intermediary piece (table 1). The information concerning this phenomenon, whose origin is currently debated, is thus still heterogeneous and generally trivial, even though these traces are observed in many archaeological assemblages and on a rather high number of artifacts whose primary function was not as a hammerstone.

A precise identification of the origin of percussion marks is necessary to complete the available information concerning the technical behaviors of Neandertals. While the hypothesis of a recycling of cores and bifaces in the context of an activity other than that for which they were apparently intended seems plausible, their mode of functioning, the materials worked and the exact objective of their reuse remains to be determined. Our aim was thus to identify, describe and attempt to interpret these traces, which are present in Middle Paleolithic assemblages from several different sites: Cantalouette 1 (Dordogne, excavation M. Brenet), Combe Brune 2 (Dordogne, excavation M. Brenet), Saint-Césaire (Charente-Maritime, excavation F. Lévêque), Chez-Pinaud (Charente-Maritime, excavation J. Airvaux then J. Jaubert), Les Rochers-de-Villeneuve (Vienne, excavation C. Beauval then E. Morin) and Abri Romaní (Catalogne, Spain, excavation E. Carbonell). To reach a functional interpretation of these traces, it is first necessary to precisely characterize the stigmata produced by diverse activities. We thus conducted experiments in the framework of a collective research program entitled "*Des Traces et des Hommes*" (Thiébaut *et al.,* 2009a), which allowed us to create an experimental reference base.

## 2 - Experimental approaches

### 2.1 - The functional hypotheses tested

We only tested the hypotheses based on technical actions and we excluded assumptions which were impossible to test as the one suggesting that the intention was making noise. The possible use as an anvil was not retained because this debitage method has not been observed in the assemblages studied and the traces on archaeological cores are mainly located on their convex or pyramidal surfaces, which are not adapted to this use. The use of bifaces as intermediary pieces was not systematically tested since it implies a precise localization of the traces on two zones opposite each other, which has not been observed on archaeological bifaces, except for two from Cantalouette 1. We also rejected the idea that the edges of bifaces could have been struck in order to facilitate their prehension because the locations of the crushed edges do not correspond to potential or attested prehensile zones on the archaeological bifaces.

The functional hypotheses retained and experimentally tested thus concern percussion tools associated with:
- the working of vegetal materials for technical or alimentary purposes;
- the treatment of animal carcasses;
- the transformation of stone materials, especially stone knapping activities.

These experiments allowed us to test the feasibility of these different actions and to describe the traces produced depending on the material that was struck, and thus to define the criteria of identification of the different use modes through usewear analyses. The material, analyzed in tandem with the experiments, permitted us to identify the type of material worked and thus to orient and advance in our study of the activities associated with the traces compatible with those observed on archaeological artifacts.

## 2. 2 - Experimentation

The following activities were performed in association with seven alimentary or technical objectives:
- tree felling by percussion;
- fracturation and grinding of oak galls to tan skins;
- fracturation of horse long bones and mandibles to extract the marrow;
- crushing and grinding of horse bones to collect the fat to make soup;
- the production of stone blanks (debitage);
- the shaping of cutting-edges (retouch);
- the fracturation of cores.

The reference base was realized using different techniques defined by the type of blank employed (core, chopper or biface), the physical gesture and the morphology of the active zones (dihedral, pyramidal, flat, etc. (table 2).

A total of 88 zones located on 36 cores, 15 bifaces and 18 choppers were used to treat diverse raw materials.

### *2.2.1 - Vegetal materials*

#### 2.2.1.1 - Tree felling

The lateral edges of eight bifaces, hafted or held in the hand with a sheath, were used (figure 1). Several trees with small diameters (around 10 cm) were felled despite problems related to the stability of the bifaces in their handle.

#### 2.2.1.2 - Fracturation and grinding of oak galls

In this experiment, we used three Discoid cores to fracture and reduce galls into powder in order to liberate their tannin for the treatment of hides. The galls were placed on a limestone anvil where they were directly pounded and ground (figure 2). The cores were thus used to work between 20 and 90 oak galls. The techniques used were effective but had no advantage over the use of a simple cobble.

Table 1 - Lists of the assemblages containing one or several pieces with percussion stigmata.
In bold, assemblages studied in the framework of the collective research project "Des Traces et des Hommes".
*the bibliographic references given are only those mentioning the presence of bifaces or cores with percussion marks.

| Sites | Dates BP (mean age) | Site type | Large fauna |
|---|---|---|---|
| Grotte du Renne, Aurignacian levels | 30 800 | cave | horse, reindeer, mammoth, chamois, bos/bison, red deer... |
| **Saint-Césaire, level Egpf** | **40 900** | **rock shelter** | **bison, reindeer, horse** |
| Combe-Grenal, c.11 | OIS 3 | cave | bison, horse, reindeer, red deer... |
| **Jonzac US07** | **41 575** | **collapsed rock shelter** | **large bovids and horse dominant** |
| **Jonzac US08** | **49 250** | **rock shelter** | ***Bos/bison dominant then horse and reindeer*** |
| **Les Rochers de Villeneuve, level N** | **40 700 - 45 200** | **cave** | **red deer, large bovids, hyena, reindeer, horse, mammoth** |
| **Abri Romaní, level M** | **52 200 - 54 500** | **rock shelter** | ***Equus ferus, Cervus elaphus, Bos primigenieus*** |
| La Chapelle-aux-Saints, Bouffia 118 | in progress | rock shelter | *horse, reindeer* |
| **Payre, level D** | **OIS 5 -OIS 8** | **cave** | **bear and red deer dominant** |
| Camiac | - | - | - |
| Le Roc | - | open-air (surface collection) | bisons |
| Vallée de la Vanne | OIS 3 - OIS 5e | open-air | not preserved |
| Caours, sector 1 | 122 000 | open-air | red deer, aurochs, fallow deer, roe deer, wild boar, elephant, ... |
| Barbas, C'3 | 147 000 | open-air | - |
| **Combe Brune 2, level X** | **195 000 ± 16 000** | **open-air** | **not preserved** |
| **Combe Brune 2, level VIIa** | **185 ± 23 -195 ± 16 ka** | **open-air** | **not preserved** |
| **Combe Brune 2, level VIIb** | **187 000 ± 21000** | **open-air** | **not preserved** |
| **Cantalouette 1, level V** | **222 900** | **open-air** | **not preserved** |
| La Grande Vallée | before 200 000 | open-air | - |
| Orgnac, levels 6, 5B, 5a, 4a | 280 000 - 350 000 | swallow-hole | bovids, horse, rabbit dominant |
| La Micoque, level E | 350 000 - 500 000 | rock shelter | horse dominant, red deer, reindeer, bovids |
| Barnfield Pit (Swanscombe Skull, England) | 380 000 - 400 000 | open-air | - |
| Hoxne (Suffolk, England) | OIS 11 | open-air | cervids, horse, aurochs, wooly rhinoceros |
| South Woodford (Essex, England) | - | open-air | not described |
| Boxgrove (West Sussex, England) | 420 000 - 524 000 | open-air | horse, cervids |

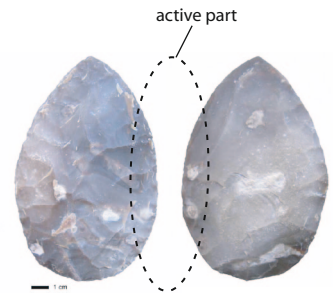
| Industry | Objects with stigmata | Hypotheses | References |
|---|---|---|---|
| blade, bladelet and flake debitage | blade cores | cores struck on an anvil | Bon and Bodu 2002 |
| **Discoid debitage, denticulates** | **44 cores** | **hammerstones for debitage and retouchers** | **Thiébaut 2005 (t. 2, p. 234-238), Thiébaut *et al.* 2009 and PCR** |
| Discoid and Levallois debitage, denticulates and scrapers | cores | hammerstones | Thiébaut 2005 (T. 2, p. 234) |
| **Levallois debitage, biface shaping, scrapers, denticulates and notches** | **7 bifaces (surface and edge)** | **retouchers** | **Claud 2008 (p. 327-349, 375-387, 449-451) and PCR** |
| | **3 cores** | **hammerstones for debitage and retouch and on an intermediary piece** | |
| **Levallois, Discoid, Kostienki debitage, denticulates, scrapers and notches** | **8 cores** | **hammerstones for debitage and retouchers** | **Thiébaut in Jaubert *et al.* 2008 (p. 233-235) and PCR** |
| **Levallois and Discoid debitage, denticulates and scrapers** | **3 cores** | **hammerstones for debitage** | **Asselin 2006 and PCR** |
| **Levallois and Discoid debitage?, denticulates, notches and a few scrapers** | **3 flakes** | **hammerstones for debitage** | **Chacón PCR** |
| biface shaping, discoid debitage, denticulates, scrapers and notches | study in progress | hammerstones | Mourre in Beauval *et al.* 2007 |
| **Discoid debitage almost exclusive, scrapers and convergent tools** | **1 core** | **hammerstone for debitage?** | **Chacón PCR** |
| Discoid debitage, scrapers, denticulates | 1 core | hammerstone for debitage | Thiébaut *et al.* 2007 |
| Discoid debitage, denticulates | cores | hammerstones | Thiébaut 2005 (T. 2, p. 234) |
| not described | cores | occasional hammerstones for debitage | Depaepe *et al.* in Deloze *et al.* 1994 (p. 220) |
| Discoid debitage, unmodified edges | 1 discoid core | hammerstones for knapping or breaking bone | Antoine *et al.* 2006 |
| biface shaping, scrapers and denticulates on biface shaping flakes | bifaces (altered, on edges) | hammerstone without a precise use and/or anvil | Boëda *et al.* 2004 (p. 302) |
| **presence of bifaces, Levallois, Discoid, laminar and trifacial debitage** | **5 cores et 1 bifacial piece** | **hammerstone for debitage and retouch, percussion on an intermediary tool** | **Brenet *et al.* 2008 (p.99, 105, 110, 128, 146, 148) and PCR** |
| **presence of bifaces, Levallois, Discoid, laminar and trifacial debitage** | **3 cores, 1 bifacial piece** | **hammerstones for debitage and retouch** | **Brenet *et al.* 2008 (p.99, 105, 110, 128, 146, 148) and PCR** |
| **presence of bifaces, Levallois, Discoid, laminar and trifacial debitage** | **3 cores** | **hammerstones for debitage and retouch** | **Brenet *et al.* 2008 (p.99, 105, 110, 128, 146, 148) and PCR** |
| **biface shaping, Levallois debitage, scrapers, denticulates and notches** | **3 cores, 1 flake, 2 bifacial pieces** | **hammerstones and intermediary tool** | **Brenet *et al.* 2004 (p. 88-90) and PCR** |
| mostly biface shaping, a few scrapers and denticulates | 1 biface | percussion with a mineral material | Airvaux *et al.* 2007 |
| Levallois debitage, scrapers | 10 bifaces | anvil/hammerstone without details | Moncel 1995 (p. 165), 1999 (p. 157) |
| discoid and polyhedral debitage, Quina scrapers | study in progress | in progress | Paravel unpublished |
| undetermined debitage and shaping, lightly retouched flakes (notches) | 10 + 1 biface (surface) | hammerstone / retouch | Wymer 1964 (p. 32), Wenban-smith and Bridgland 2001 (p. 247, 249, 254) |
| undetermined debitage and shaping | 1 biface (tr.) | no interpretation | Keeley 1980 (p. 143-144) |
| biface shaping, undetermined debitage | 4 bifaces | hammerstone or anvil | Mitchell 1998 (p. 130-135,139-140) |
| mostly biface shaping, a few scrapers and notches | 3 bifaces<br>1 biface | intermediary piece between an element to be crushed (bone/nut) placed on an anvil and a hammerstone | Mitchell 1998 (p. 475-476)<br>Roberts *et al.* 1997 (p. 337-338) |

Table 2 - Activities practiced and characteristics of the utilized zones.

| Activities practiced and number of utilized zones | Type of zone utilized | Morphology of the zone | Angle of the zone | Mean length | Mean width | Mean thickness | Mass |
|---|---|---|---|---|---|---|---|
| tree felling | edges = 8 | dihedral | 48 to 65 | 114 | 75 | 23 | between 82 and 295 |
| bone fracturation n = 12 | edges = 9 | dihedral | 73 to 96 | 95 | 94 | 61 | between 326 and 941 |
| | intersection of the two core surfaces n = 1 | dihedral | 105 | 70 | 79 | 78 | 459 |
| | core surface n = 2 | pyramidal and convex | 90 and 150 | 97 | 87 | 71 | 524 |
| bone crushing and grinding n = 5 | edges = 5 | dihedral | 64 to 88 | 78 | 66 | 52 | between 142 and 442 |
| fracturation and crushing of oak galls n = 4 | core surface n = 4 | pyramidal and convex | 90 to 150 | 61 | 55 | 36 | between 96 and 122 |
| debitage of blocks n = 25 | edges n = 2 | dihedral | 80 and 90 | 75 | 94 | 63 | 465 and 613 |
| | striking platform n = 7 | flat and pyramidal | 90 to 180 | 58 | 59 | 39 | between 89 and 269 |
| flake retouching n = 32 | edges n = 6 | dihedral | 30 to 90 | 81 | 56 | 22 | between 56 and 150 |
| | intersection of the two core surfaces n = 1 | dihedral | 74 | 40 | 35 | 35 | 54 |
| | striking platform n = 5 | convex, concave and pyramidal | 90 to 150 | 50 | 50 | 30 | between 50 and 161 |
| | core surface n = 20 | convex, pyramidal and flat | 90 to 180 | 70 | 58 | 28 | between 49 et 305 |
| core fracturation n = 3 | surface n = 3 | flat and convex | 120 to 180 | 78 | 65 | 34 | between 112 and 245 |

Position
- edge, dihedral morphology
- direct oblique percussion

Hafting




used biface

Figure 1 - Experimental tree felling with a biface (photo: Des Traces et des Hommes, DAO: CT and EC).


Figure 2 - Experimental fracturation and grinding of oak galls with Discoid cores (photo: Des Traces et des Hommes, DAO: CT).

## *2.2.2 - Animal materials*

### 2.2.2.1 - Bone fracturation

A horse tibia, humerus and three mandibles, as well as seven cow femurs, were fractured using nine choppers and two flint cores (one of which was used on its two faces). Most of the bones were placed on a limestone slab and fractured by direct percussion. The edges of the choppers struck the bones in a longitudinal or perpendicular direction relative to their main axis (figure 3). In order to obtain stigmata corresponding to different degrees of tool use intensity, we varied the number of strikes (table 3). While our objectives were attained in nearly all cases, we must recognize that the objects used did not seem to be any more efficient than a simple cobble, or even another bone (Gerbe *et al.* 2009).

Tableau 3 - Number of strikes made during the different activities.

| | Number of strikes | n = |
|---|---|---|
| bone fracturation n = 12 | < 20 | 4 |
| | 20 to 50 | 6 |
| | 51 to 100 | 1 |
| | > 100 | 1 |
| debitage of blocks n = 25 | < 20 | 7 |
| | 20 to 50 | 16 |
| | > 50 | 2 |
| flake retouching n = 32 | < 20 | 4 |
| | 20 to 50 | 6 |
| | 51 to 100 | 14 |
| | > 100 | 9 |

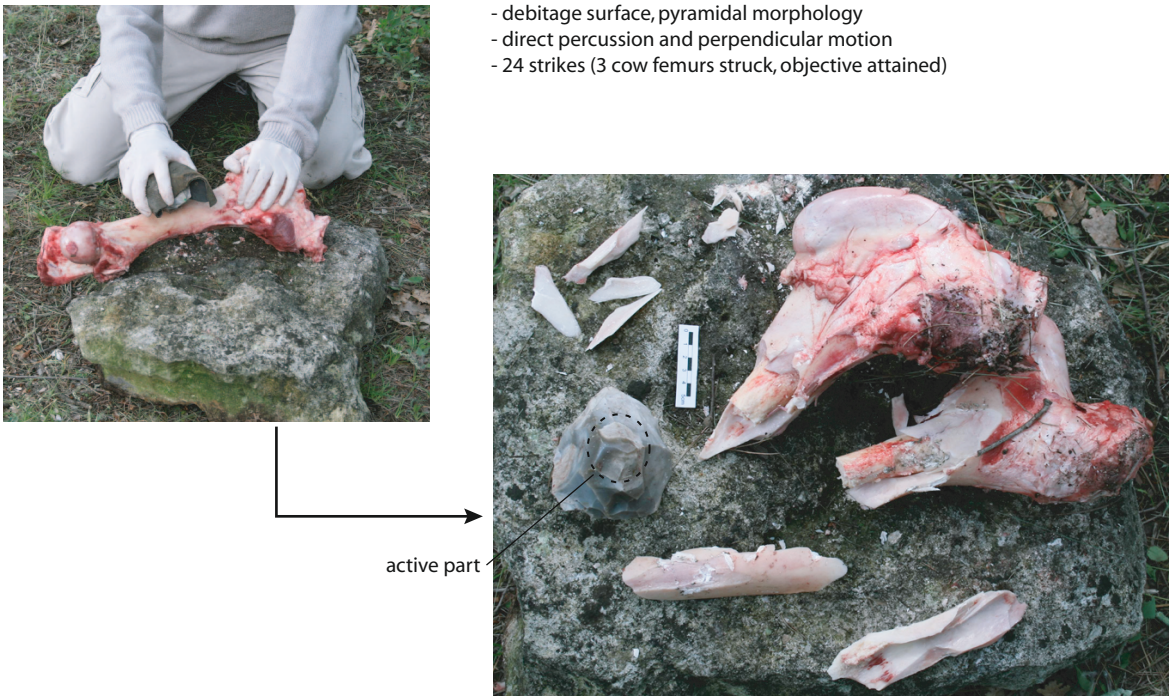



Figure 3 - Experimental bone fracturation with a Discoid core (TH 08 N16) (photo: Des Traces et des Hommes, DAO : CT).

### 2.2.2.2 - Bone crushing

The objective of pounding bones was to crush the *spongiosa* so that it could be used to make a fat based soup. For this experiment, we used horse diaphysis fragments containing *spongiosa* and articular extremities. Five choppers were used for direct percussion only, with varied movements and axes. Only the edges of choppers were used as active parts. The bone fragments were all placed on a small limestone anvil and the choppers were used for 14 to 32 minutes. The use of this tool type proved to be less effective than a simple cobble.

### 2.2.3 - Stone materials

Due to convergences that were rapidly observed between the traces produced experimentally by percussion on hard stones and those present on archaeological objects, we focused our experiments on stone materials. The characteristics of the hammerstones were taken into account, as well as the intensity of use and activity type.

#### 2.2.3.1 - Debitage

A total of 24 zones on 17 hammerstones (cores and choppers) were used to detach flakes using a Discoid method. The flint blocks were held in the hand or placed on the thigh of the knapper and flaked by direct percussion (figure 4). We used active zones with diverse morphologies and varied the use intensity of the hammerstones in order to obtain the broadest reference base possible. The use intensity of objects that struck less than 20 blows was considered to be low, those that struck between 20 and 50 blows as medium, and those that struck over 50 blows as intensive (table 3).

Position of the knapper

- debitage surface, pyramidal morphology
- direct perpendicular percussion
- 30 strikes

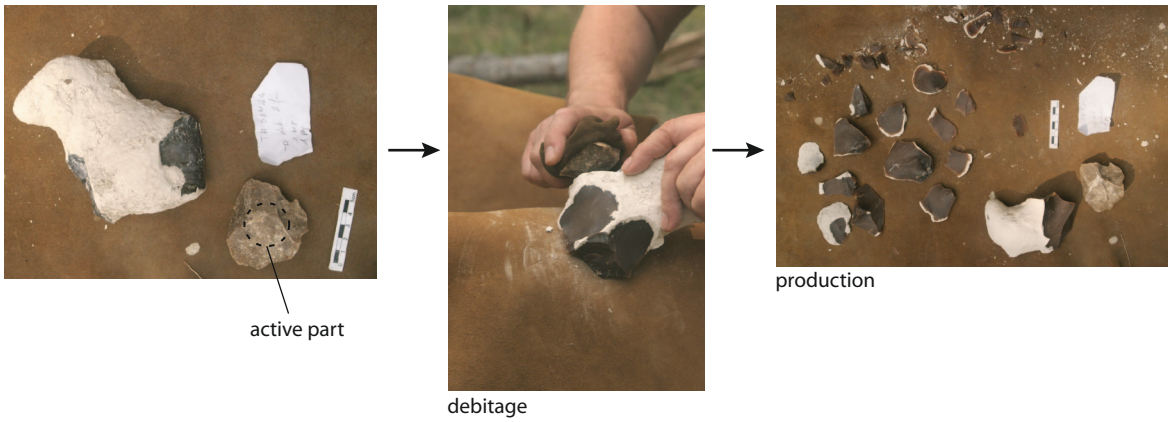



Figure 4 - Experimental debitage of a flint block with a Discoid core (TH 08 N24) (photo: Des Traces et des Hommes, DAO : CT).

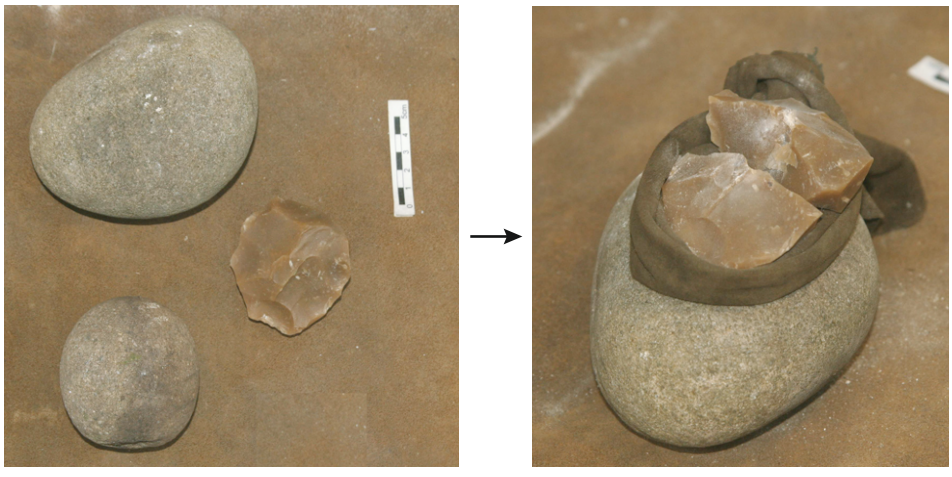
#### 2.2.3.2 - Retouch

All of the blanks retouched in our experiments were of flint. Thirty two zones located on seven bifaces, 14 cores and one chopper were used to retouch end scrapers, side scrapers and denticulates. Once again, varied morphologies and active zones were used (table 2), as well as varied use intensities (table 3).

For both debitage and retouch, the use of cores or bifaces as hammerstones is not the most effective technique, even when their mass is sufficient. According to the knapper (V.M.), a cobble allows better prehension and greater precision. Only the use of a biface edge appears appropriate to realize a microdenticulation on the edge of a denticulate tool. The retoucher in this case is equipped with a dihedral angle that allows greater precision and the production of regularly spaced notches (Thiébaut *et al.,* in press).

#### 2.2.3.3 - Core fracturing

Frequent location of traces on pyramidal surfaces or where the piece thickness is the largest made a priori little likely that they resulted from attempts to fracture them. Nonetheless, since intentionally fractured cores have been identified at some of the sites considered here (Jonzac US08, unpublished observations C.T. and Abri Romaní *in* Thiébaut, 2007), we produced a few experimental examples in order to compare the stigmata present on the cores used as hammerstones and those struck with a stone hammer with the intention of fracturing them. Our experimenter thus attempted to fracture three cores. Two of them were held in the hand and struck by direct percussion with a sandstone cobble. The third one was placed on a sandstone anvil (figure 5). While five and eleven strikes were sufficient to fracture two of the cores, the third was still not fractured after 35 strikes.



- core struck on the debitage surface, pyramidal morphology
- core placed on an anvil and directly struck by a sandstone cobble
- 11 strikes

Figure 5 - Experimental fracturation of a Discoid core (TH 08 N22) struck on an anvil (photo: Des Traces et des Hommes, DAO : CT).

## 2.3 - The stigmata observed on archaeological objects

### *2.3.1 - Observation technique and typology of the observed stigmata*

The observations were made with the naked eye and with a binocular magnifier (magnification 10× to 40×).

Four types of stigmata were identified (figure 12):

- impact cracks with no material loss;
- ripping away of material, initiating from the impact cracks;
- Scaling gradually graduating into small removals;
- crushing, most often located at the point of initiation of scaling and removals.

### *2.3.2 - Description of the stigmata associated with each activity*

#### 2.3.2.1 - Tree felling

The biface edges used for this activity display only small scaling with a bending initiation, identical to the beta type 2 removal scars described by D.-C. Prost (1993), and are rarely superimposed.

#### 2.3.2.2 - Fracturation and grinding of oak galls

The stigmata on the cores used to fracture or crush oak galls are very light; only one piece displays scaling of less than one millimeter on one of its ridges. Being only slightly characteristic and rarely present, these stigmata could be interpreted on archaeological pieces as resulting from natural or accidental processes.

#### 2.3.2.3 – Bone fracturation and crushing

The dihedrals used display superimposed scaling of medium dimensions (14 mm long on average, with a standard deviation of 10.1), and no crushing (figure 6) except on one chopper used to fracture a horse mandible. These crushed areas are highly localized and could result from a contact between the tool edge and the limestone anvil.

No traces are present on any of the core surfaces used, whether they are convex or pyramidal. One of them was nonetheless used to fracture four cow femurs, with a total of 27 strikes on one face and 16 on the other. This observation is very important because it does not support the hypothesis that the crushing and scaling present on cores results from bone fracturing activities (Antoine *et al.* 2006).

The choppers used to crush bone present small superimposed scaling with a maximum length of 17 mm. No crushing was observed.

#### 2.3.2.4 - Debitage and retouch

On all the pieces used (cores, choppers and bifaces), we observed impact cracks, sometimes associated with rips and superimposed scaling of variable dimensions, always in association with crushing.

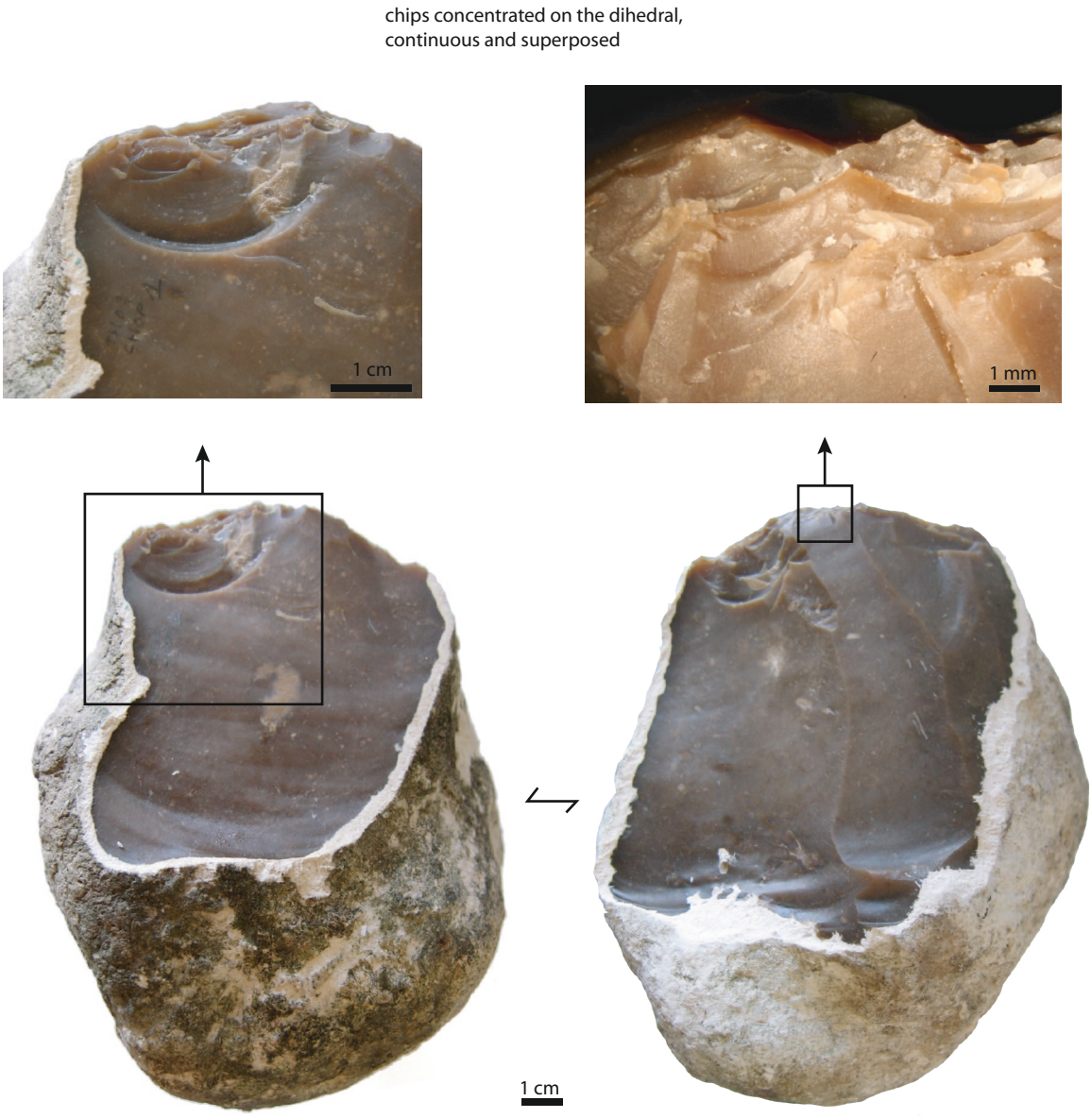
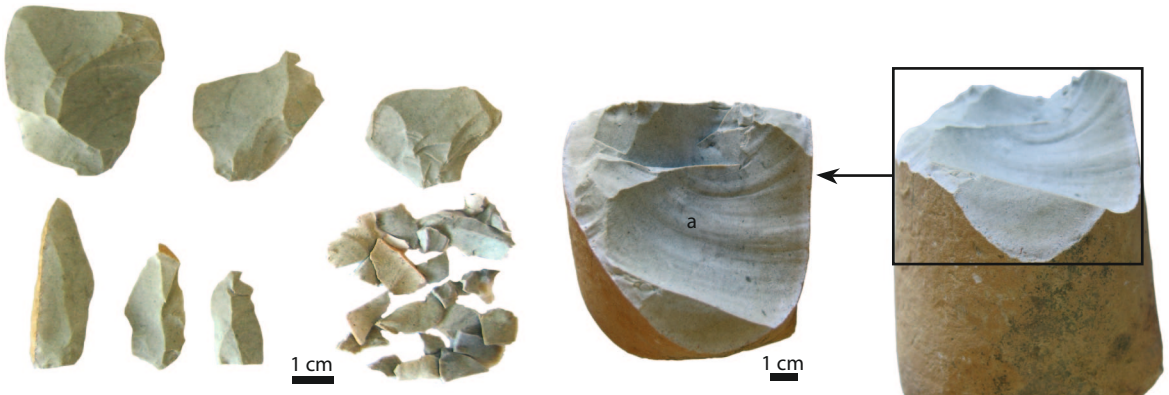
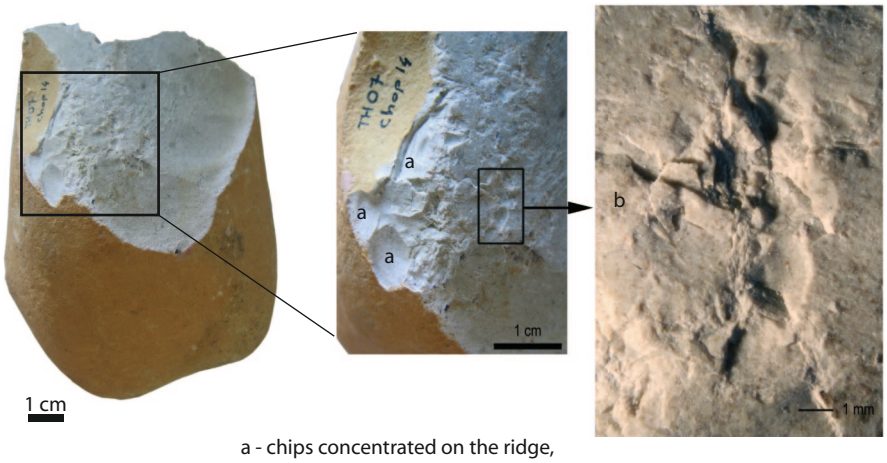



Figure 6 - Stigmata on the edge of a chopper used as a hammerstone to fracture long bones (photo and DAO : CT and EC).

The presence of different types of stigmata depends mostly on the morphology of the active zone. On the zones with a dihedral morphology (chopper and bifaces edges, or the ridge between two core surfaces), we observe mostly chipping, or even removals (figures 7a and 8a), as well as crushing (figure 8b) that completely destroyed the sharp edge, in contrast to bone and vegetal materials. In contrast, when the active parts consist of flat or convex surfaces, only impact cracks and rips are produced (figures 7b and 8c), and the ridges are chipped (figure 9). The pyramidal and convex zones with one or several ridges present the entire range of observed stigmata: cracks and rips on the flat zones and small scaling and crushing at the beginning of the ridges (figure 10).

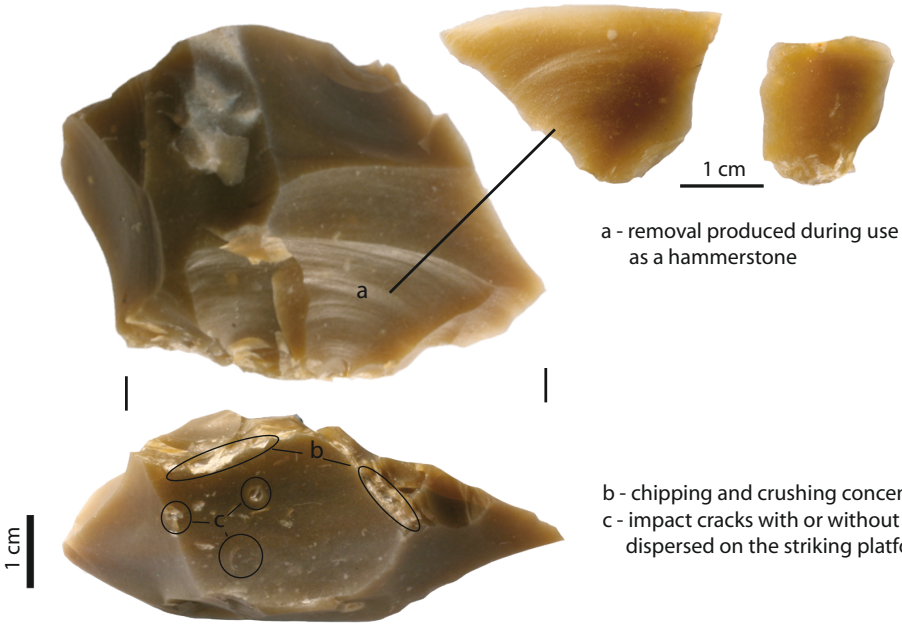



a - removals produced during use of the chopper




a - chips concentrated on the ridge,
b - chipping, crushing and ripping concentrated on the surface, continuous and superposed

Figure 7 - Stigmata present on a chopper used as a hammerstone for the debitage of a block (photo and DAO: CT and EC).




a - removal produced during use of the core as a hammerstone

b - chipping and crushing concentrated on the ridge
c - impact cracks with or without ripping, dispersed on the striking platform surface

Figure 8 - Stigmata present on a core used as a hammerstone the debitage of a block (photo and DAO: CT and EC).

The dimensions, distribution and morphology of these stigmata vary in function of the activity practiced. In the case of debitage, even of a light intensity, the chips are larger, crushing is very frequent and the impact cracks are larger than those produced by intensive retouch. The utilized zones are more damaged, or even completely transformed, with dihedrals becoming convex zones (figure 11).

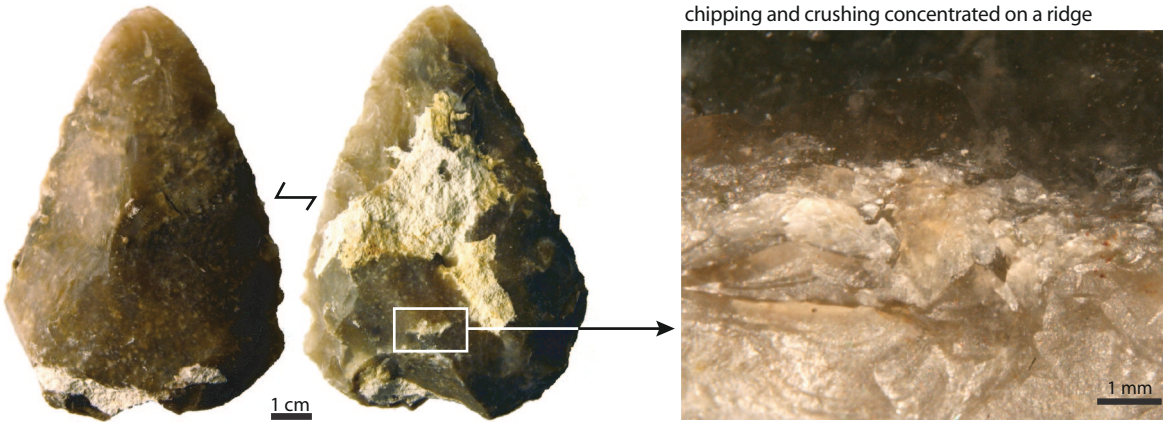
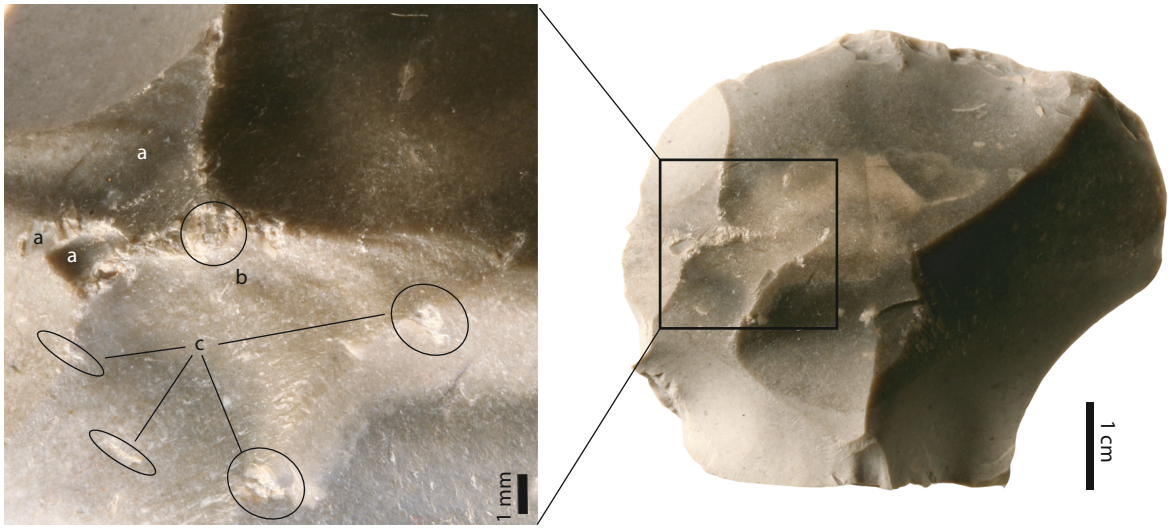



Figure 9 - Stigmata present on a biface used as a retoucher (photo and DAO: CT and EC).




a - chipping on a ridge
b - crushing concentrated on a ridge
c - impact cracks with ripping (linear and oval shaped) dispersed over the ridges and surface

Figure 10 - Stigmata present on a core used as a retoucher (photo and DAO: CT and EC).

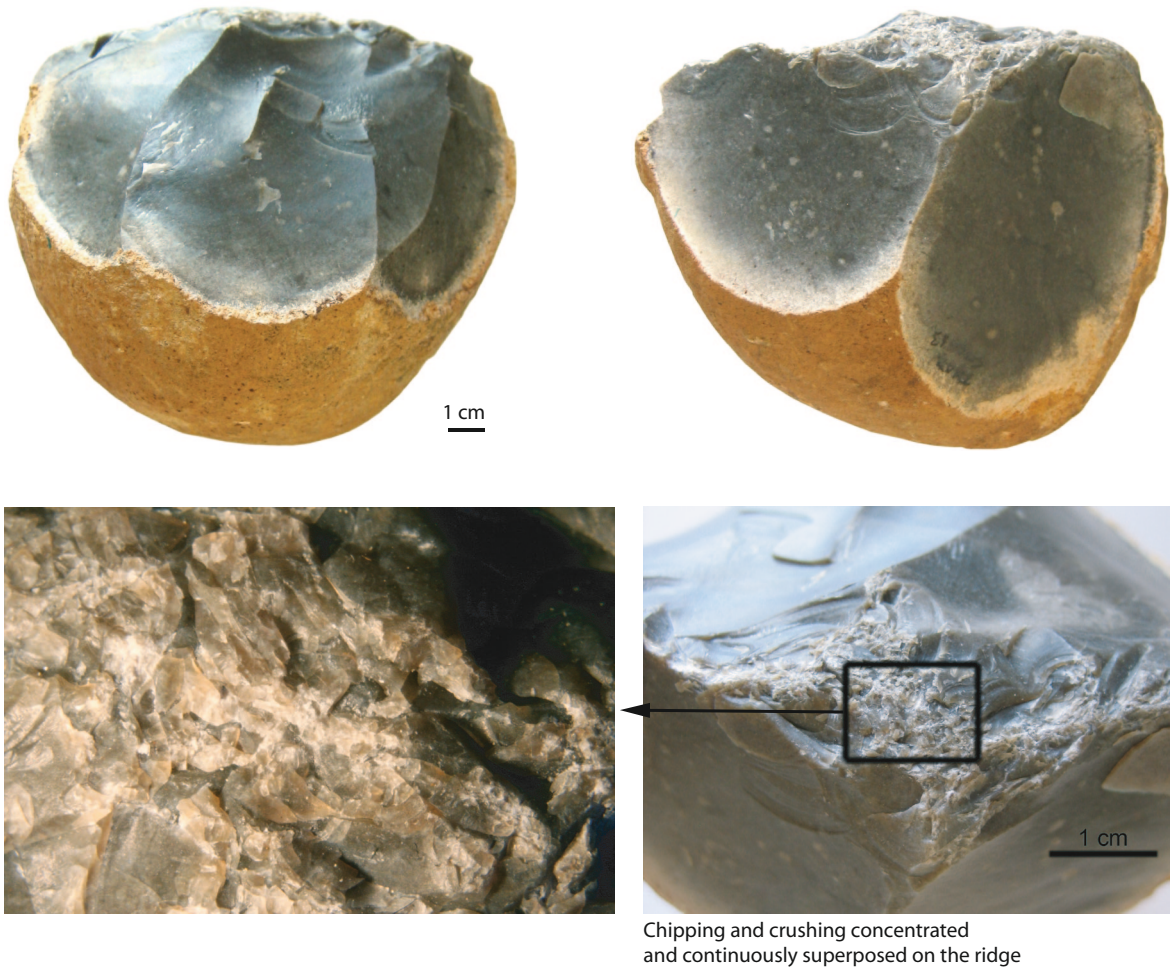



Figure 11 - Stigmata present on a chopper used as a hammerstone for debitage (photo and DAO: CT and EC).

### *2.3.3 - Key elements for the interpretation of archaeological objects*

The presence and number of stigmata depend on the material struck, the morphology of the active zone of the tool and the intensity of use.

#### 2.3.3.1 - Use stigmata and materials worked (figure 12)

Impact cracks are present only on the surfaces of objects used for percussion on stone materials. Meanwhile, not all of the pieces used in this way have this type of use wear. These cracks are thus a discriminating characteristic when they are present, but not when they are absent. They have a punctiform morphology, or sometimes a linear morphology when used as retoucher. They have greater dimensions on cores struck with the intention of fracturing them than on cores uses as hammerstones (figure 13, no. 1).

Rips and crushing are also present only on pieces used in contact with stone materials.

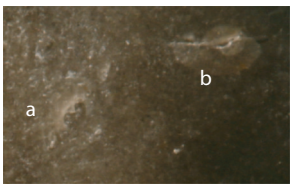
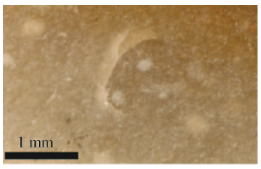
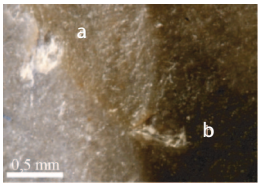
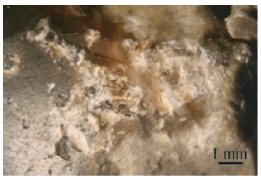
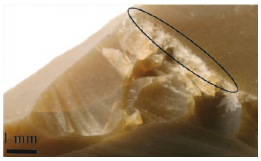
| | | Materials worked | | |
|---|---|---|---|---|
| | | Fresh bone n = 16 | flint: *Retouch* n = 32 | flint: *Debitage* n = 24 |
| stigmata observed | impact cracks | absent |   isolated on one surface a: oval and b: linear |   superposed ovals |
| | ripping / crushing | absent |   ripping isolated on one surface; a: oval and b: linear |  concentrated crushing superposed on one surface |
| | | |   concentrated ripping superposed on one surface |   concentrated crushing superposed on a ridge (at removal initiations) |
| | chipping / removal negatives |   |   |   |

Figure 12 - Stigmata present according to the material worked (photo and DAO: CT and EC).

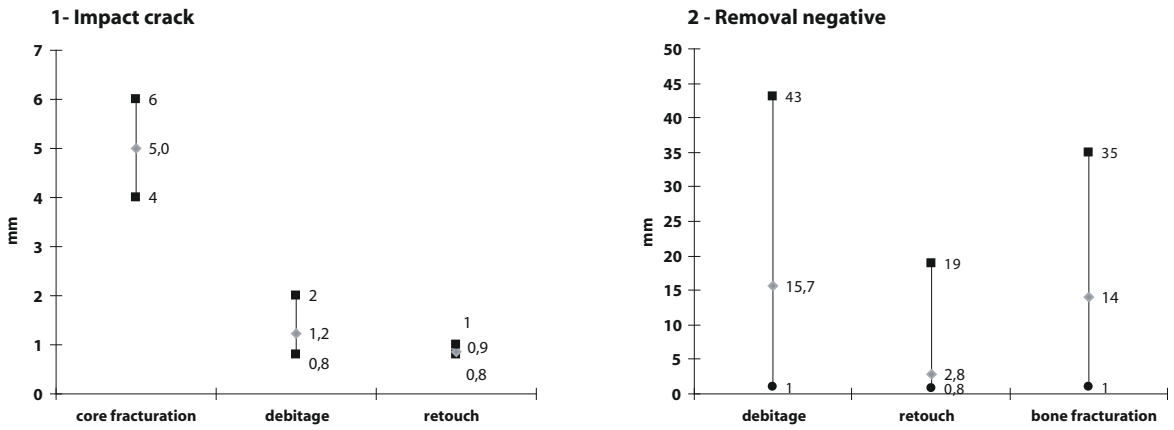



Figure 13 - no. 1, minimum, median and maximum diameter of impact cracks depending on the activity practiced; no. 2, minimum, median and maximum dimension of removal scars depending on the activity practiced.

Though chips do not seem to be a discriminating characteristic for the identification of the material worked, their dimensions are greater on pieces with a dihedral active zone used with a sweeping gesture (debitage or bone fracturation). They are also larger when the hammerstone came into contact with stone (debitage). In some cases, moreover, this resulted in the creation of true removal scars.

### 2.3.3.2 - Use stigmata and the morphology of the active zone (figure 14)

The morphology of the active zone induces certain variations in the types of use stigmata produced and their amplitude. For instance, impact cracks and rips are more often produced on flat or convex surfaces without ridges, while chipping and crushing occurs on convex or pyramidal surfaces with ridges and on dihedrals.

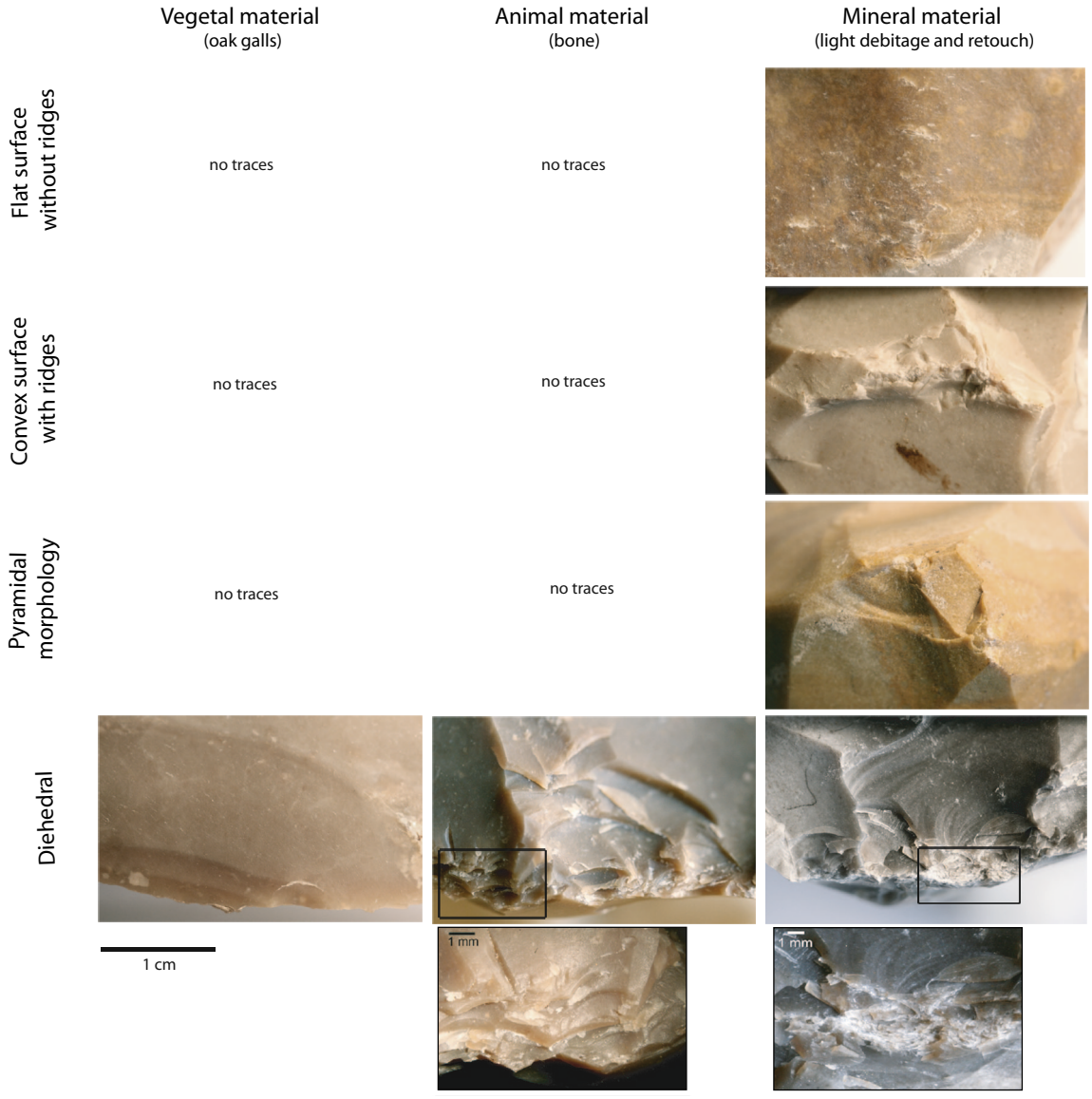



Figure 14 - Stigmata present according to the material worked and the morphology of the utilized zone (photo and DAO: CT and EC).

2.3.3.3 - Use stigmata, activity practiced (debitage versus retouch) and use intensity (figure 15)

While the number of impact cracks depends on the number of strikes, and thus the intensity of use of the hammerstone, their dimensions and morphologies vary in function of the activity practiced. They are smaller on the objects used as retouchers than on those used for debitage (figure 13). In addition, linear morphologies are present only on retouchers. Rips and crushing are also lighter when the active part was used for retouching, even intensive, than when it was used for debitage, even if to detach only a few flakes.

The chips produced during debitage, even of light intensity, are also larger than those produced through intensive retouch.

Following these observations, analysis of the characteristics of use stigmata according to the morphology of the active zone allows us to differentiate a zone used for debitage from one used for retouch and gives an approximate indication of the intensity of use of the hammerstone, regardless of the morphology of the active zone.

## 3 - Comparisons with archaeological objects

The sole interest of the experimental approach implemented here was to better understand the functions and functioning of the archaeological pieces with percussion traces present in the assemblages studied. Ten assemblages from varied economic and technical contexts were considered (table 4). Within each one, the proportion of remains with percussion traces is rather low (between 1 and 8%), except for those of Saint-Césaire and Combe Brune 2 (niveau X), in which the proportion of cores with percussion traces is 14% and 16% respectively, as well as that of Jonzac US07, in which nearly 19% of the bifaces have these types of traces (table 5).

### 3.1 - Nature of the material struck and activities identified

Comparisons of the stigmata observed on the archaeological objects from the different sites studied with those documented by our reference base allowed us to identify the use of archaeological cores and bifaces as tools used in the percussion of stone materials. They systematically present impact cracks, as well as rips or crushing, that indicate contact with a stone material.

The traces present on nearly all the archaeological pieces concerned (107/111 active zones) are identical to those that resulted experimentally from the debitage of a block or the retouching of a flake. The location, distribution and characteristics of the stigmata, as well as the morphology of the utilized zones, are similar to those observed on flint nodules and quartz cobbles whose interpretation as hammerstones is accepted by the scientific community.

Both debitage and retouch activities were sometimes identified on the same piece, but in distinct zones. This is the case of two cores from Saint-Césaire.

A few zones (n = 5) are difficult to interpret because they could have been used for either light debitage or heavy retouch.

Four cores (Saint-Césaire, Jonzac US07 and Combe Brune 2) have percussion stigmata in a concavity. While this morphology excludes their use for direct percussion in debitage or retouch, the stigmata are nonetheless linked to a percussion activity on a stone material. These cores could thus have been used to strike the edge of an intermediary piece (figure 16).

The number of objects, the number of utilized zones and the functional interpretation of artifacts in the sites considered are summarized in the following table (table 4).

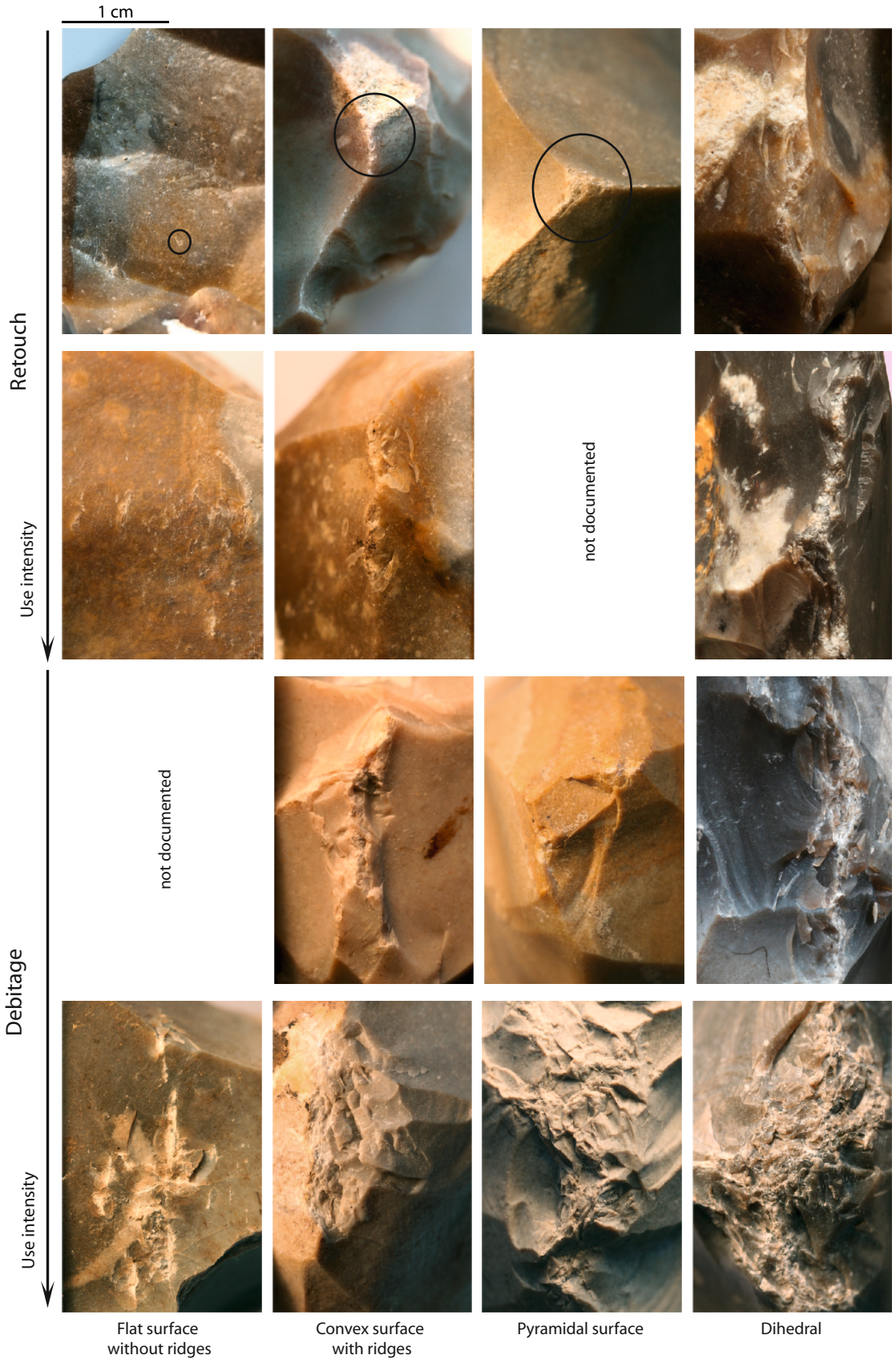



Figure 15 - Stigmata present according to the activity practiced and the use intensity (photo and DAO: CT and EC).

Table 4 - Synthesis of the general characteristics of the archaeological assemblages studied, number of pieces with percussion impacts and functional interpretation.

* in this case, the use of cores for percussion on a stone material is attested by knapped flakes with percussion marks on their upper face.

| Site | Typological facies | Site function | Lithics n = | Phases of the *chaîne opératoire* |
|---|---|---|---|---|
| **Rochers de Villeneuve, level N** | Denticulate Mousterian | hyena den and temporary habitat | 9105 | all |
| **Saint Césaire, level Egpf** | Denticulate Mousterian | undetermined habitat | 46 974 | all, with importation of raw and retouched blanks in Turonian flint |
| **Chez-Pinaud / Jonzac, US07** | Mousterian of Acheulean Tradition | undetermined habitat | 3171 | all, with importation of bifaces in Turonian flint and sandstone quartzite |
| **Chez-Pinaud / Jonzac, US 08 (sample from excavations before 2007)** | Mousterian | undetermined habitat | 1968 | all, with importations of quartz and quartzite cobbles |
| **Combe Brune 2, level X** | Early Mousterian with bifaces | blank production site with exportation, *in situ* consumption of 6.5% of the blanks | 553 | import of initially prepared cores, *in situ* production and export of blanks |
| **Combe Brune 2, level VIIa** | Early Mousterian with bifaces | blank production site with exportation, *in situ* consumption of a small quantity of blanks | 952 | import of initially prepared cores, *in situ* production and export of blanks |
| **Combe Brune 2, level VIIb** | Early Mousterian with bifaces | blank production site with exportation, *in situ* consumption of a small quantity of blanks | 4623 | all, with exportation of nearly 20% if the blanks produced |
| **Cantalouette 1, level V** | Early Mousterian with bifaces | site of production and consumption of bifacial tools | 4163 | all, with importation of a few bifaces in exogenous flint |
| **Payre** | Ferrassie type Charentian Mousterian | temporary habitat | 2 979 | flint: all phases *in situ*<br><br>basalt and quartz: segmented sequence |
| **Abri Romaní** | Denticulate Mousterian | habitat | 6 087 | all, with importation of raw and retouched blanks in flint and limestone |

| "Classic" hammerstones | Cores and bifaces | Cores and bifaces used as hammerstones | Active zones n = | Functional interpretation (I : intensité) |
|---|---|---|---|---|
| n = 2 in quartzite | cores = 46<br>bifaces = 0 | cores = 2 | cores = 2<br>flake = 1 | **- debitage: I medium (2)**<br>- undetermined |
| n = 2 in flint | cores = 305<br>bifaces = 0 | cores = 44 | cores = 58 | - debitage: I light (9), medium (20), medium/high (5), high (6), undetermined (5)<br>- retouch: I medium/light (2), high/medium (3), high (2)<br>- undetermined: debitage or retouch (4)<br>- other activity: percussion on an intemediary piece? (2) |
| n = 7 in quartz/quartzite,<br>1 in sandstone,<br>1 in flint | cores = 145<br>bifaces = 48 | cores = 3<br>bifaces = 9 | cores = 3<br>bifaces = 9 | - debitage: I very high (1)<br>- retouch: I medium (1)<br>- other activity: percussion on an intermediary piece (1) ?<br>- debitage: I undetermined (1)<br>- retouch: I very light (2), light (4), medium (2) |
| n = 19 in quartz/quartzite,<br>4 in flint | cores = 154<br>bifaces = 2 | cores = 7<br>tested block = 1 | cores = 8<br>tested blocks = 2 | - debitage: I light (2), high (1)<br>- retouch: I light (2), medium (2), high (1)<br>- debitage: I light (1), medium (1) |
| n = 3 in quartzite | cores = 31<br>bifaces = 5 | cores = 5<br>bifaces = 1 | cores = 6<br>bifaces = 3 | - debitage: I medium (1), very high (1)<br>- retouch: I light (2), high (1)<br>- other activity: percussion on an intermediary piece (1) ?<br>- debitage: I medium (2), high (1) |
| n = 17 in quartzite | cores = 93<br>biface = 9 | cores = 3<br>bifaces = 1 | cores = 4<br>bifaces = 2 | - debitage: I medium (2)<br>- retouch: I light (1), high (1)<br>- debitage: I medium (1), high (1) |
| n = 3 in flint,<br>n = 10 in quartzite | cores = 120<br>biface = 3 | cores = 3 | cores = 4 | - debitage: I medium (1), high (2)<br>- retouch: I high (1) |
| n = 6 quartzite<br>1 in sandstone | cores = 35<br>biface = 80 + 36 preforms | cores = 3<br>bifaces = 2<br>flake = 1 | cores = 6<br>bifaces = 4<br>flake = 1 | - debitage: I light (1), medium (2), high (2)<br>- undetermined: debitage or retouch (1)<br>- debitage: I very light (1), medium (1), high (1)<br>- undetermined: light debitage or intensive retouch (1)<br>- debitage: I medium (1) |
| n = 1 in limestone<br>4 in quartzite<br>40 in basalt<br>1 other | cores = 89<br>biface = 0 | core = 1 | core = 1 | **- debitage: I high? (1)** |
| n = 24 in limestone<br>2 in schiste<br>1 in sandstone | cores = 57<br>biface = 0 | core = 0* | | |

Table 5 - Proportion of remains with percussion marks.

| Assemblages | Cores (total number) | Bifaces (total number) | Used cores (number) | Used bifaces (number) | Cores used (%) | Bifaces used (%) |
|---|---|---|---|---|---|---|
| RDV | 46 | - | 2 | - | 4,3 | - |
| ST-Césaire | 305 | - | 44 | - | 14,4 | - |
| Jonzac US07 | 145 | 48 | 3 | 9 | 2,1 | 18,8 |
| Jonzac US08 | 154 | 2 | 8 | 0 | 5,2 | 0,0 |
| CB2, 1000 | 31 | 5 | 5 | 1 | 16,1 | 20,0 |
| CB2, 6500-7000 | 93 | 9 | 3 | 1 | 3,2 | 11,1 |
| CB2, 70 000 | 120 | 3 | 4 | 0 | 3,3 | 0,0 |
| Cantalouette 1 | 35 | 116 | 3 | 2 | 8,6 | 1,7 |
| Payre, level D | 89 | - | 1 | - | 1,1 | - |

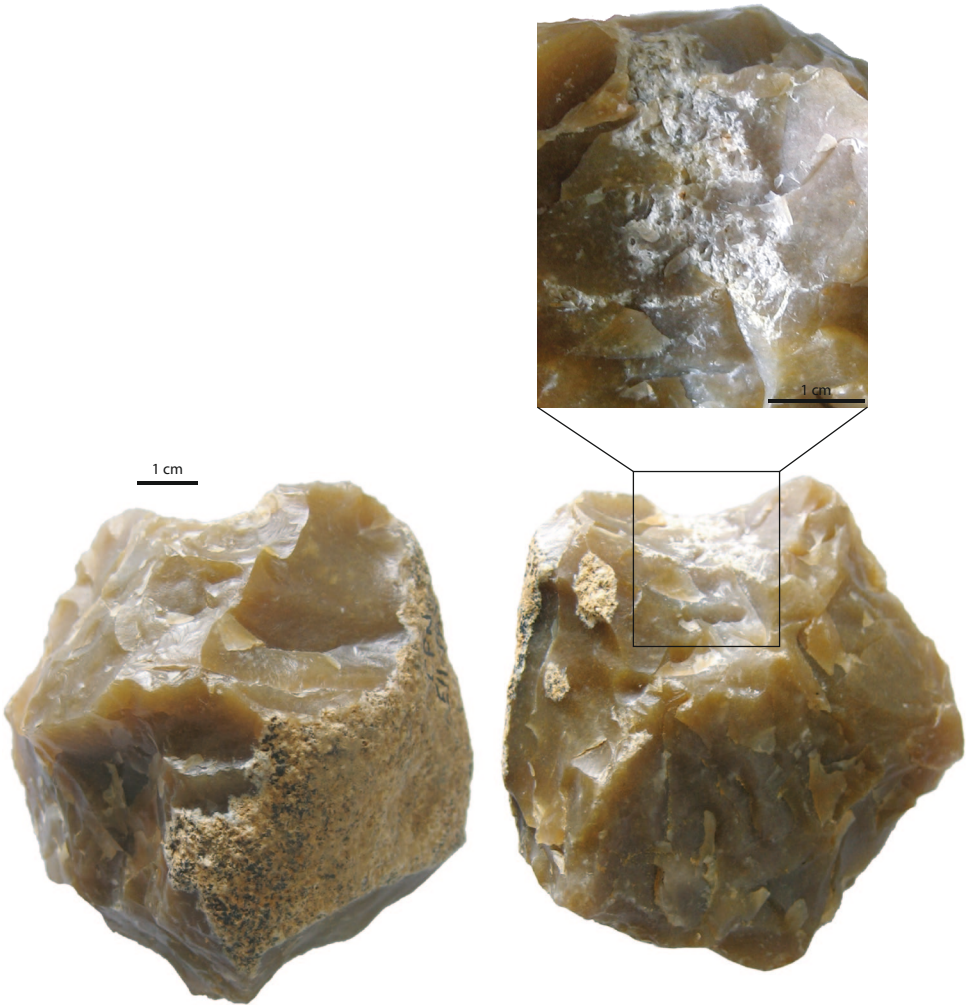



Figure 16 - Core from Jonzac US07 with percussion marks in a concave zone (photo and DAO: CT and EC).

## 3. 2 - Bifaces and cores used as hammerstones for debitage

This activity was identified in all of the assemblages studied. It concerns both cores and bifacial pieces.

Nearly half of the cores used were produced through a Discoid debitage method. We nonetheless cannot conclude that cores produced with this method were preferentially selected because they are most frequently represented in assemblages with a high number of cores used as hammerstones (Saint-Césaire). They are followed by cores originating from the first phases of exploitation and by undetermined cores (figure 17). The bifaces that could have be used as hammerstones for debitage and which were not subsequently reshaped (n = 2 with 5 zones) come from Combe Brune 2 and have rather large dimensions and masses (135 × 93 × 53 mm for 580 g and 98 × 88 × 34 mm for 256 g).

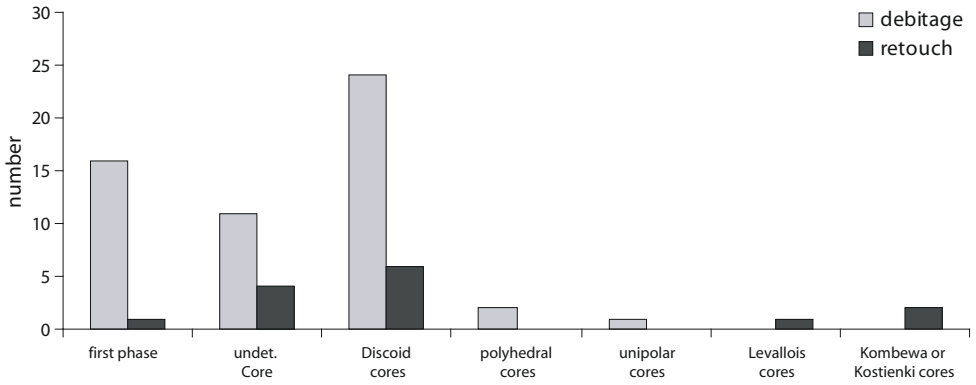



Figure 17 - Archaeological core types originating from the assemblages studied and with percussion marks related to their use as a hammerstone for debitage or retouch.

The intensity of the traces resulting from this activity is highly variable, ranging from very low to very high (figure 18, nos. 1 and 3). The intensively used pieces, such as certain cores from Saint Césaire, or even more so, one of the cores from level X of Combe Brune 2 (figure 19), thus do not appear, as we could be expected, to have been used only due of a lack of other better adapted hammerstones to occasionally detach a small number of flakes.

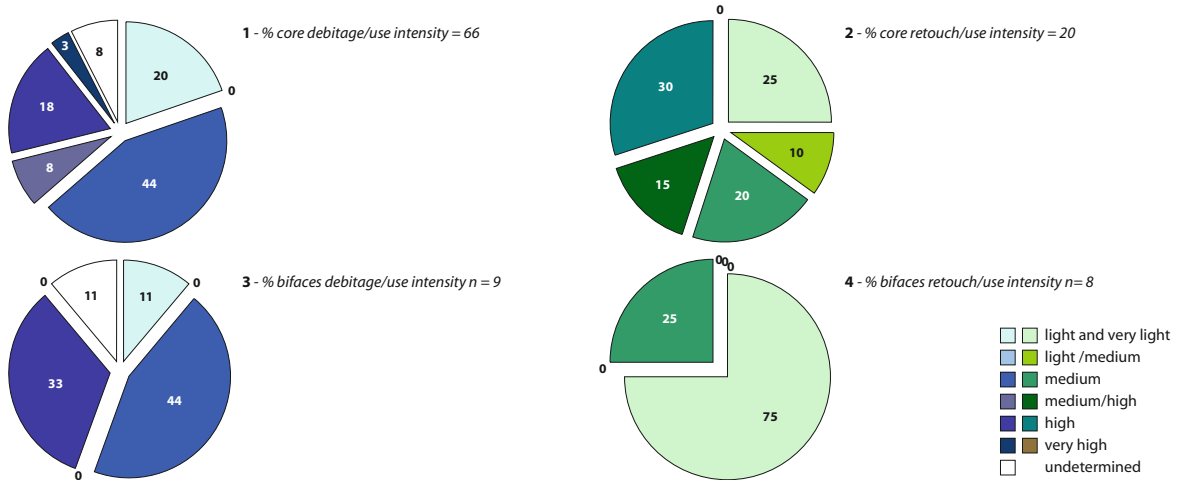



Figure 18 - Proportion of cores and bifaces used according to the activity practiced and the use intensity.

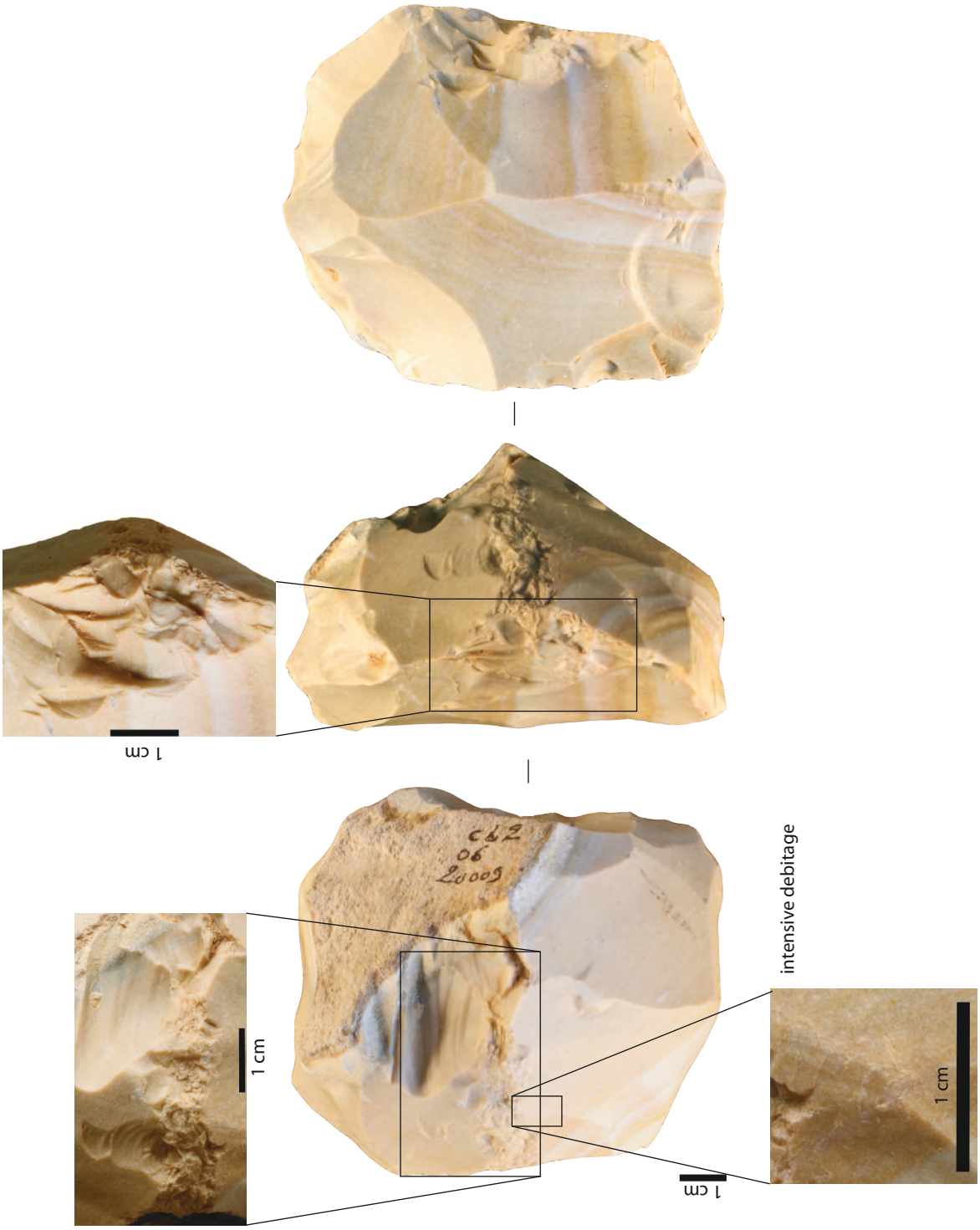



Figure 19 - Core from Combe Brune 2, niv. X, used as a hammerstone for debitage (photo and DAO: CT and EC).

Two or three active zones are sometimes present on a single object; this is the case at Saint-Césaire, Jonzac US08, Cantalouette 1 (figure 20, n° 4) and Combe Brune 2.

Though most of them are convex, the active zones have rather variable morphologies (flat, convex, pyramidal and dihedral). On the cores, most of the active zones used for debitage are located on the debitage surface (figure 20, nos. 2 and 3), sometimes on the striking platform (figure 20, no. 1), and rarely at the intersection between the debitage surface and the striking platform. On the bifacial pieces, most of the traces are located on the faces, but the edges of bifaces were also used in two out of nine cases (figure 21, nos. 1 and 2).

The utilized surfaces sometimes have cortex that is not intersected by removals and it is thus impossible to know whether their use as a hammerstone preceded the debitage of the nodule or not: this is the case for 15 of the 58 utilized zones at Saint-Césaire, one zone of one piece from level V of Cantalouette 1, and 2 cores from Jonzac US07 and US08.

### 3.3 - Bifaces and cores used as retouchers

The assemblages from Saint-Césaire, Combe Brune 2 (all levels) and Jonzac US08 and US07 yielded cores and/or bifacial pieces that could have been used as retouchers.

Discoid cores are also predominant in this case, but we must note the presence of one Levallois core from level VIIa of Combe Brune 2 and two cores on flakes at Jonzac (one from US07 and another from US08 are of the Kostienki type, figure 22, no. 1). All of the utilized bifaces come from level US07 at Jonzac and can be categorized as "denatured" bifaces (Claud 2008). These latter were used as retouchers after several resharpenings or even a transformation resulting in the loss of their initial functional properties (figure 23). With the cores, this activity was practiced with varying intensities, though high intensities are rather well represented (30 %, or 6 zones out of 20, figure 22, no. 3). The bifaces, on the other hand, were not intensively used (figure 18, nos. 2 and 4). While most of the pieces could have been used to resharpen an edge or to create a denticulate, for example, others were used more intensively. Therefore, at least some of these retouchers were considered by the Neandertal artisans to be efficient tools.

As is the case with debitage, the same object can have two or three active zones dedicated to retouching, such as at Jonzac US08 and Saint-Césaire (figure 22, no. 2).

The active zones are most often located on the debitage surfaces of cores, but also sometimes on the striking platforms (Saint-Césaire) or on the lower face of cores on flakes, as at Jonzac US08. On bifacial faces, the utilized zones are randomly located on the edges and the faces. The most common morphology is convex, despite the use of pyramidal and dihedral zones.

### 3.4 - Relationships between the mass and function of bifaces and cores used as hammerstones

When a comparison is possible, the archaeological bifaces and cores with stigmata interpreted as being the result of use as retouchers are generally lighter and smaller than most of those interpreted as hammerstones for debitage (figure 24). In the Cantalouette 1 and Combe Brune 2 assemblages, the mass distribution of bifaces and cores used as retouchers and as hammerstones is similar to that of the more classic retouchers and hammerstones on blocks: the retouchers have masses between 48 and 149 g and the hammerstones between 50 to 1350 g, with a majority of values at around 300 g. The cores and bifaces used as hammerstones and retouchers were probably selected based on their weight; moreover, their range of masses does not differ from that of more classic hammerstones and retouchers (figure 22, no. 1).

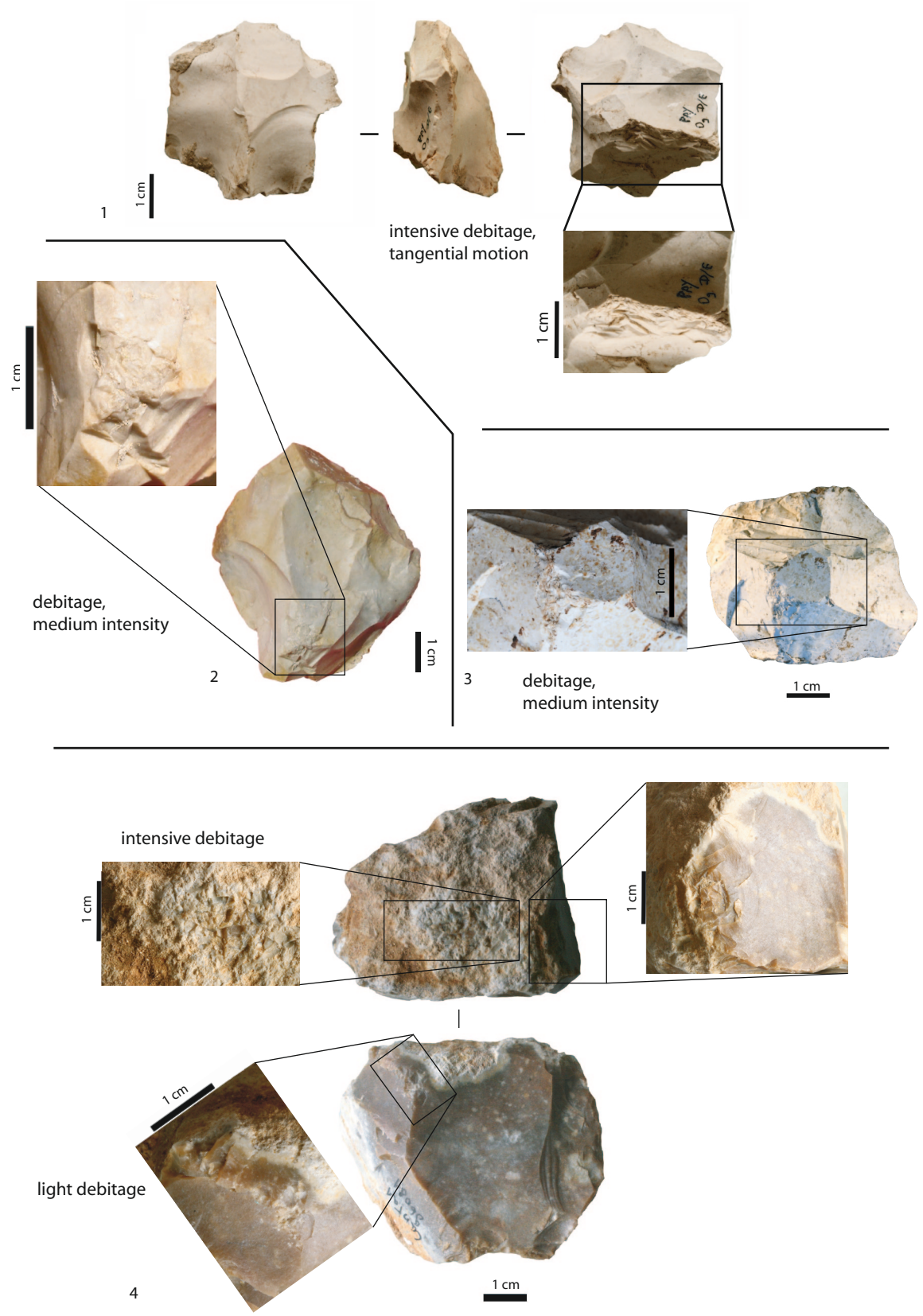



Figure 20 - Cores used as hammerstones for debitage. No. 1,Romaní, level M; no. 2, Saint-Césaire, level Egpf; no. 3, Les Rochers-de-Villeneuve, level N; no. 4, Cantalouette 1, level V (photo and DAO: CT and EC, MGC and GA).

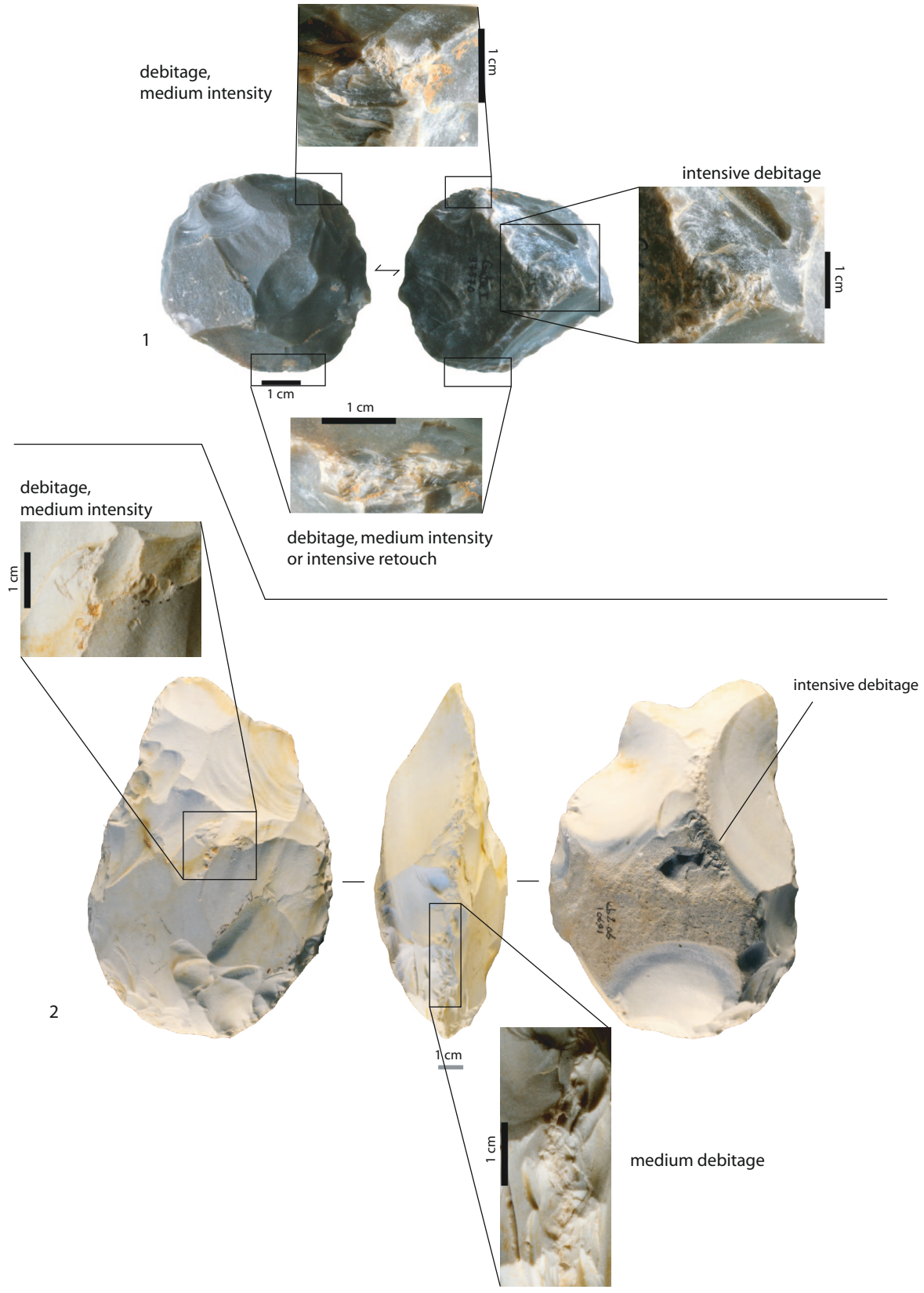
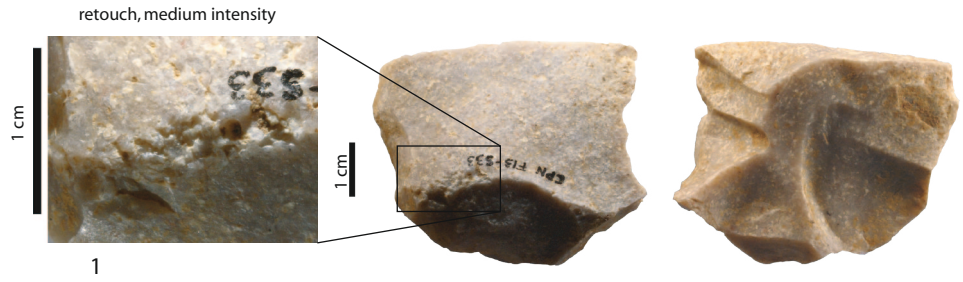
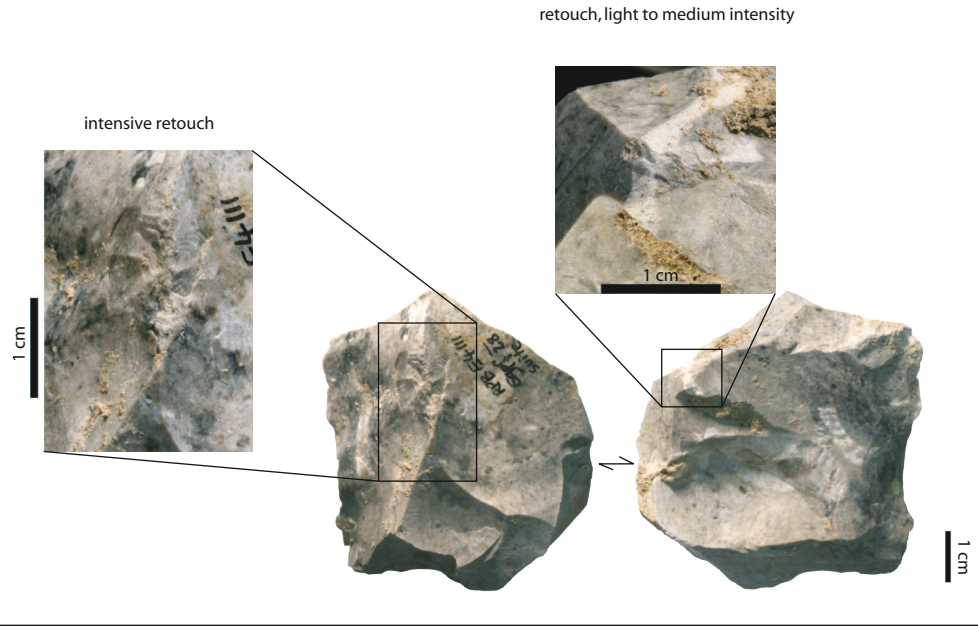



Figure 21 - Bifacial pieces used as hammerstones for debitage.
No. 1, Cantalouette 1, level V; no. 2, Combe Brune 2, level X (photo and DAO: CT and EC).



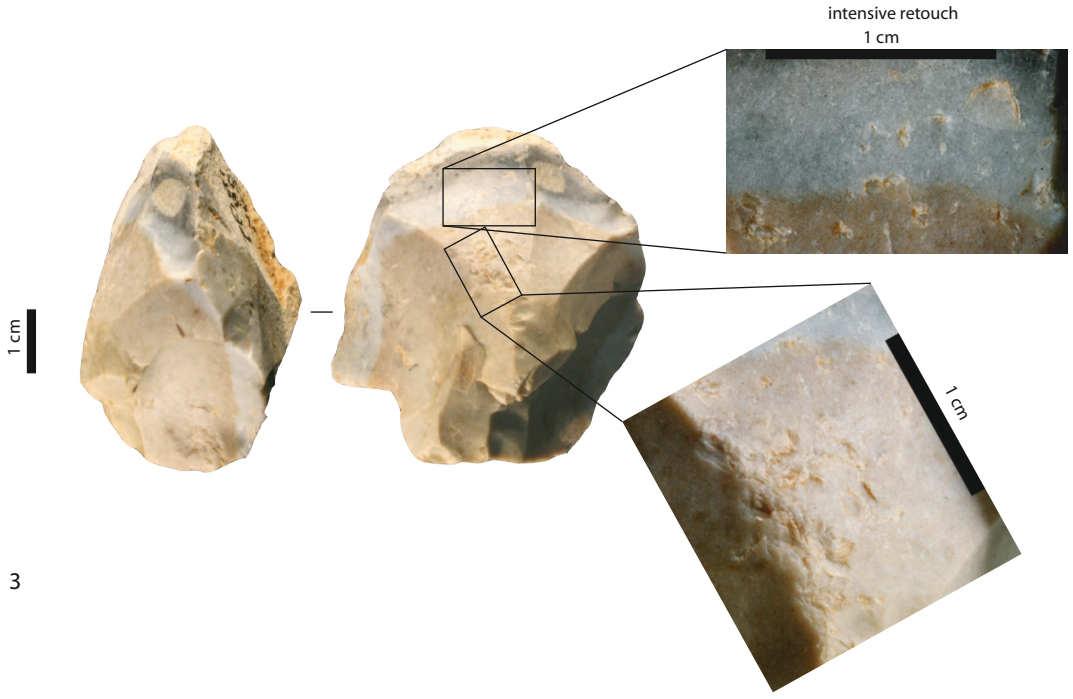
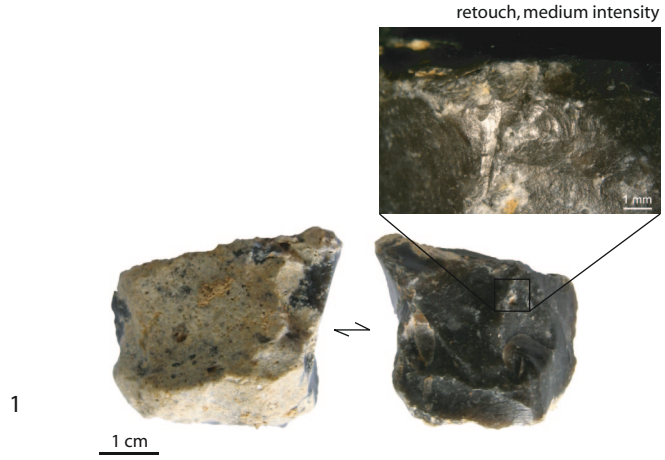
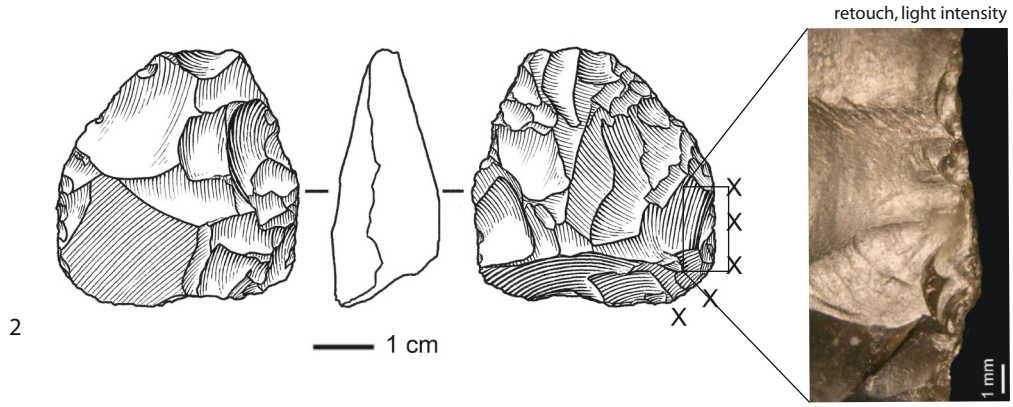




Figure 22 - Cores used as retouchers. No. 1, Jonzac US08; no. 2, Saint-Césaire, level Egpf; no. 3, Combe Brune 2, level VIIb (photo and DAO: CT and EC).



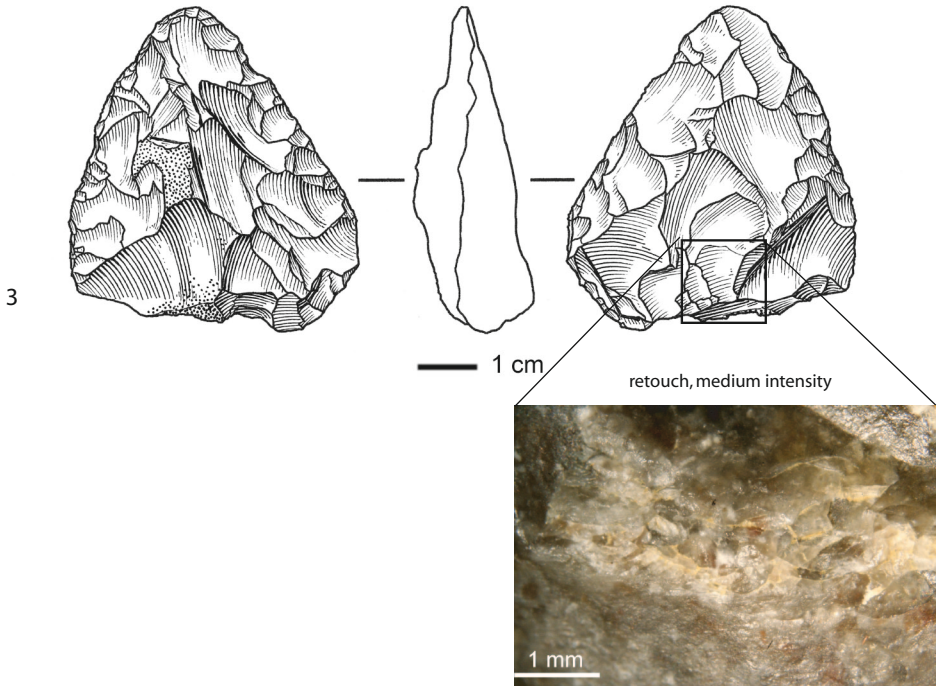




Figure 23 - Bifaces from Jonzac (US07) used as retouchers (photo and DAO: CT and EC, drawings S. Pasty).

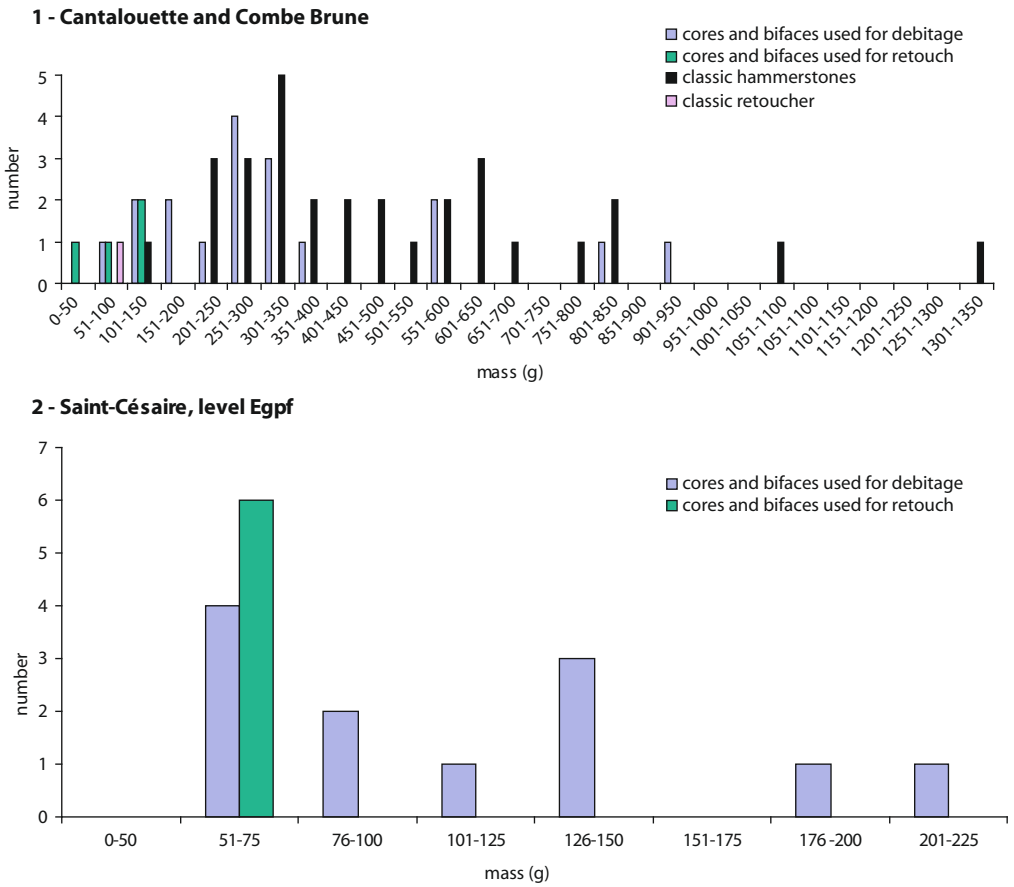



Figure 24 - Mass of classic archaeological cores, bifaces and hammerstones.
* These are cores that were not re-flaked or re-shaped after their use as a percussion tool. The assemblages of Cantalouette 1 and Combe Brune 2 were grouped together because they yielded objects produced form the same types of blocks.

# 4 - Discussion

## 4.1 - Toward a dynamic vision of the functioning of cores and bifaces: recycling, reuse, or the integration of two functions?

The primary intended use of cores and bifaces was not as hammerstones. Cores are defined as sub-products resulting from the exploitation of raw material volumes to obtain flakes (Inizan *et al.,* 1995), while bifaces were generally fabricated to be used in the treatment and exploitation of organic materials (Claud, 2008), even if some bifaces may have secondarily furnished flakes that were used as tools (Geneste, 1985; Soressi, 2002; Faivre, 2003; Boëda *et al.,* 2004; Brenet *et al.,* 2006; Faivre, 2006; Claud, 2008). The presence of percussion traces on cores and bifaces thus indicates that their use sometimes deviated from their primary intended function, a practice that could be interpreted as simple recycling. However, these objects were sometimes reused after their use for percussion activities: the presence of removal scars that intersect percussion traces show that they were subsequently reflaked or reshaped. Some cores and bifaces thus returned to their primary intended function. These intersecting removals, frequently observed at Saint-Césaire (n = 17/58), have also been identified on one biface and one core from Jonzac US07, one core from Rochers-de-Villeneuve, two cores and one biface from Combe Brune 2 and one bifacial piece from

Cantalouette 1. Some assemblages have also yielded flakes with percussion stigmata on their upper face that are identical to those observed on cores and bifaces: these stigmata also attest to the reuse of these objects, consisting of a re-flaking of the cores and re-shaping of the bifaces after their use as hammerstones. Such flakes are present at Abri Romaní, Saint-Césaire, Jonzac, Rochers-de-Villeneuve and Payre (table 6 and figure 25). Most of these objects appear to have been detached from the core after it was used as a hammerstone for debitage. Only three biface flakes from Jonzac US07 and four from Saint-Césaire have stigmata indicating a probable use of the initial tool as a retoucher. The flakes are cortical, partially cortical, as well as ordinary, with a cortical back or overshot back, indicating the use of cores at different stages of their exploitation and/or on different parts of them (striking platform, debitage surface). The sizes of the detached flakes are sufficient to indicate an intentional production of flakes, rather than an unintentional removal of large chips linked to the use of cores or bifaces. At Rochers-de-Villeneuve and Saint-Césaire, two flakes were subsequently retouched into denticulates, and one was then flaked (figure 25, no. 1) and the other thinned. Two others, from Jonzac US08 and Saint-Césaire, were transformed into cores.

Use as a hammerstone thus does not forcibly constitute the last stage in the use life of these objects and is distinct in this sense from a definitive recycling (figures 26 and 27). It is possible, as in the case of Saint-Césaire, for example, that the flint blocks integrated two distinct functions: as a source of raw material and as a hammerstone.

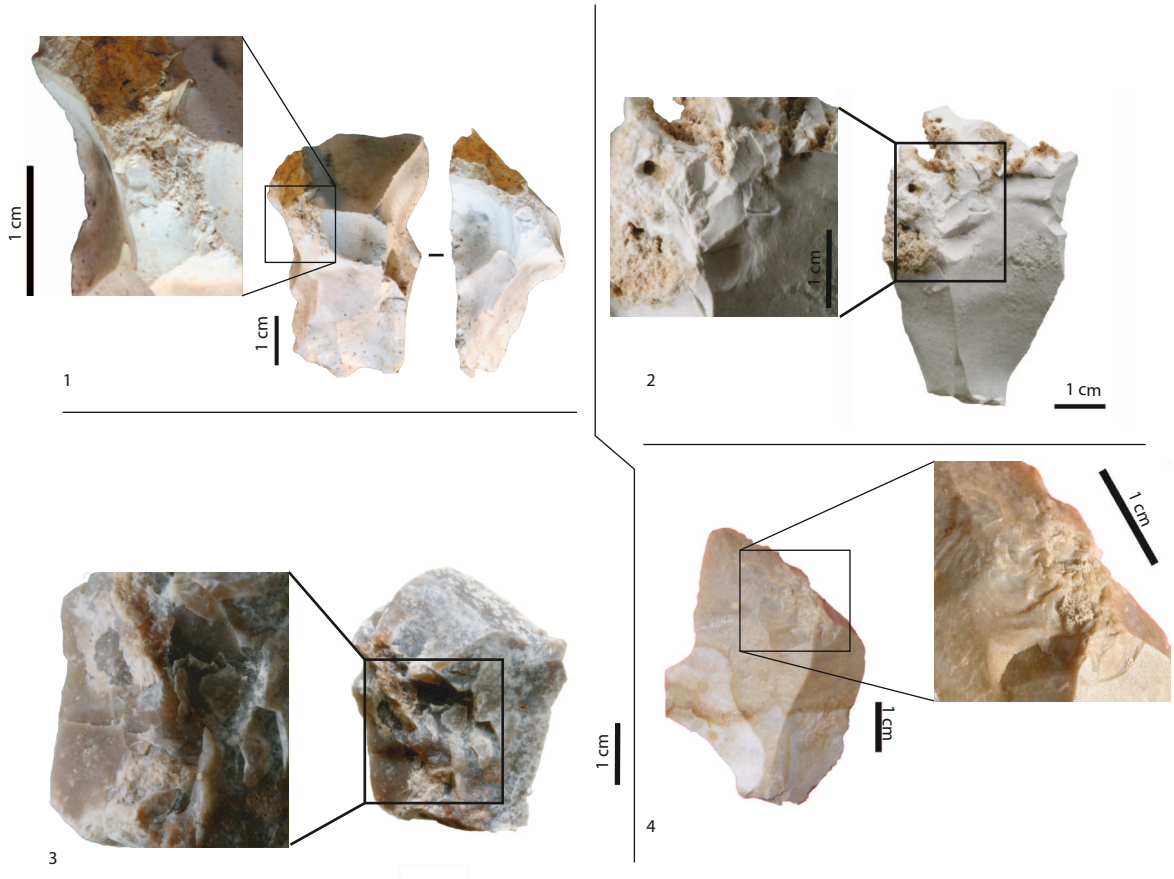



Figure 25 - Flakes with percussion marks. No. 1, Les Rochers-de-Villeneuve, level N; nos. 2 and 3, Romaní, level M; no. 4, Saint-Césaire, level Egpf (photo and DAO: CT and EC, MGC and GA).

Table 6 - Assemblages containing flakes with percussion marks and functional interpretation.

| Assemblages | Number of flakes displaying stigmata | Functional interpretations of cores or bifaces before the detachment of a flake |
|---|---|---|
| RDV, level N | 2 | debitage |
| St Césaire, level Egpf | 16 | 10 debitages, 4 retouches and 2 undetermined |
| Jonzac, US 07 | 4 including 3 biface flakes | 3 retouchs (biface flakes) and 1 debitage |
| Jonzac, US 08 | 2 | debitage |
| Payre, level D | 1 | débitage |
| Abri Romaní, levels M and Minf | 3 | debitage |

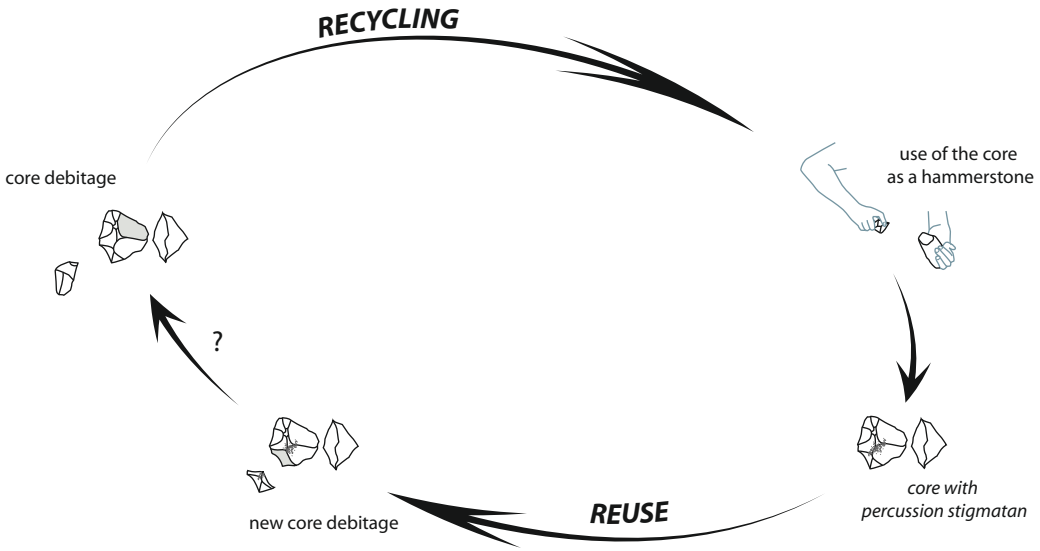



Figure 26 - Schematic representation of recycling as a hammerstone and reuse of a core (DAO: VM).

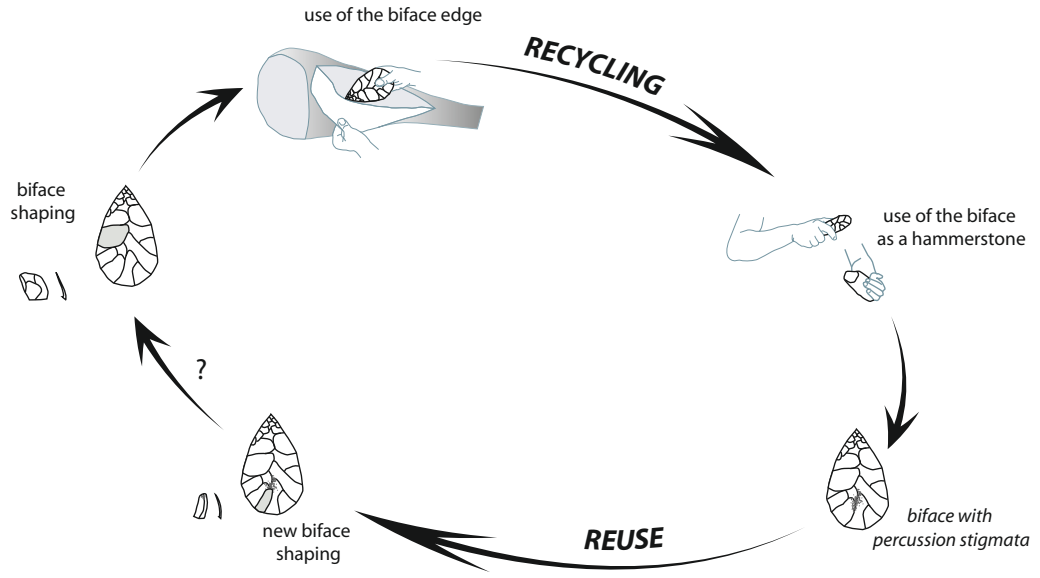



Figure 27 - Schematic representation of recycling as a hammerstone and reuse of a biface (DAO: VM).

## 4.2 - The use of cores and bifaces as hammerstones: a response to a specific environmental context or a characteristic of a cultural group?

We have shown that cores and bifaces were very likely used as hammerstones in debitage and retouching activities, even though these were not the best adapted objects for these purposes. Cores with a particularly inappropriate morphology, such as Discoid cores (pyramidal morphology and irregular contours) were used to detach flakes. In addition, the objects used as hammerstones were sometimes reflaked or reshaped even if the incipient cones of percussion created during their use could hinder the normal development of fracture waves. How can we interpret this behavior?

One possibility is to attribute these objects to the actions of young, inexperienced knappers, or young individuals during a phase of apprenticeship or imitation. The concentration of stigmata within well delimited zones does not support this hypothesis, however, as the stigmata of apprentice knappers would be more randomly distributed on the artifacts.

Some of the pieces were intensively used, showing that this was not just a brief and occasional behavior, but that this type of hammerstone was sometimes deliberately chosen.

The absence of cobbles or oval shaped blocks in the immediate environment could explain the recycling of cores and bifaces as hammerstones. However, all the assemblages studied include hammerstones in quartz, quartzite, limestone, sandstone and flint. More classic hammerstones were thus also employed for debitage and retouching activities (cf. US08 de Jonzac). The Saint-Césaire assemblage is the only one lacking cobbles and in this case, numerous unworked spherical flint blocks were uses as hammerstones. The recycling of cores and bifaces as hammerstones or retouchers is thus not exclusively linked to the absence of cobbles or appropriate blocks. This is also the case at La Chapelle-aux-Saints, where one quartzite core was used as a hammerstone for debitage even though alluvial cobbles were abundantly available near the site (figure 28).


Figure 28 - Quartzite core from La Chapelle-aux-Saints, bouffia 118, with percussion marks (photo and DAO: CT).

The reuse of cores and bifaces for their initial intended purpose after their use as hammerstones could be linked to a scarcity of raw materials. Most of the raw materials used, however, originate from the immediate, sometimes local (less than 5 km), environment. At Saint-Césaire, Senonian flint is abundant on the plateau located above the site (Thiébaut *et al.*, 2009 b). This is a good quality flint present in the form of blocks with variable dimensions and morphologies. The re-debitage of the cores used as hammerstones was thus not related to a lack of raw materials and was not intended as a manner of economizing high quality blocks. The same is true at the sites of Rochers-de-Villeneuve (Asselin, 2006), Combe Brune 2 and Cantalouette 1, where the raw materials used were abundantly available in close proximity (Brenet *et al.,* 2006 and 2008).

This behavior thus did not respond to an economic need, or even a technical need, since these objects were not the best adapted to these uses, except perhaps for the biface edges used to fabricate denticulates. It therefore corresponds to a deviation, at least temporary, of the initial mode functioning of cores and bifaces. These latter can thus be considered as catachretic[1] objects whose breadth remains difficult to apprehend.

If the simplest functional and economic explanations can be rejected, does this mean that this behavior is a characteristic of a specific cultural group? An enlarged bibliographic summary including assemblages that we have not studied indicates that the use of bifaces and cores for percussion activities is not unique to the Middle Paleolithic and has been identified in diverse locations (table 1 and figure 29). If we consider only the assemblages that we directly studied, there does not seem to be any regularity between the different levels concerned, whether technical, environmental, chronological or economic. In effect:

- this phenomenon exists from the oldest phases (OIS 8) until the latest phases (end of OIS 3);
- it is not limited to a particular region and thus not to identical raw material resources;
- different contexts are concerned (caves, shelters and open-air sites);
- the levels concerned were attributed to different site functions (knapping workshop, occupations of varied durations);
- the associated fauna is more or less diversified and originates from diverse environments;
- different knapping methods are attested (Levallois and Discoid debitage, and shaping) and the dominant tool types are highly variable (bifaces, scrapers and denticulates).

The identification of cultural groups based on lithic and osseous assemblages was the principal objective of many prehistorians during the late 20th century. Due to the inherent limits of research in the field of Prehistory, the goals now tend to be more modest: most researchers today attempt to reveal the existence of choices linked to the cultural domain within archaeological assemblages. To do so, they do not rely on the identification of a single behavior at a given moment, but rather on its recurrence in different places and in varied contexts. For J. Pelegrin, in order to attribute a cultural value to a technical concept or modality, we must show that the modality chosen by the prehistoric humans represents one possibility among others (Pelegrin 1995). In other words, a technical act is linked to a cultural choice not only if another solution could have been adopted, but even more so if this other solution was more efficient or simpler to carry out. The use of bifaces and cores in hard stone knapping activities is not linked to a particular context, however, whether technical, chronological, economic or environmental. The use of these techniques was not the best response to a need. This phenomenon recurs in different geographic locations at least from OIS 8 to OIS 3. It thus represents a cultural choice related to the cultural domain.

1. "The term catachretic is borrowed from the fields of linguistics and rhetoric where it designates the use of a word for a meaning other than its accepted one. By extension, the idea was transposed to the domain of tools to designate the use of one tool instead of another or the use of a tool for uses for which it was not conceived." (Rabardel 1995; p. 123).


Figure 29 - Locations of the sites mentioned in table 1 (map Thiébaut 2005, after Encarta).

## 5 - Conclusion

It would be interesting to know if this technical behavior is unique to Neandertal artisans or if it was practiced by Lower Paleolithic or Anatomically Modern Humans as well. There appear to be a few indications that it existed in early periods (table 1). In the Upper Paleolithic, cores with "a battered zone at the base" have been recorded in the Aurignacian occupation of the Grotte du Renne at Arcy-sur-Cure (Bon & Bodu, 2002, 126-127). These are blade and bladelet cores whose last phase of exploitation consisted of the production of small flakes. The authors consider that the stigmata would be linked to the detachment of flakes by anvil percussion, perhaps by individuals with a low technical skill level. An exhaustive documentary summary will be necessary to determine if the recycling of cores and bifacial tools is indeed a universal human behavior, or if it is limited in time.

Beyond a systematic documentation of the technical behaviors of Neandertals, whose richness and diversity no longer need to be demonstrated, what meaning can we attribute to the fact that a knapper uses, as a percussion tool, an object poorly adapted to this use – but probably handy and readily available – rather than a hammerstone with a more appropriate morphology – but which is absent from his immediate environment, and perhaps simply from his field of vision? There is probably no more to see here than a simple expression of the "principal of least effort", which is sufficiently universal among modern humans to have served as the basis of statistic linguistics (Zipf, 1949). In a review of the work of W. Winsemius, P. Rabardel also notes that within contemporary societies the choice of a tool poorly adapted to its intended use is determined by its availability in the immediate environment (199 ; p. 126-127). In the end, should we not simply see this Neandertal tendency toward laziness as a confirmation of their true humanity?

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