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GENESIS AND TAPHONOMY OF THE ARCHAEOLOGICAL LAYERS OF PEDRA FURADA ROCK-SHELTER, BRAZIL

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Martine FAURE⁴ & Mercedes OKUMURA⁵

Pour Claude, un Maître et un ami.

ABSTRACT

New sedimentological and taphonomic analyses of a preserved bulk of Pedra Furada rock-shelter characterize the mixed origin of the filling, both from the sandstone wall and from the uppermost conglomerate layer. Statistical analysis of quantitative and qualitative data on waterfalls and archaeological assemblage, both dated from the Upper Pleistocene and Holocene, demonstrated no causal relationship among Eastern waterfall talus, lithic tools and archaeological structures. Technical similarities have been reported between extant monkeys unintentional flaking by-products and the lithic toolkit from the previous archaeological excavations. Comparison between present monkey's hammerstones and the quartz elements recorded in archaeological structures point to a clear anthropic selection in the making of archaeological structures in the site, regardless of any association with charcoals. Because of the similarities between the present monkey stone-tools and the (supposed) human tool-kit, the inclusion of both human and primate archaeologies in an interdisciplinary research program is needed to clarify the nature of pre-Clovis presence in South America.

Keywords: Sedimentology, Upper Pleistocene, Pedra Furada, statistics, lithic tools, archaeological structures, Platyrrhines

RÉSUMÉ

GENÈSE ET TAPHONOMIE DES NIVEAUX ARCHÉOLOGIQUES DE L'ABRI DE LA PEDRA FURADA, BRÉSIL

Les nouvelles recherches sédimentologiques et taphonomiques conduites sur le bloc-témoin de l'abri de la Pedra Furada mettent en évidence la double origine du remplissage, provenant de la paroi gréseuse et des niveaux conglomératiques supérieurs. Les données quantitatives et qualitatives concernant les chutes d'eau et le contenu archéologique du site, tant dans les niveaux pléistocènes que holocènes, démontrent l'absence de relation de causalité entre le talus de la chute d'eau orientale, l'outillage lithique et les structures archéologiques. Des similarités technologiques ont été observées et comparées entre les produits lithiques non intentionnels des singes actuels et ceux provenant des anciennes fouilles. La comparaison entre la masse des percuteurs utilisés par les singes actuels et celle des galets de quartz utilisés, retrouvés dans les structures archéologiques, indique une évidente sélection d'origine anthropique dans la disposition des structures, avec ou sans restes de combustion. Du fait de la similarité entre l'outillage des singes actuels et celui (supposé) humain dans le passé, une double archéologie anthropique et simienne est le seul moyen d'éclaircir la vraie nature de la présence humaine pré-Clovis en Amérique du Sud.

Mots-clés : Sédimentologie, Pléistocène supérieur, Pedra Furada, statistiques, outillage lithique, structures archéologiques, Platyrrhiniens

1 - INTRODUCTION

For more than twenty years, the region of the Serra da Capivara National Park, located in Piauí state, Northeastern Brazil, has been the focus of a harsh debate on pre-Clovis evidence in South America, mainly centered on the evidence of the reference site, the Boqueirão da Pedra Furada (BPF) rock-shelter (main references: Guidon & Delibrias, 1986; Butzer, 1988;

Meltzer *et al.*, 1994; Borrero, 1995; Guidon *et al.*, 1996; Michab *et al.*, 1998; Parenti, 2001). Since 1974 the entire Serra da Capivara National Park and its surroundings have been intensively studied from a multidisciplinary approach, recording - among others - several sites presenting Pleistocene palaeontological (Guérin & Faure, 2008, 2014) and archaeological remains (Lourdeau & Pagli, 2014). In particular, since 2008, research under the direction of Eric Boëda has been conducted with the aims

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of replicating and refining the data obtained at the BPF site and discovering new evidence of Pleistocene occupations in the region (Lahaye *et al.*, 2013; Boëda *et al.*, 2014, 2016). Although the results obtained at BPF, excavated between 1978 and 1988, have been exhaustively published since 2001 (Parenti, 2001; Santos *et al.*, 2003; Valladas *et al.*, 2003; Chaves *et al.*, 2006), many recent publications do not even consider the abovementioned detailed data, preferring to focus their critiques on a generic and conjectural set of taphonomic and technological remarks or even, naively, ignoring the existence of the site itself when considering the issue of a pre-Paleoindian occupation in South America (Bueno *et al.*, 2013; Vialou *et al.*, 2017).

Meanwhile, several research programs have focused on complementary aspects of the main debated issue, i.e. the hypothesis of a human colonization of the Americas during the Pleistocene; among these are: 1) a huge array of genetic studies that aim at tracing the origin of population stock(s) and the timing of their spread(s), generally admitting a first peopling event not older than 20 ka BP (Zegura *et al.*, 2004) 2) a model of two settlement waves based on cranial morphology (Hubbe *et al.*, 2014); 3) new archaeologically consistent and well-dated pre-Clovis sites (McAvoy & McAvoy, 1997; Stanford *et al.*, 2014 ; Dillehay *et al.*, 2015); 4) the role of Beringia refugia during the Last Glacial Maximum as cradle of American population waves (Hoffecker *et al.*, 2016); 5) a re-birth of the controversial hypothesis of an North-Atlantic Ice-Age coastal entry route in North America, i.e. the “Solutrean hypothesis” (Stanford & Bradley, 2012; Eren *et al.*, 2013). To add to this debate

there has recently been the discovery of platyrrhine monkeys as battering and flaking agents in the Brazilian lowlands (Proffitt *et al.*, 2016).

In the background of the criticisms advanced about the Pleistocene sites in Serra da Capivara region, we are well aware that the core issue is the taphonomic and contextual analysis of each specific set of evidence. For a long time the focus of research has been the chronology and classification of archaeological remains, without paying due attention to the formation processes of deposits and evaluation of alternative explanations. In this sense, a first step was made in the book on BPF, when considering gravity as a possible agent for cobbles fracture (Parenti, 2001, ch. 5). However, at the time of this study (1988-1992) a detailed sedimentological analysis was still missing and therefore a well-founded statistical analysis could not be carried out.

In this article we present four new sets of data concerning the formation processes at BPF: 1) a sedimentological description of the filling, partially based on the 1987-1988 excavations but mainly on unpublished data from a field campaign conducted in 1996 on the preserved bulk in the Eastern sector of the site; 2) a statistical comparison between the natural fracture of quartz cobbles from the base of the western waterfall and the artifacts recovered in the excavations, in order to investigate any gravitational action in the making of the assemblage and its relation to the artefacts, manuports or supposed geofacts; 3) a comparison between the granulometry of the filling and the composition of some representative features of Pleistocene units; 4) a synopsis of main

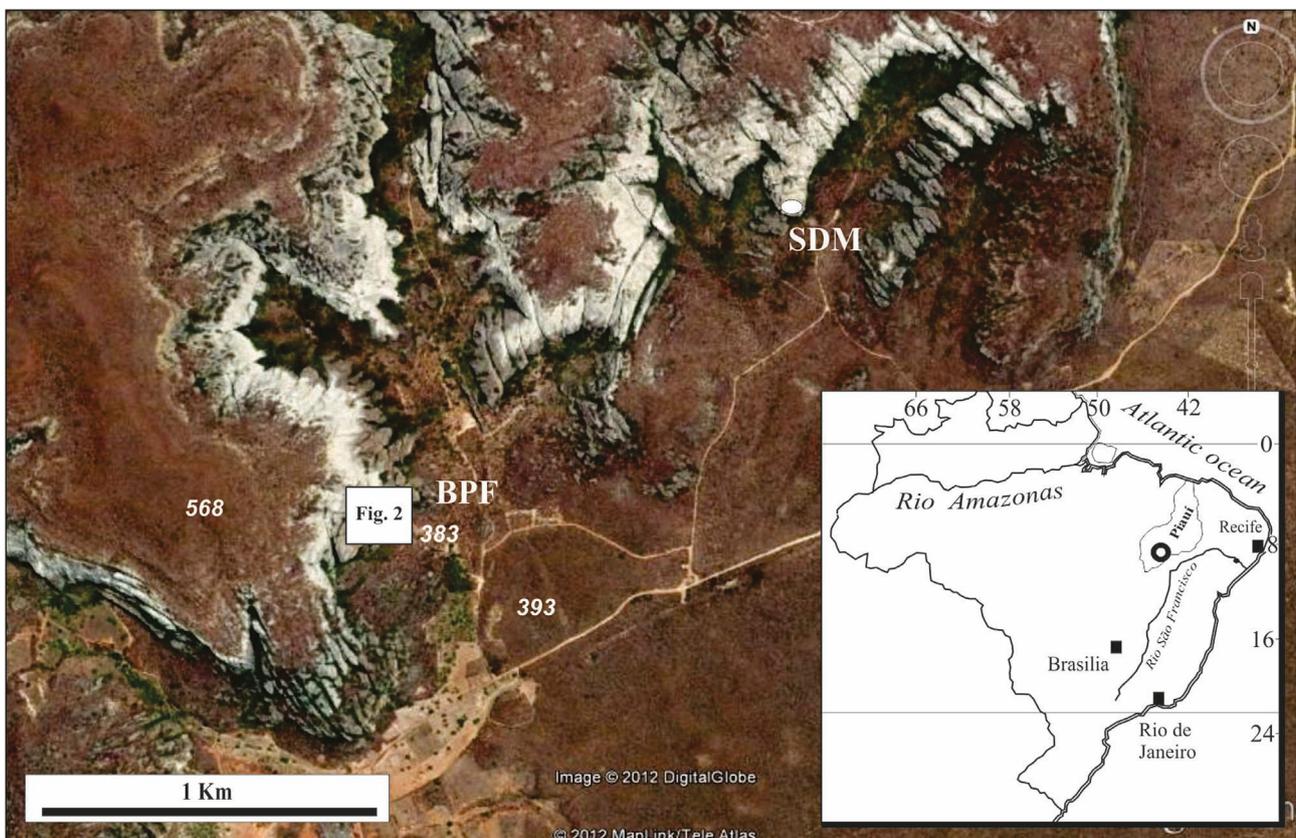


Fig. 1: Position of the site (BPF) in relation to the sandstone *cuesta* and the nearby rock-shelter of Sítio do Meio (SDM) ; image from GoogleEarth.
 The whitish edge of the cliff is the uppermost outcropping conglomerate layer. Note the *thalweg* just South of BPF, comprised between elevations 383 and 393.
Fig. 1 : Localisation du site (BPF) par rapport à la *cuesta* gréseuse et à l'abri-sous-roche du Sítio do Meio (SDM) ; image de GoogleEarth. Le bord blanchâtre de la falaise est le niveau conglomératique le plus élevé. A noter que le *thalweg* immédiatement au Sud de BPF est compris entre les élévations 383 et 393.

technical parameters observed on lithic tools compared both with waterfall breakage and with available data of unintentional flaking made by monkeys.

2 - SEDIMENTOLOGY OF THE FILLING

The Boqueirão da Pedra Furada rock-shelter ($8^{\circ}51'S$ and $42^{\circ}33'200''W$) lies at the bottom of the Serra Grande Silurian formation with a 70 m high *cuesta* (figs. 1 & 2).

The lower part of the cliff is carved from medium to coarse grained siliceous, low cemented, sandstone, presenting a slightly extended cross-bedding stratification (maximum thickness 80 cm). Some finer, centimetric, silty layers are interbedded at the bottom. The whole formation dips north-northwest between 8 and 15°. These sandstones are overburdened by a widely cross-bedded conglomerate (fig. 2). Pebbles and cobbles are heterometric and normally graded. The largest are found in the lowermost meters and reach a length of 30-40 cm. Their composition is heterogeneous: quartz, quartzite, sandstone and occasionally basic rocks. Progressively there are medium to coarse grey sandstones, with conglomeratic lenses. Several fractures systems determine the orientation of main drainage axis and *cuesta* dissection.

The shelter is formed by differential erosion between sandstone and silty layers, engendering a 19 m overhang at the reference section (fig. 2, section II-II'). At the bottom of the drip line a talus points to the last retreat of the cliff, responsible for the overhang formation and closing the shelter to South. Four waterfalls drain the uppermost conglomerate, the main one affecting the site being waterfall C (fig. 2 & 3). The shelter substratum has a 10° east-west dip, according to the general sandstone dip.

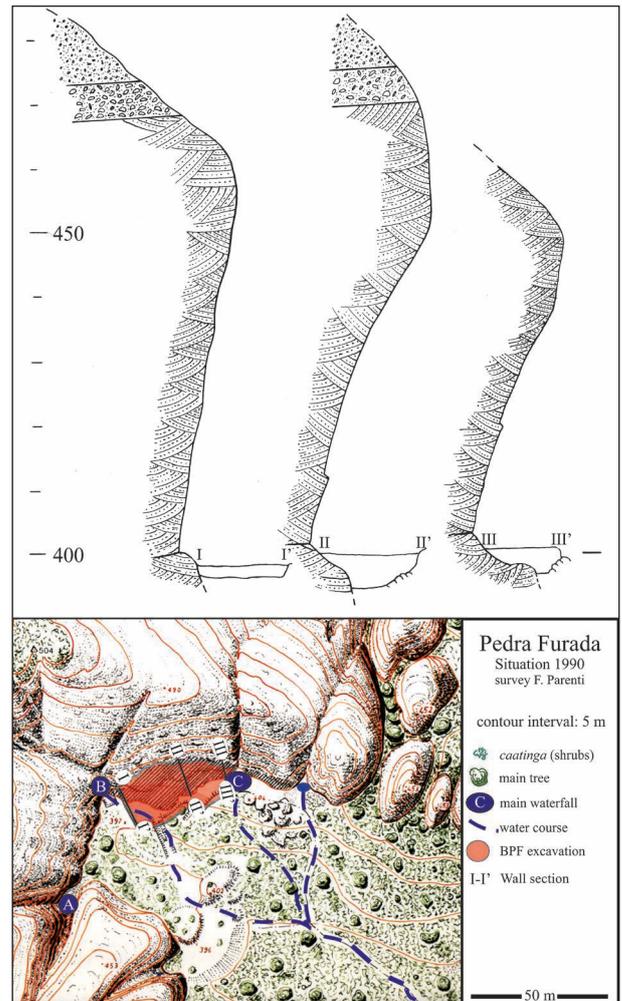


Fig. 2: Sections of the sandstone wall (top) and situation of waterfalls and excavations in 1990 (bottom).

Fig. 2 : Coupes de la paroi gréseuse (en haut), et localisation des chutes d'eau et de la fouille de 1990 (en bas).

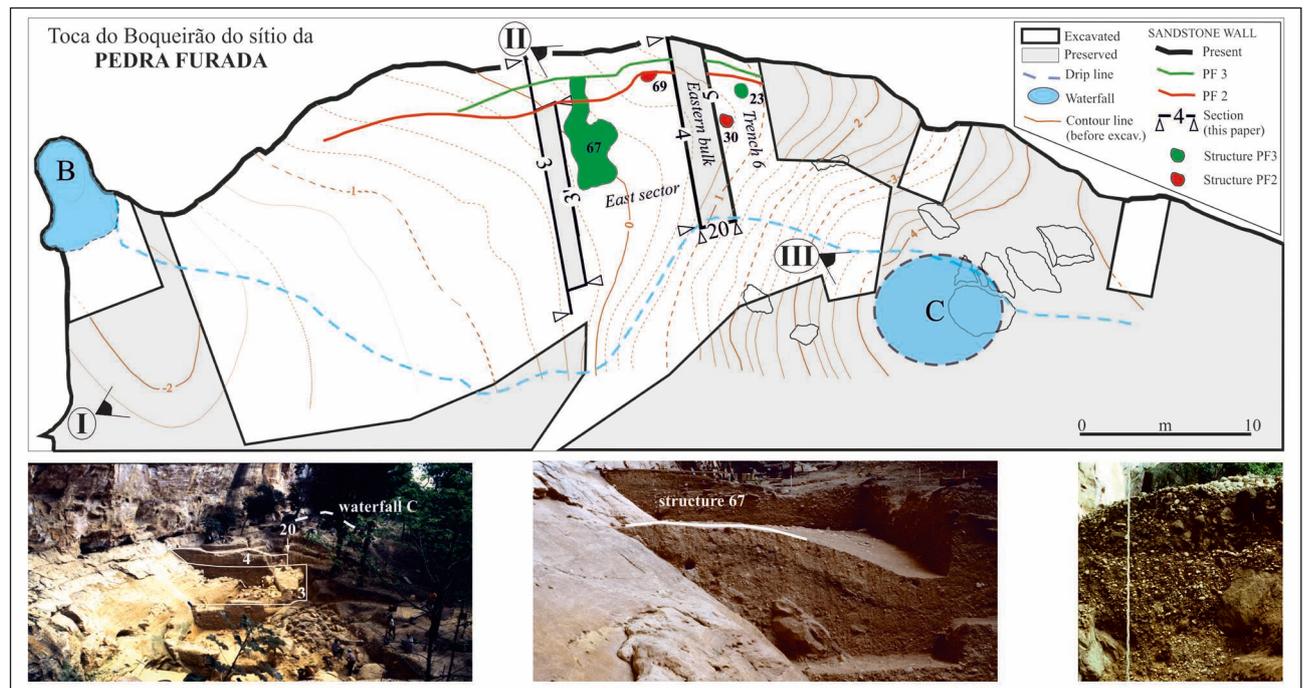


Fig. 3: Top: position of waterfalls, excavations, sections and structures discussed in this paper; bottom: I) Panoramic view at the end of excavations (July 1988) with sections discussed in this paper, II) Northern half of section 3 during excavations (November 1987), III) section of waterfall C; note the block collapse beneath cobbles filling.

Fig. 3 : En haut : situation des chutes d'eau, des fouilles, des coupes et des structures dont il est question dans cet article ; en bas : I) Vue panoramique à la fin de la fouille (juillet 1988) avec les coupes présentées dans cet article, II) Moitié Nord de la coupe 3 pendant la fouille (novembre 1987), III) Coupe au niveau de la chute d'eau C ; à noter l'effondrement d'un bloc au-dessous des galets du remplissage.

2.1 - SEDIMENTOLOGICAL ANALYSIS

The chronostratigraphic reference during the excavations and the one utilized for the regrouping of cultural evidence is the central section (Parenti, 2001, pl. 8).

In 1996, eight years after the last excavation, the best preserved portion of the filling was the Eastern bulk (fig. 3). It lies on a sandstone wall and is the reference for the present stratigraphic description (tab. 1), especially for sections 4 (fig. 4) and 20 (fig. 5); the latter showing the deposit's evolution outside the drip line.

A preliminary sedimentary study was carried out by

Joël Pellerin in 1988 and published in Parenti (2001). Three sedimentary groups had been defined at that time, taking into account their structure and alteration.

Sediment samples of the 1996 campaign were taken close to the wall for section 4 and underneath the drip line for section 20. Moreover, in order to know sedimentary variation westward, three samples were taken on section 3' (fig. 6), 1 m east and below section 3 (fig. 3).

Elements larger than 3 cm were never a majority in the analyzed samples (fig. 7), these comprise between 5 and 25 % of the samples from section 20, yet are completely absent or scarcely represented in section 4. The only

| Layers | Stratigraphic description | Thickness | Colour | Lateral and vertical variations | Remarks |
|--------|---|-------------|---|---|---|
| 1 | coarse sand containing small quartz pebbles (1-2 cm) et some sandstone plates | 1 - 5 cm | dark yellowish brown (10YR 4/2) | present only in Northern part of the bulk | highly reworked |
| 2 | coarse sand with two thin lenses of granules and gravels | max : 14 cm | moderate yellowish brown (10YR 5/4) | close to the wall, gravel and small pebbles are more abundant | highly reworked by ants |
| 3 | lens rich in small pebbles (1-2 cm) and round gravel | max: 15 cm | dark yellowish orange (10YR 6/6) | clearly thicker in its Northern part | pebbles are imbricated, mostly flatly disposed against the limits |
| 4a | sand surrounding isolated small pebbles | 30 - 40 cm | grayish orange (10YR 7/4) | the area closer to the wall is coarser. Lesser amount of matrix and some imbricated pebbles in sectors attained by runoff | highly bioturbated by ants. Rich in large and dispersed charcoal fragments, sometimes clustered as in a fireplace |
| 4b | small sandstone plates, associated with scattered pebbles (1-5 cm), in a rich sandy matrix | 10 - 35 cm | grayish orange (10YR 7/4) | largest plates, horizontally resting, form two lines on the edges of the layer | some large quartz cobbles (10x15 and 6x10 cm) |
| 4c | sandstone plates and quartz pebbles in a rich sandy matrix containing many gravels and small pebbles | 40 - 50 cm | grayish orange (10YR 7/4) | in its lower part, some sandstone blocks and large siliceous cobbles (7 cm wide), most of the time horizontally disposed | one large block diving into the lower layer |
| 4d | angular granules, isolated or aligned in small lenses in a very rich grey-orange matrix. Gravels and abraded small pebbles (1-3 cm), with no preferential orientation | 40 - 50 cm | grayish orange (10YR 7/4) | | |
| 5 | sand rich in fragmentary charcoals visible all along its height. Small sandstone plates and small quartz pebbles (1-4 cm) were observed | 5 - 20 cm | light brown (5YR 6/4) | general dip to NW. On section 20 (fig. 5), coarser sand with sparse cobbles (max 4 cm) | lower limit is irregular |
| 6 | rich sandy matrix, with granules, gravels and scattered small pebbles. | 20 - 25 cm | grayish orange (10YR 7/4) | more small sandstone plates close to the wall and at the opposite (in Southern portion) more siliceous gravels and small pebbles | |
| 7 | sandy matrix rich in micro-charcoals and charcoals homogeneously distributed along its thickness. Sandstone plates (5 cm long) are plentiful and often altered | max : 15 cm | grayish orange (10YR 7/4) to dark yellowish orange (10YR 6/6) | | |
| 8 | similar to layer 6 with abundant sandy matrix surrounding granules and small pebbles without preferential orientation in relation to layer's boundaries. | 30 - 35 cm | grayish orange (10YR 7/4) | from the drip line outward there is a rise in pebble length to some 7 cm. They are distributed in two beds on the top and the bottom of the layer. | |
| 9 | charcoal layer, more widespread than the others, but with the same stochastic distribution of charcoals | 5 - 20 cm | grayish orange (10YR 7/4) | Southward, it vanishes and is visible only by the presence of isolated charcoals among many small pebbles. In section 20 (fig. 5) it is reduced to a small charcoal lens. | |
| 10 | similar to preceding layers : finer granulometry in Northern part, coarser in the South, with many pebbles 1-5 cm long | 20 - 25 cm | grayish orange (10YR 7/4) | | |
| 11 | very coarse, with abundant quartz pebbles associated with plates and small blocks of sandstone. Large charcoal fragments scattered among pebbles. | 30 - 35 cm | light brown (5YR 5/6) | to the South, increase in number of pebbles but not in their size | sandstone elements are altered and friable |
| 12 | sandy matrix surrounding small elements (granules, gravels, small pebbles 1-2 cm). Micro-charcoals. | 12 - 15 cm | grayish orange (10YR 7/4) | Southward it covers the blocks at the bottom of section 20. | |
| 13 | very coarse layer with large pebbles (6-7 cm) associated with sandstone plates | 40 cm | dark yellowish orange (10YR 6/6) | Large blocks in its upper part pointing to the last roof collapse in the Eastern sector of the shelter. | the layer envelops a talus formed in a previous collapse with a 40° dip to NW |
| 14 | fine layer : sand and most elements less than 1 cm | | dark yellowish orange (10YR 6/6) | | fills the gaps between the substrate and the collapsed blocks |

Tab. 1: Stratigraphy of the Eastern bulk

Tab. 1 : Stratigraphie du témoin Est.

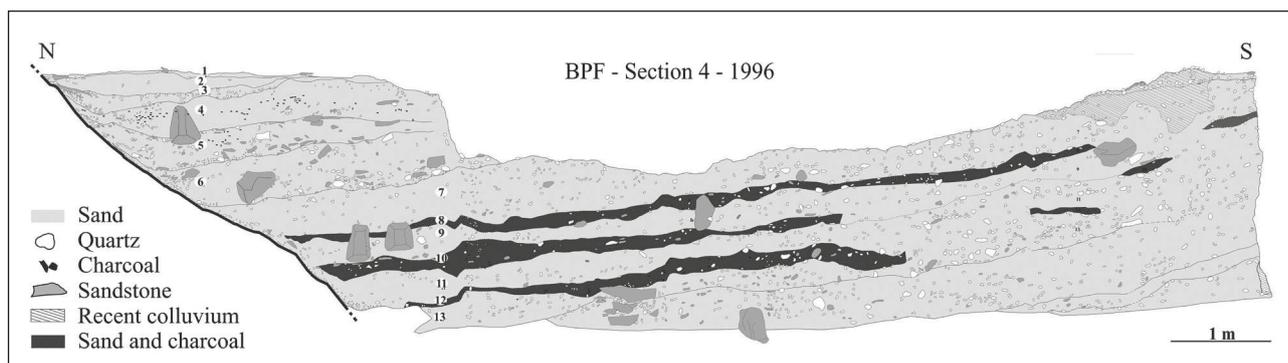


Fig. 4: Section 4, western side of preserved bulk.
 Fig. 4 : Coupe 4, côté ouest du bloc-témoin.

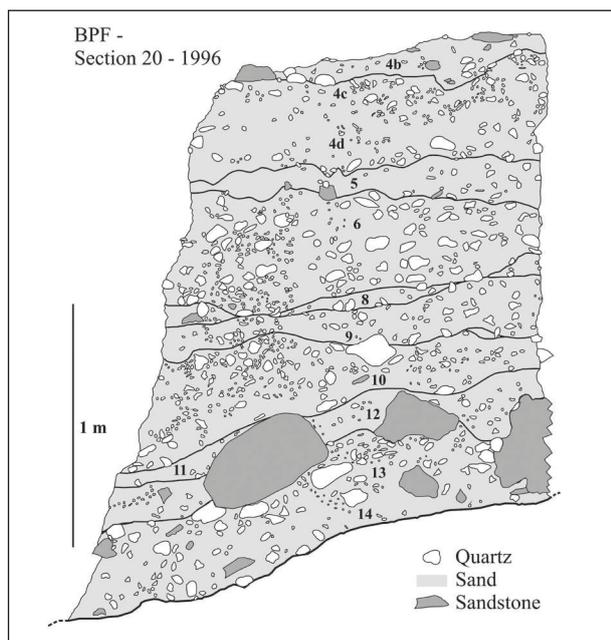


Fig. 5: Section 20, southern side of preserved bulk.
 Note its position slightly outside the drip line (fig. 3).
 Fig. 5 : Coupe 20, côté sud du bloc-témoin. À noter sa position légèrement en dehors de la ligne d'égouttement (fig. 3).

exceptions are layers 4a and 4b with 10-15 % of coarse elements. These are also present in layer 1 of section 3'.

The bulk of the sediment is composed by particles smaller than 2 mm (figs. 8 & 9). These are mostly coarse sands with a 15-20 % of silt and very scarce clay (2-3 %). Close to the wall, the samples present a greater

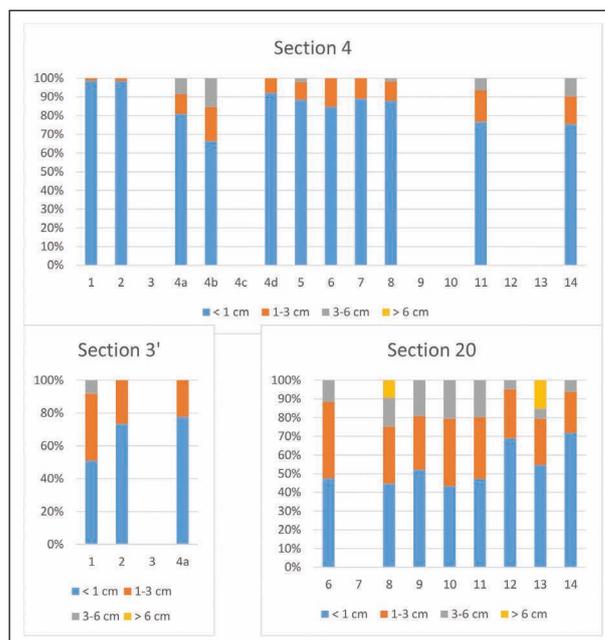


Fig. 7: Comparison of all global granulometries.
 Fig. 7 : Diagrammes comparatifs des granulométries globales.

contribution of silt than in the ones more distant from the wall (section 20, fig. 5). The ones close to the wall are relatively homogeneous except in layer 7, which is finer. Sediments in section 20 are more heterogeneous. The sample from layer 4 in section 3' is clearly different because it contains 30 % of silt. A sample from the filling below waterfall B, draining the upper conglomerate, contains only sands (silt contribution is less than 5 %).

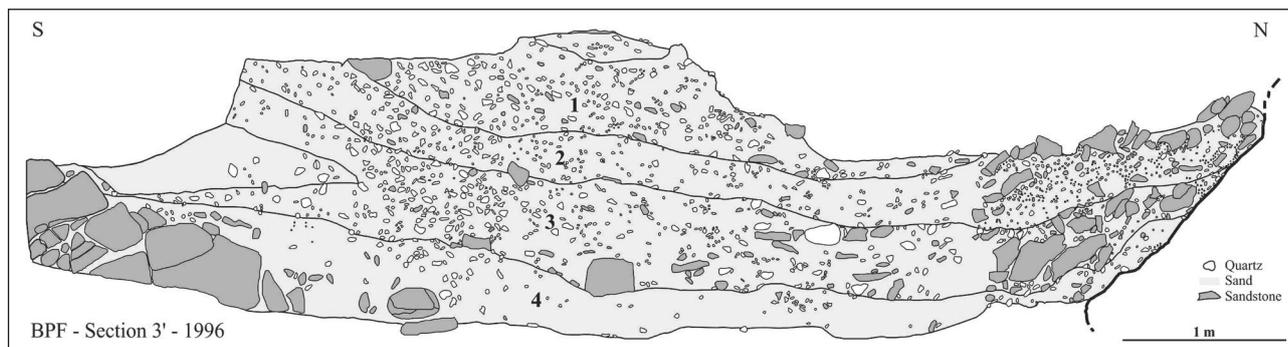


Fig. 6: Section 3', eastern side of central preserved bulk.
 This section is 1 m east and below section 3.
 Fig. 6 : Coupe 3', côté est de la partie centrale du bloc-témoin (fig. 3). Cette coupe se trouve 1 m à l'est et en contre-bas de la coupe 3.

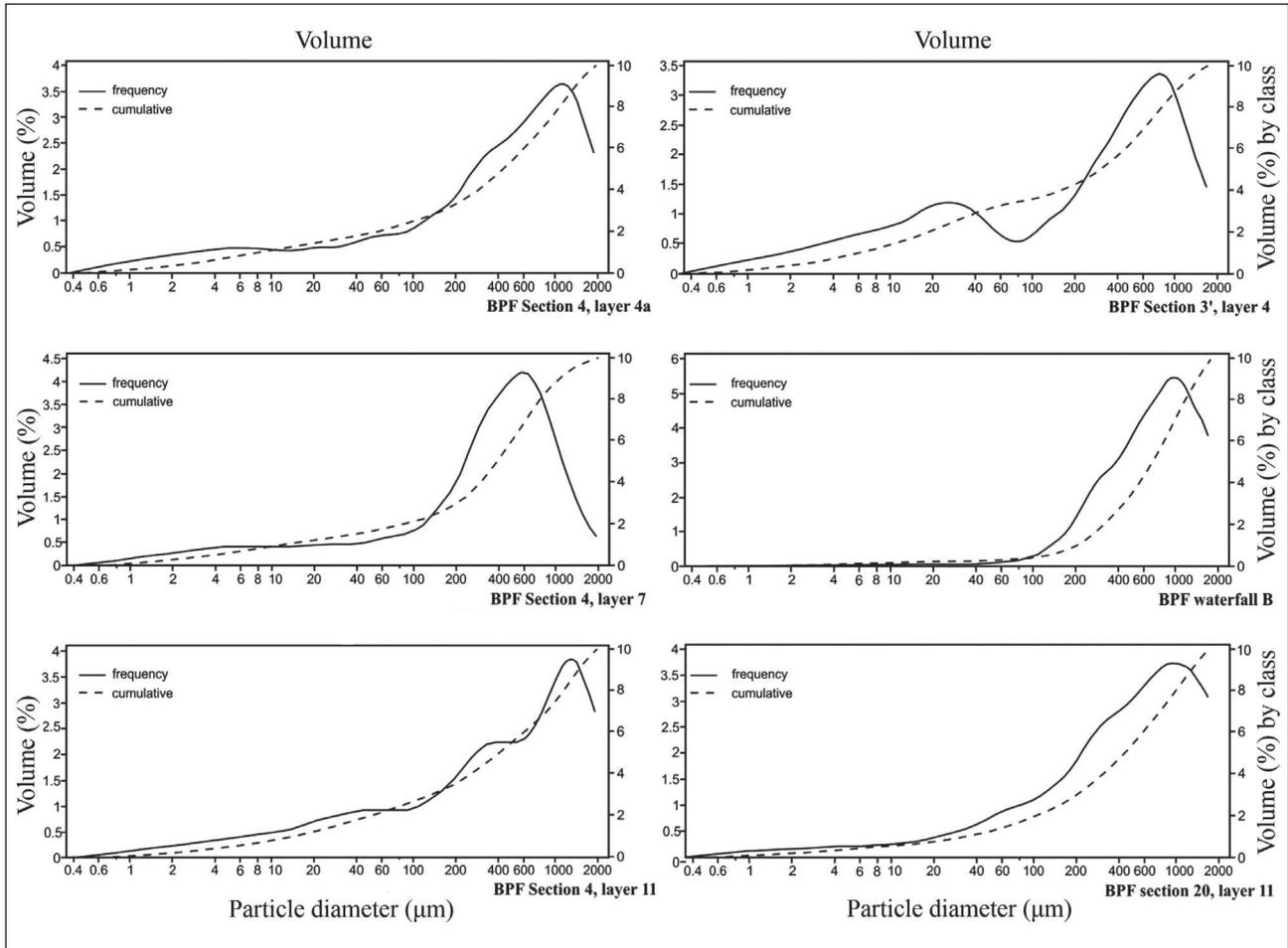


Fig. 8: Selected granulometric curves from sections 4, 3', Waterfall B, section 20.

Fig. 8 : Sélection de courbes granulométriques cumulatives des coupes 4, 3', chute d'eau B, coupe 20.

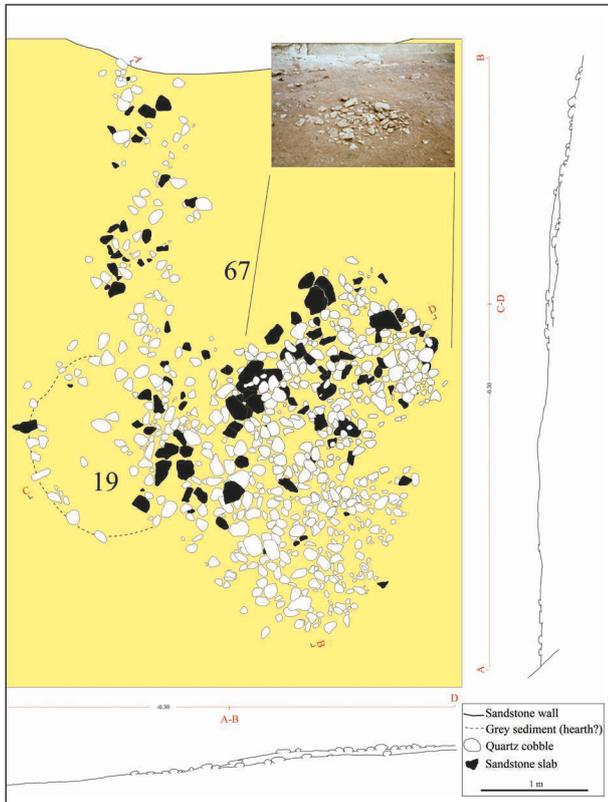


Fig. 9: Structure 67, PF3 phase, and fireplace 19 (19 300 ± 200 BP).

Fig. 9 : Structure 67, phase PF3, et foyer 19 (19 300 ± 200 BP).

In general, the sedimentological analysis shows the difference between samples lying just below the drip line (section 20) - coarser and heterogeneous - and the ones well inside the sheltered area (sections 3' and 4), which are finer and more homogeneous. The latter, however, present some variability due to the sandstone lenses from which, partly, they are derived. The siltiest sample from section 3' shows a strong contribution of fine sediments due to runoff at the center of the sheltered area. Some layers (layer 3 for example) are clearly thicker in Northern part of the bulk and could be the result of a higher runoff along the sandstone wall.

Field observations and granulometric analysis confirm the twofold origin of the deposit, as previously proposed by Guidon and Parenti (1989). The bulk of the fine elements is derived from the disintegration of the sandstone wall, as the weak cementation of the majority of its layers might contribute to this process. Although continuous, the main causal agents might have changed over time, including chemical alteration during the moister phases, haloclasty and/or wind erosion during the drier periods. In some layers rich in charcoals (layer 7 for example), sandstone plates are often altered: apart from pedological process, their alteration may be due to heating.

The presence of sandstone slabs and blocks points to the peeling phases of the wall. Their nature varies according

to the weathered layers of the wall: coarse sandstone, rich in iron oxides or without limonite, fine yellowish sandstone. This is particularly clear for the sediments of the northern sector, where sandstone fragments may be related to rip scars still visible on the wall. It is the same for the eastern block (mostly on its Eastern part) as well as for the central bulk (section 3').

Siliceous coarser elements (measuring more than 1 cm) are derived from conglomeratic layers; these were deposited during events of wetter periods or simply thunderstorms which stimulated the activity of the waterfalls. For the sectors exposed in this study, presenting the maximum concentration of archaeological structures (eastern sector and Trench 6), the bulk of cobbles and pebbles is derived from waterfall C and, partially, from minor drains eroding the wall upon the shelter.

2.2 - DEPOSITION DYNAMICS

Just after the last recession of the wall (older than 60 ka BP; Parenti, 2001, pl. 8 and Santos *et al.*, 2003), which originated the block collapse closing the shelter to the south, the first sediments, derived from the wall and from the upper conglomerate filled up the existing hollows according to the dip both of talus and substratum. These sediments have been accompanied by block collapses inducing the wall regularization. The presence of large sandstone slabs in some layers points to the spheroidal weathering of harder layers, favorable to an erosion in "onionskin". Sedimentation continued on with a granulometric gradient from east to west and from south to north for the elements originated from conglomerates and from north to south for the elements delivered from the wall; the original NW dip decreased along time.

In this monotonous sedimentary dynamic, there are layers of coarser cobbles, pointing to moister episodes which enhance the potential of creeks and waterfalls, as well as indicating the erosion of coarser lenses inside the conglomerate.

Some cobbles observed in the sheltered area could not have been naturally deposited. The regular structure of layers and the lack of channel beds rule out any torrential event that could have contributed to the deposit of cobbles inside the shelter. No geodynamic agent, water or gravity, could have transported large elements, such as the big cobble (22 x 14 cm) found in section 3' among finer elements and with a reduced dip (fig. 6). An anthropic (or other animal?) intervention must therefore be assumed to explain the presence of such large cobbles within the shelter.

3 - COMPARISON BETWEEN THE STONES DEPOSITED BY WATERFALLS AND THE ARTEFACTS.

A first comparison between the two sets was established on the basis of the observation of 2,000 cobbles from

the three Talus cones (A, B, C, fig. 2) (Parenti, 2001, p. 144). In summary, during the 1987-1988 excavations, any artifacts in the sheltered area that complied with the criteria of at least one clear (i.e. with a concave surface and evident point of impact) flake-scar for flaked pieces (cores or choppers) and, for detached pieces, the presence of an evident butt and bulbar surface were collected. Here we statistically compare the stones from Talus cone A (considered as presenting a natural, non-anthropogenic origin) and the BPF excavated material (considered as having an anthropogenic origin). The BPF sample includes materials both from Holocene (Agreste and Serra Talhada) and from Pleistocene (Pedra Furada) units (fig. 4). Our hypothesis is that there are important differences between cobbles from Talus cone A and BPF artefacts, the latter presenting characteristics that are different from stones broken by gravity (Talus cone A).

The sample from Talus cone A consisted of complete and broken cobbles, natural flakes, and fragments (defined as pieces of rock that do not present common flake features, like a bulb, butt or a sharp edge). Elements greater than 32mm were suitable for analysis. The archaeological pieces consisted in cores and flakes, either retouched or not.

The following variables were analyzed for broken pebbles (Talus cone A) and flaked pebbles or cores (excavation): number of bulb scars larger than 1 cm : 1, 2 or > 3; maximum length, in mm: 32-64, 64-128, 128-256 (Wentworth, Krumbein modified, granulometric classes); pseudo-retouch: present or absent. The variables analyzed for flakes were : flaking angle: > 90° or ≤ 90°; cortex: present or absent; non cortical butt: present or absent; pseudo-retouch: present or absent.

We assume that human flaking would result in cores presenting a greater amount of flake scars and pseudo-retouch, non-cortical flakes, non-cortical butt and flaking angle greater than 90°. Z-tests for the equality of two proportions were applied using 5 % significance level in order to test the presence of significant differences between proportions of flake and core attributes between Talus cone A materials and archaeological artifacts.

Table 2 presents the number of bulb scars larger than 1 cm observed in broken or flaked pebbles for Talus cone A and the archaeological layers. Materials from Talus cone A do not present more than four flake-scars, whereas archaeological materials present the full range of such feature (data not shown in detail due to z test limitations). Pleistocene and Holocene materials presented no

| Variable | Talus cone A | Archaeological Layers | | |
|----------------------|--------------|-----------------------|------------|------------|
| | | Pleistocene | Holocene | |
| Number of bulb-scars | 1 | 65 (81.2) | 8 (4.6) | 12 (5.3) |
| | >1 | 15 (18.8) | 165 (95.4) | 216 (94.7) |
| Total | 80 | 173 | 228 | |

Tab. 2: Number of bulb-scars observed in broken or flaked pebbles from Talus cone A and archaeological layers (% in parentheses).

Tab. 2 : Nombre d'esquillettes observés sur les galets cassés ou débités du talus du cône A et des couches archéologiques (% entre parenthèses).

significant differences between the proportion of the number of bulb scars (one and more than one, z-score -0.2911, p-value 0.77182), therefore, it was possible to sum up these numbers when comparing to Talus cone A. There were significant differences in the proportion of the number of bulb scars between Talus cone A and the archaeological layers (z-score 16.3284, p-value 0). In fact it is possible to observe that 81.2 % of pebbles from Talus cone A present only one bulb scar, while the same attribute can be observed in around 5 % of Pleistocene and Holocene cores.

Granulometric information regarding materials from Talus cone A and the archaeological site is presented in table 3. Due to limitations of the z-test, data from 64-128 and 128-256 mm was summed up, creating a new interval from 64 to 256 mm. Interestingly, there were significant differences between the proportions of the samples from Talus cone A (with and without flake scars, z-score 2.7071, p-value 0.00672) and between the Pleistocene and Holocene materials (z-score -3.5687, p-value 0.00036). The comparison between proportions of Talus cone A (without flake scars) and Pleistocene revealed significant differences (z-score 5.218, p-value 0). The other comparisons (Talus cone A without flake scars and Holocene, Talus cone with flake scars and Pleistocene, and Talus cone with flake scars and Holocene) did not present significant differences between proportions.

| | | 32-64 mm | 64-128 mm | 128-256 mm | Total |
|--------------|-----------------|------------|------------|------------|-------|
| Talus cone A | No bulb-scars | 171 (45.1) | 200 (52.8) | 8 (2.1) | 379 |
| | With bulb-scars | 24 (28.9) | 55 (66.3) | 4 (4.8) | 83 |
| Pleistocene | | 40 (22.2) | 125 (69.4) | 15 (8.4) | 180 |
| Holocene | | 94 (38.5) | 138 (56.6) | 12 (4.9) | 244 |

Tab. 3: Number of elements according to granulometric range in broken or flaked pebbles from Talus cone A and archaeological layers (% in parentheses).

Tab. 3 : Nombre d'éléments en fonction de la granulométrie des galets cassés ou débités du cône A et des couches archéologiques (% entre parenthèses).

Table 4 shows that the observed proportion of pseudo retouch in broken pebbles from Talus cone A and flaked pebbles from the site are very low. Due to the lack of significant differences between the proportions observe for Pleistocene and Holocene materials (z-score -0.2424, p-value 0.81034), these values we summed up and compared to the values observed in Talus cone A, showing significant differences between the natural materials and the archaeological ones (z-score -2.0384, p-value 0.04136).

| | | Talus cone A | Pleistocene | Holocene |
|----------------|---------|--------------|-------------|------------|
| Pseudo-retouch | present | 2 (0.4) | 3 (1.7) | 5 (2.0) |
| | absent | 461 (99.6) | 175 (98.3) | 244 (98.0) |
| Total | | 463 | 178 | 249 |

Tab. 4: Number of broken or flaked pebbles presenting pseudo-retouch from Talus cone A and archaeological layers (% in parentheses).

Tab. 4 : Nombre de galets cassés ou débités du talus du cône A et des couches archéologiques (% entre parenthèses) présentant des pseudo-retouches.

Table 5 shows that there is a very low number of natural flakes with a striking angle greater than 90° when compared to the absolute numbers in the archaeological material from the Pleistocene (there are no data from Holocene materials). The z-test points to a significant difference between the proportional natural and archaeological flakes regarding the flaking angle (z-score -6.7087, p-value 0).

| Variable | | Talus cone A | Pleistocene |
|---------------------|---------|--------------|-------------|
| Flaking angle > 90° | present | 3 (10.7) | 85 (78.7) |
| | absent | 25 (89.3) | 23 (21.3) |
| Total | | 28 | 108 |

Tab. 5: Number of flakes presenting striking angles greater than 90° from Talus cone A and archaeological layers (% in parentheses).

Tab. 5 : Nombre d'éclats du talus du cône A et des couches archéologiques présentant un angle de frappe supérieur à 90° (% entre parenthèses).

Table 6 presents the number of flakes according to the presence of cortex. There is a complete absence of natural flakes (from Talus cone A) presenting cortex and a great proportion of flakes presenting cortex in the archaeological layers. However, the proportion between Pleistocene and Holocene materials is significantly different (z-score 3.3619, p-value 0.00078), as well as the proportion between Talus cone A and Pleistocene flakes (z-score -11.9462, p-value 0) and Talus cone A and Holocene flakes (z-score -15.4117, p-value 0).

| Variable | | Talus cone A | Archaeological layers | |
|----------|---------|--------------|-----------------------|-------------|
| | | | Pleistocene | Holocene |
| Cortex | present | 0 | 112 (97.4) | 1598 (86.6) |
| | absent | 42 (100) | 3 (2.6) | 247 (13.4) |
| Total | | 42 | 115 | 1845 |

Tab. 6: Number of flakes presenting cortex from Talus cone A and archaeological layers (% in parentheses).

Tab. 6 : Nombre d'éclats corticaux du talus du cône A et des couches archéologiques (% entre parenthèses).

Given that the proportions observed for the flakes presenting non cortical butt do not show significant differences between Pleistocene and Holocene contexts (z-score 0.151, p-value 0.88076), these values were summed up to be compared to the values from Talus cone A (tab. 7). There is a complete absence of flakes from Talus cone A presenting non cortical butt, while the opposite pattern can be observed in the archaeological materials. The z-test shows that there are significant differences between such proportions (z-score -5.222, p-value 0).

| Variable | | Talus cone A | Archaeological layers | |
|-------------------|---------|--------------|-----------------------|-------------|
| | | | Pleistocene | Holocene |
| Non cortical butt | present | 0 | 50 (40.3) | 767 (39.6) |
| | absent | 42 (100) | 74 (59.7) | 1168 (60.4) |
| Total | | 42 | 124 | 1935 |

Tab. 7: Number of flakes presenting non cortical butt from Talus cone A and archaeological layers (% in parentheses).

Tab. 7 : Nombre d'éclats non corticaux du talus du cône A et des couches archéologiques (% entre parenthèses).

Table 8 presents the number of flakes according to the presence of pseudo retouch. Both the Talus cone A and the archaeological layers present a very low frequency of flakes where retouch can be observed. However, there are significant differences between the proportions observed in the Pleistocene and Holocene materials (z-score 12.4613, p-value 0), as well as between the Talus cone A and Pleistocene artifacts (z-score -2.4353, p-value 0.01468). No significant differences were observed between Talus cone A and Holocene materials (z-score 1.9512, p-value 0.05118).

| Variable | | Talus cone A | Archaeological layers | |
|----------------|---------|--------------|-----------------------|-------------|
| | | | Pleistocene | Holocene |
| Pseudo-retouch | present | 5 (11.9) | 53 (30.5) | 103 (5.1) |
| | absent | 37 (88.1) | 121 (69.5) | 1910 (94.9) |
| Total | | 42 | 174 | 2013 |

Tab. 8: Number of flakes presenting pseudo-retouch from Talus cone A and archaeological layers (% in parentheses).

Tab. 8 : Nombre d'éclats du talus du cône A et des couches archéologiques présentant des pseudo-retouches (% entre parenthèses).

When comparing the pieces from Talus cone A and from the archaeological layers, it is possible to state that there are significant differences between the frequencies observed for the analyzed variables in natural pieces and in the ones we assumed anthropogenic (from the archaeological layers). Such differences in the proportion of features between the natural and archaeological materials can be observed in most analysed variables: number of bulb scars (tab. 2) and the presence of pseudo retouch in pebbles or cores (tab. 4), as well the presence of a striking angle greater than 90° in flakes (tab. 5), and presence of non-cortical butt in flakes (tab. 7). For some other variables, the differences between the natural and archaeological materials were not so clear, but still could be observed in some comparisons (tabs. 3, 6, & 8). The important differences between natural and archaeological materials revealed by the statistical analysis supports our hypothesis that endogenous raw materials from both Pleistocene and Holocene layers from BPF are of a different origin (anthropogenic) than natural materials from Talus cone A.

4 - THE FILLING AND THE ARCHAEOLOGICAL STRUCTURES

For illustrating the relationship between archaeological features and the sedimentary matrix of the filling, we chose some well-defined stone structures from Pleistocene layers, as described in Parenti (2001). All the selected features (figs. 9 & 10) are not only well inside the drip line, but also in upslope position, frontally opposed to the talus slope, as shown in figure 3.

The lithological composition of these structures, i.e. the proportion between quartz cobbles and sandstone slabs is variable, but all their elements are concentrated and clearly larger than the sedimentary matrix, excluding the possibility of deposition due to hydraulic transport from eastern waterfall. Among the relevant structures

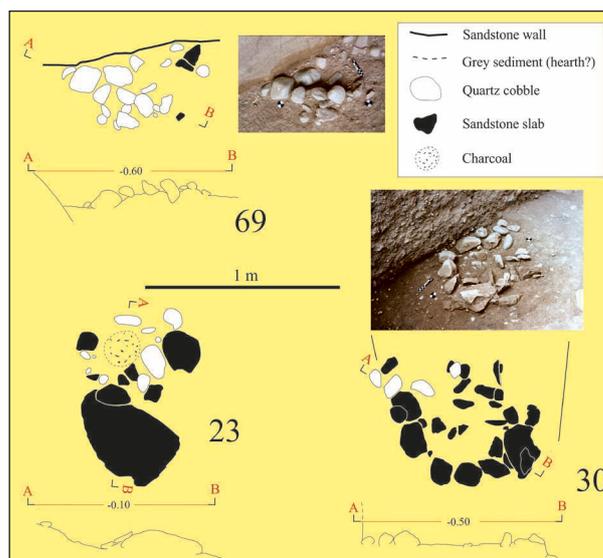


Fig. 10: Selected structures from Pleistocene layers.

69 (PF2)/ small structure close to the sandstone wall, composed by large (apparently unheated) quartz cobbles, none of them having traces of pitting; 23 (PF3)/ fireplace composed by sandstone blocks and quartz pebbles, with charcoal concentration in the central concavity; 30 (PF2)/ fireplace boarded by rounded sandstone blocks and four quartz cobbles; note the fine gravelly matrix of the sediment.

Fig. 10 : Sélection de structures des couches pléistocènes. 69 (PF2)/ petite structure proche de la paroi gréseuse, faite de grands galets en quartz (apparemment non chauffés), aucun ne présente de traces de pitting ; 23 (PF3)/ foyer fait de blocs de grès et galets de quartz, avec une concentration de charbon au centre de la concavité ; 30 (PF2)/ foyer bordé de blocs de grès arrondis et de quatre galets de quartz ; à noter la fine matrice de graviers du sédiment.

from Pedra Furada 3 phase, we unearthed structure 67, a very large stone pile, composed of 515 cobbles and 102 sandstone blocks, elongated in north-south direction and bordered on its Western side by a darkened circular area (hearth 19, fig. 9) presenting charcoals dated at 19,300 ± 200 BP (GIF 8125). Such structure was found on the inner portion of the shelter, with a slight N-S dip, as observed in fig. 3-II.

Besides the presence of these abovementioned structures that very likely resulted from anthropogenic deposition, a dimensional analysis of a cross-section from N-S was also performed on structure 67. A total of 617 cobbles, presenting a maximum dimension of 240 mm were analyzed (fig. 11). Not only there is a

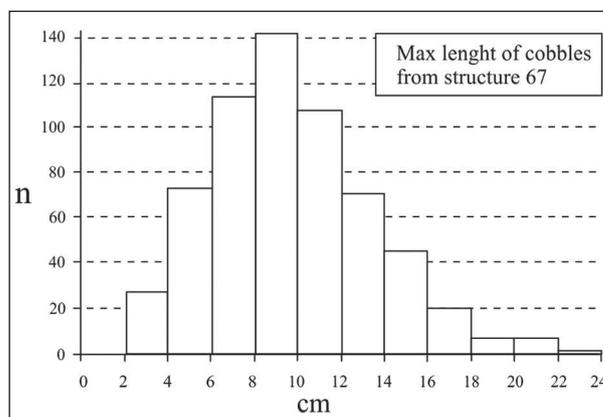


Fig. 11: Distribution of cobbles from structure 67 by maximum length (2 cm intervals).

Fig. 11 : Répartition des galets de la structure 67 en fonction de leur longueur maximum (intervalles de 2 cm).

weak correlation ($r = 0.49$) between the size of the stones and the distance from the actual waterfall, but their distribution is random, with no apparent differentiation by slope (fig. 12); moreover, the whole structure is dipping opposite to the talus slope (fig. 3II). That means we can reject the hypothesis that these stones were carried and sorted by gravity, related to the distance from the waterfall. The distribution of these stones, according to maximum length (grouped by 2 cm intervals) is shown in fig. 11. There is a marked preference for stones with a maximum length of between 8 and 10 cm, followed by those of 6 to 8 and 10 to 12 cm. The mean maximum length of these stones was 92 mm, which corresponds to a mass of about 400 g for quartz cobbles, based on data between average mass and lengths for cobbles (Falótico & Ottoni, 2016). As indicated below, this distribution around a mean of 400 g is typical of anthropic selection (Cannell, 2002, 2018).

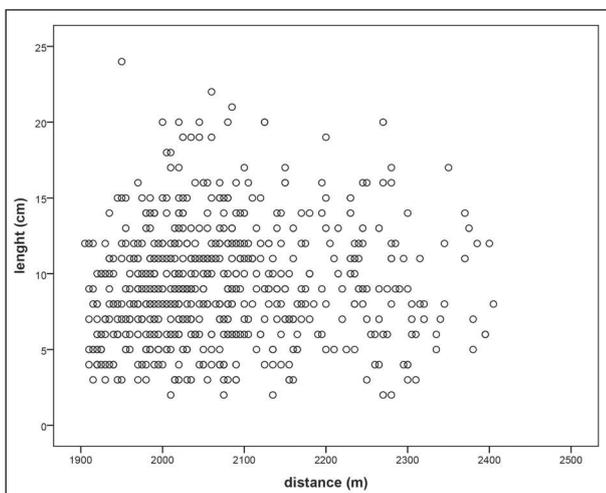


Fig. 12: Structure 67: maximum cobbles dimension (cm) by distance from waterfall C (m). Distances are irregularly spaced because of the different quantity of cobbles for each meter considered.

Fig. 12 : Structure 67 : dimension maximale des galets (en cm) en fonction de la distance de la chute d'eau C (en mètres). Les distances sont irrégulièrement espacées du fait de la différente quantité de galets pour chaque mètre pris en compte.

5 - MONKEYS, ARTEFACTS AND STRUCTURES AT BPF

In the last decades cognitive and instrumental capabilities of non-human primates have been largely studied, leading to a review of the former more anthropocentric view asserting that tool use is a unique human feature (Moura & Lee, 2004; Haslam *et al.*, 2009; Visalberghi *et al.*, 2015). A large body of research has documented material cognition and tool use in Old World Hominid, but less attention has been paid to the instrumental behavior of platyrrhine monkeys of the New World until the end of 20th century. Stone-tool using behavior in captive *Cebus* / *Sapajus* is systematically documented from the first half of 20th century onwards (Visalberghi, 1990; Westergaard & Suomi, 1994). The use of tools by capuchin monkeys in the *caatinga* and *cerrado* environment of Southern Piauí has been intensely studied since at least 2007, showing a very rich and diversified

behaviour regarding tool use (Visalberghi *et al.*, 2007; Mannu & Ottoni, 2009; Falótico, 2011; Falótico & Ottoni, 2013; Visalberghi & D. Fragaszy, 2013; Falótico & Ottoni, 2016). In parallel a new body of research has been developed in order to study material remains of non-human primate's instrumental and social activities, leading to the creation of a true non-human primate archaeology, firstly developed on the present African *Pan* territory (Mercader *et al.*, 2002; Carvalho *et al.*, 2008; Carvalho & McGrew, 2012) and after also applied in northeastern Brazil and notably the Serra da Capivara region (Haslam *et al.*, 2016).

However, the difficulty is the scarcity of primate fossil remains which often prevent any reliable attribution of authorship of a specific artefact assemblage. In the Serra da Capivara region, despite the copious Upper Pleistocene fossil assemblage consisting in more than 7000 faunal remains of about 60 species proceeding from 12 paleontological sites (Guérin & Faure, 2008), monkey fossil remains are absent except for one tooth of *Alouatta* from Toca do Barrigudo site (Guérin & Faure, 2014). *Alouatta* sp. has been also reported in the Toca dos Ossos cave, Ourolandia, Bahia state (Auler *et al.*, 2006). Also in Bahia state a new species of *Alouatta*, *A. mauroi*, has been described in the late Upper Pleistocene site of Gruta dos Brejões (Morro do Chapéu) (Tejedor *et al.*, 2008). Two fossilized specimens of Atelinae were discovered in 1992 in the Pleistocene megafauna of Toca da Boa Vista site (Campo Formoso, Bahia), about 300 km SE of Serra da Capivara Park. One of the skeletons has been attributed to *Protopithecus brasiliensis* Lund, 1838, defined in the fossiliferous deposits of Lagoa Santa, Minas Gerais state, Brazil (Hartwig & Cartelle, 1996). The other was described as a new genus and new species *Caipora bambuiorum* Cartelle & Hartwig, 1996, an Atelinae possibly reaching a body mass of 20 kg. Recently Halenar (2012) reviewed *Protopithecus brasiliensis*, and Halenar & Rosenberger (2013) reassessed the almost complete skeleton from the Toca da Boa Vista defining it as a new genus and new species *Cartelles coimbrafilhoi* Halenar & Rosenberger, 2013, presenting a body mass of about 25-28 kg.

Beside these discoveries, paleontological data are meager (Macphee & Horovitz, 2002). Without going into the details of the Cebidae phylogenetic relationship and dispersal, the ancestor of the Cebinae presently living in northeastern Brazil is unknown. Ruiz Ramoni *et al.* (2017) recently published the discovery of a Plio-Pleistocene molar tooth of Cebidae from Venezuela, being “the first definite evidence of capuchine monkeys in the South America fossil record”. We do not yet know when Cebinae colonized northeastern Brazil, so it is impossible to confirm their presence in Upper Pleistocene. Haslam *et al.*, (2016) dated stone anvils probably used by Cebidae some 600-700 years ago in the Serra da Capivara Park; this Pre-Columbian age was immediately quoted by Fiedel (2017) but it is irrelevant to say that the Cebinae lived in this region in the Upper Pleistocene. However, fossil Atelidae are well attested. At present, Cebinae are the only known platyrrhine monkeys using stone

hammers. Do they have the monopoly of this behavior? We know that in Africa several catarrhine primates (early Hominins, *Homo*, Apes) had, and have, this behavior; so we should wonder if in South America the large-sized extinct Atelinae (*Protopithecus*, *Caipora* and/or *Cartelles*) also showed this behavior; demonstrating this would be a great advance in knowledge of the anthropoid platyrrhine evolution.

Currently capuchin monkeys frequently feed at the bottom of sandstone wall, where cobbles for smashing nuts of various species are very common; they also repeatedly smash quartz cobbles in outcropping conglomerate layers inside the sandstone *cuesta*, apparently in order to produce a desirable powder smell (Mannu & Ottoni, 2009; Falótico & Ottoni, 2016; Proffitt *et al.*, 2016); bang stones as auditory behaviour (Moura, 2007), as well as use stones as digging tools for the extraction of underground food (Falótico *et al.*, 2017). In these activities they use quartz cobbles as hammerstones, sometimes unintentionally producing cores and flakes, some of them with human-like intentional flaking features as: 1) concave negative scars on cobbles, 2) angle between platform and ventral face > 90, resembling that produced in human flaking, 3) flake-scars on dorsal face of flakes (Proffitt *et al.*, 2016).

As very correctly stated by Fiedel (2017) in a recent comment on the Proffitt *et al.* (2016) publication, the stone remains produced by these primates can mimic the simplest elements of the lithic assemblage recovered in the Serra da Capivara region, in both the Pleistocene and Holocene layers. Because equifinality of unintentional stone flaking by neo-tropical primates is an important novelty, the authors of this article consider that the entire lithic production on endogenous raw material from this region should be re-considered in the light of this important paradigm shift.

In order to distinguish between the monkey's and the (supposed) anthropic lithic collection of Pedra Furada, an initial comparison between the two assemblages is presented. The bulk of the Pedra Furada toolkit is composed of very simple trimmed cores, quartz fragments with macroretouches and few clear flakes. In this comparison only data collection from the surface was used (Lasca OIT Surface; Proffitt *et al.*, 2016), as the possibility that their excavated artifacts had an anthropic origin is not - in our opinion - completely ruled out in the Serra da Capivara region. Thus the sample from OIT is composed of 60 stones, divided as follows (Proffitt *et al.*, 2016, Extended Data tab. 1) (tab. 9):

The most evident difference between the two sets is their mass: archaeological artifacts are two or three times heavier than the monkey artifacts for cores and flaked pieces in general and three to four times for flakes. Holocene archaeological flakes are on the average lighter because of the intense knapping of cores (fig. 13). It is also important to note that the average mass values of archaeological choppers and cores lie mostly around the 300-500 g mark, similar to Pleistocene and modern artefact values (Cannell 2012, 2018). The mass distribution of both the Pleistocene and Holocene

| | PF1 | PF2 | PF3 | ST1 | ST2 | AG | Oit surf | Oit TOT |
|-----------------------------|-----|-----|-----|-----|-----|-----|----------|---------|
| Choppers+cores | 66 | 72 | 40 | 115 | 104 | 25 | 10 | 21 |
| Av. weight | 419 | 504 | 464 | 442 | 284 | 494 | 130 | 204 |
| Av. mx. Length | 97 | 99 | 95 | 84 | 84 | 86 | 65 | 72 |
| % of cortical coverage >50% | 73 | 81 | 90 | 60 | 48 | 56 | | 82 |
| Complete flakes | 26 | 42 | 15 | 889 | 876 | 145 | 19 | 31 |
| Av. weight | 66 | 67 | 94 | 35 | 35 | 55 | 15 | 20 |

Tab. 9: Comparison between Pedra Furada site (endogenous raw material) and Capuchin monkey's materials.

Total number of pieces is reported on the right (Proffitt *et al.*, 2016).

Tab. 9 : Comparaison entre les artefacts du site de la Pedra Furada (matériaux bruts endogènes) et ceux des singes capucins. Le nombre total de pièces est indiqué à droite (Proffitt *et al.*, 2016).

assemblages at BPF also shows striking similarities, strongly suggesting that there was a technological *continuum* in endogenous raw material selection and tool preparation (fig. 13).

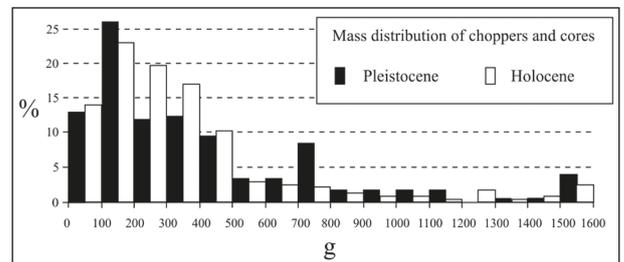


Fig. 13: Mass distribution of choppers, cores and flakes in BPF layers.

Fig. 13 : Répartition des galets aménagés, nucléus et éclats dans les couches de BPF en fonction de leur masse.

Beside stone-tool using in multiple tasks by monkeys, we should also consider the possibility that these animals could have produced rock piles or cairns similar to those previously defined as anthropic structures in BPF. Stone throwing from proceptive females was reported by Falótico and Ottoni (2013) as a “provocative” behavior during estrus, but no stone accumulation or storage places related to capuchine monkeys have been currently observed in Serra da Capivara.

However, when considering the possibility that monkeys could have contributed to the site formation, some points concerning the lithic assemblage of (Pleistocene and Holocene) units at BPF should be kept in mind :

a) Unambiguous hammerstones have not been recovered in any of the Pleistocene BPF layers; several putative specimens have one or more, not spatially constrained, incipient hertzian cones on cortical surface (Parenti, 2001, plates 57, 61, 67, 85), but none exhibited repeated, crushed and concentrated micropitting on a restricted surface. These are the features commonly attributed to (and used to define) hammerstones and are clearly associated to percussive activities of monkeys (Haslam *et al.*, 2014; Proffitt *et al.*, 2016, Extended Data fig. 2). Thus, the isolated impact points on some core or chopper at BPF were attributed to the stochastic falls of cobbles at the surface of waterfalls, i.e. the lithic raw material source, before its selection, transport and trimming. Moreover, the typical pitted depressions resulting from

repeated palm nut cracking percussions (Visalberghi *et al.*, 2007) on the top of the sandstone blocks excavated inside the shelter were never observed.

b) Although dorsal scars on flakes allow us to discriminate between waterfall and intentional trimming, such criteria does not apply to the discrimination between human and non-human flaking. For this reason the secondary use of flakes (retouching or scraping/ cutting activities), not observed so far in wild monkeys, can be a very important factor in ascertaining the nature of a given assemblage. The many flakes and quartz fragments with marginal retouch recovered from well inside the rock shelter and dated from the Upper Pleistocene and Holocene (Parenti, 2001, pl. 70-76, 87-93, 96-97) ought to be carefully reconsidered and analyzed; as an example we present here three quartz flakes with marginal retouch from PF1 and PF2 layers (fig. 14).

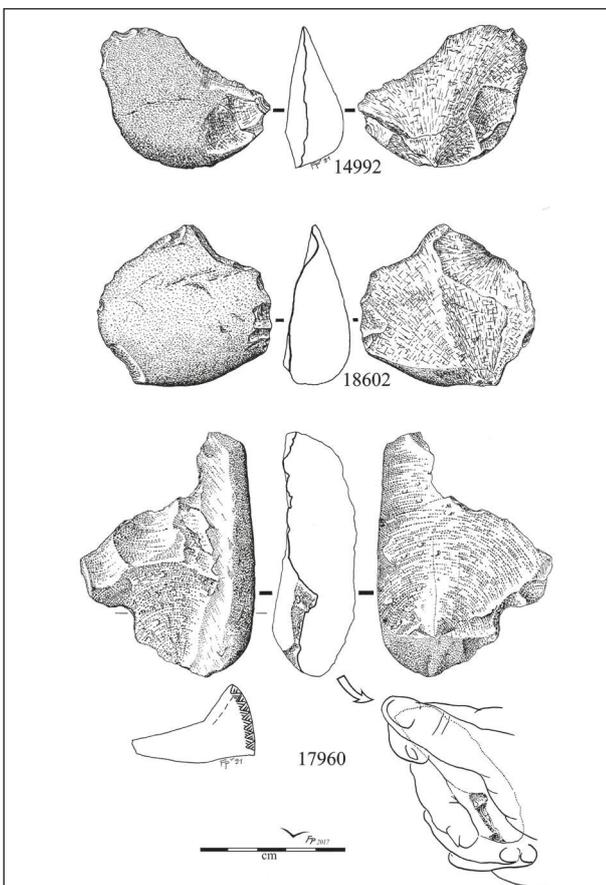


Fig. 14 : Retouched and utilized flakes.

14492/ partially cortical quartz flake; retouched on both faces, PF1; 18602/ cortical flake, quartz, marginal retouch on dorsal face, invasive retouch on ventral face, PF1; 17960/ partially cortical quartzite flake; at least three flake scars are present on its dorsal face which, on its right side, is intersected by a flat diachase surface which allows a very good grip with the right hand, explains the notch visible on side view, PF2.

Fig. 14 : Éclats retouchés et utilisés. 14492/ éclat partiellement cortical en quartz ; retouché sur les deux faces, PF1 ; 18602/ éclat cortical, quartz, retouche marginale sur la face supérieure, retouche envahissante sur la face inférieure, PF1 ; 17960/ éclat partiellement cortical en quartzite ; au moins trois enlèvements sur la face supérieure qui, du côté droit, présente un plan de clivage qui permet une très bonne prise de la main droite, ce qui explique la coche visible sur la vue de côté, PF2.

c) It is worth noting that at BPF itself the conglomerate presenting the cobbles used by monkeys is not exposed and (loose) cobbles are only available for the monkey's

disposal on the waterfall talus. Hence, their use as hammerstones would have implied a minimum transport of about 10 m. Thus, a more probable work site for the monkey smashing activity would have been at the large sandstone blocks on the talus of waterfall C (fig. 2 & 3), but in this case any by-products would have probably rolled downstream, possibly "polluting" the outer section of the site, named Vale da Pedra Furada (Parenti, 2015).

d) We agree that the multifunctional nature of the observed monkey tool-kit is a true mimesis of a simple core and flake technology and, because of this, the anthropic origin of a single (simple) artefact cannot be precisely ascertained, also taking in account the low sedimentation rate recorded at BPF (av. 1 cm/century), which allows for the multiple reutilization of the same tool (potentially by monkeys or humans). Therefore a given assemblage would only be recognizable - on statistical basis - after a careful analysis of *chaînes-opératoires* and use-wear studies.

However we still consider that the most of the more elaborate tools from BPF assemblage can be regarded as the result of intentional flaking by humans. Five trimmed cobbles are shown here as examples: two choppers from the oldest layer Pedra Furada 1 (fig. 15) and three cores from the richest Pleistocene layer, Pedra Furada 2 (fig. 16). All have technical features that could hardly be attributed to gravitational fracture or the occasional percussion by monkeys.

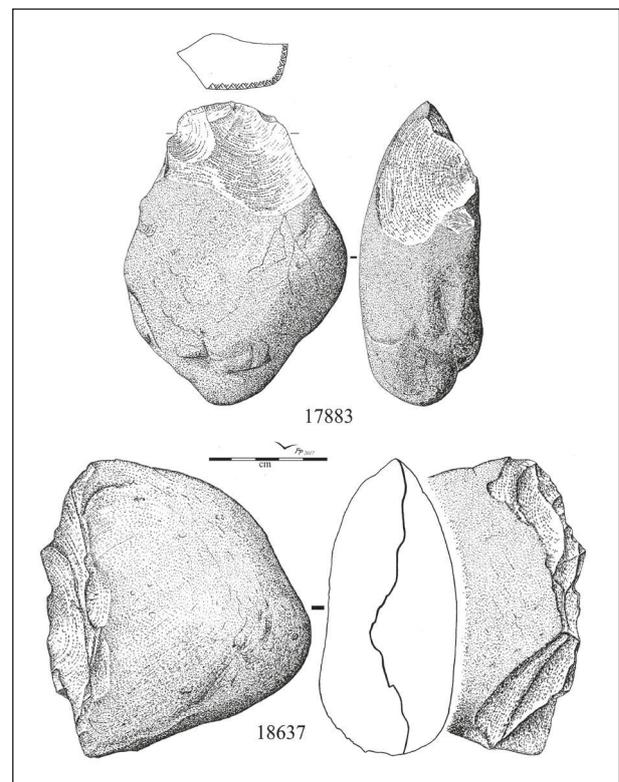


Fig. 15 : Bifacial quartzite chopper, with a sinusoidal distal edge, formed by alternate trimming, 790 g, PF1 (17883); bifacial quartzite chopper, with continuous cutting edge, defined by many flake-scars, 995 g, PF1 (18637).

Fig. 15 : Galet aménagé bifacial en quartzite, avec un bord distal sinusoidal, obtenu par retouches alternées, 790 g, PF1 (17883) ; galet aménagé bifacial en quartzite, avec un bord tranchant continu, formé par de nombreuses traces d'enlèvements, 995 g, PF1 (18637).

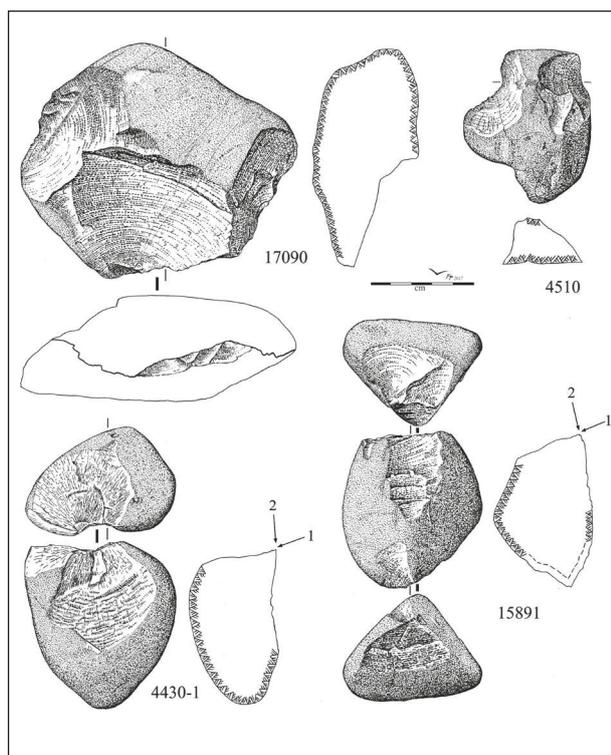


Fig. 16: Centripetal quartzite core with minimum four flake-scars, the last has been retouched, maybe indicating a last use as scraping tool, 765 g, PF2 (17090); small quartzite core, useless as hammer because of its weight (155 g) and form, PF2 (4510); orthogonal core on quartz cobble, 360 g, PF2 (4430-1); orthogonal core on quartzite cobble; lower view: double synchronous split fracture, due to percussion, 265 g, PF2 (15891). Note the recurrent technique of the last two cores.

Fig. 16 : Nucléus centripète en quartzite avec un minimum de quatre enlèvements, le dernier a été retouché, cela indique peut-être la dernière utilisation comme grattoir, 765 g, PF2 (17090) ; petit nucléus en quartzite, utilisé comme percuteur du fait de son poids (155 g) et de sa forme, PF2 (4510) ; nucléus orthogonal sur galet de quartz, 360 g, PF2 (4430-1) ; nucléus orthogonal sur galet de quartzite ; vue du bas : double fracture synchrone, obtenue par percussion, 265 g, PF2 (15891). À noter la technique récurrente des deux derniers nucléus.

6 - CONCLUSIONS

In this paper we revised the formation of Pedra Furada deposit, highlighting the main physical agent seen as the principal alternative to the anthropic origin of endogenous artefact assemblages, i.e. the waterfall. A detailed sedimentological study carried out on the preserved sections eight years after the last excavation is also presented. This study has analytically demonstrated what had already been observed during the excavations, namely: the mixed origin of the filling, both from the roof and from the waterfall, and the decrease of the presence of cobbles inside the shelter. On these basis we compared the granulometry of the Western talus A with that of the lithic assemblage and of some important stone structures from Pleistocene units, demonstrating that both did not result from the waterfalls but - on the contrary - were selected, transported, trimmed (if stone tools) or disposed (if bordering possible hearths) well inside the sheltered area.

Given the well-studied use of stone-tool by wild capuchin monkeys in the Pedra Furada area, we show also an initial comparison between the unintentional cores and flakes currently produced by these primates

and the artefacts recovered and considered as having an anthropic origin, both from the Holocene and Pleistocene layers of the site. This comparison allow us to ascertain that part – although not the totality - of the archaeological assemblage could be the result of monkey's activity, but also that some important technical traits of the artefacts along with the evidence for several stone structures still present a very strong case for a long-lasting pre-Clovis human presence in this region. We are perfectly aware that Pedra Furada - as all its analogs – needs to be studied in its archaeological and natural context and not only with a site-centered focus; it is known that BPF is not an isolated case, as our previous works and ongoing research are demonstrating.

From the time when it was dismissed by leading archaeologists as a possible collection of geofacts - without any careful examination of the evidence – Pleistocene layers of BPF have been ignored even by scholars (academically) debating on pre-Clovis peopling of lowland South America. In addition, ethologists are now trying to produce evidence for a pre-Columbian presence of monkey activity in order to develop the exciting new field of non-human primates archaeology in the Neotropics. These studies should consider existing data on archaeological and stratigraphic context as a useful tool for further discussion on this interesting research topic. If there is indeed any evidence of a long-lasting overlapping co-existence of humans and monkeys in the same region, it is time to build a well-founded research strategy including both non-human primate and human archaeology in order to achieve a full understanding of past cultural and ecological adaptations in lowland South-America.

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