

8 Tephrofacts and the first human occupation of the French Massif Central

Claims for Early Pleistocene occupation of the French Massif Central are examined within the context of the geological setting of the sites. The Massif Central is an area where volcanic processes repeatedly fractured stones, thus producing forms that look like humanly modified objects: tephrofacts. The analysis of raw material diversity proves to be an important tool to discriminate between occurrences of such tephrofacts and archeological sites, the earliest of which date from the Middle Pleistocene.

1. Introduction

The production of geofacts, objects resulting from natural fracture and imitating artefacts (Haynes 1973), is a phenomenon long recognized in many different sedimentary contexts (Pei 1937; Mortelmans 1947; Breuil 1955; Clark 1958; Bourdier 1967; Fournier 1971; Raynal and Texier 1989; Raynal *et al.* 1990). A number of works have analyzed such objects (particularly flint ones), and have tried to elaborate a method which distinguishes clearly between intentionally flaked objects and products of nature (Boule 1889; 1905; 1921; Haward 1911; Moir 1911; Warren 1914; Grayson 1986; Schnurrenberger and Alan 1985; Peacock 1991).

The Massif Central in the central mountainous region of France experienced active volcanism since the Miocene (15-20 Myr BP) and several glacial events during the Pleistocene. Because vulcanism and frost action generate rock fracturing, there is thus a high probability of the natural occurrence of pseudo-artefacts in this area. The discovery of flint pseudo-tools confused a number of archaeologists during the nineteenth century beginning with Tardy (1869), who reported the discovery of Miocene eoliths from Le Puy Courney in the Cantal. More than fifty years later Marty was still arguing for this interpretation (Capitan and Marty 1924).

The Massif Central region is well known for important excavations of Upper Palaeolithic sites and it has considerable archaeological potential for sites yielding material from the Lower and Middle Palaeolithic periods. During the last twenty years, much research has been undertaken in the region, aimed at discovering traces of the first human occupation of Europe. These investigations

have been concentrated in Velay, a province to the south of Auvergne which is rich in Plio-Pleistocene faunas, occurring in between volcanic sediments which offer the possibility of obtaining a long sequence of palaeomagnetic and radiometric dates. Basse-Auvergne and Bourbonnais have yielded a number of classic Acheulean bifaces lacking stratigraphic context, and in surface complexes of the Allier tools made on quartz cobbles have been discovered.

The lithic series discovered in the Massif Central, principally in Velay, has been classified under the name "Most Ancient Palaeolithic" (Bonifay and Bonifay 1983) and has been proposed as resolving the question of the time of the initial human occupation of Europe (Bonifay, Consigny, Liabeuf 1989; Bonifay 1981; 1983; 1989a; b; c; 1991). This perspective, which is of considerable conceptual importance and thus must be founded on decisive arguments, is not accepted unanimously by the scientific community, as doubts about the artificial character of the finds have been expressed in many publications (Delson 1989; Boëda 1990; Villa 1991; Farizy *in* Diaz 1993). We here report some results of an examination of the production of geofacts by volcanism. We will refer to these as *tephrofacts*. These pseudo-artefacts are fashioned in materials other than flint which occur in the local environment of supposedly ancient archaeological sites. Our observations, begun in 1989, are founded on the examination of a number of volcanic structures and the deposits and epiclastites associated with these structures (Fig. 1). These investigations were aimed at elucidating the possible presence of hominids in the late Pliocene and Early Pleistocene of this part of France. Special attention has been given to the site of Blassac and part of the abundant series of supposed artefacts discovered in an ancient context there and also to the site of Soleilhac, yielding the strongest evidence for an early occupation of Velay.

2. The production of tephrofacts

The production of tephrofacts is known to have occurred in pyroclastites of the Eifel in Germany (Bosinski *et al.* 1986). We collected some tephrofacts on the site of Kärlich and in strombolian lapilli of the Schweinskopf volcano in

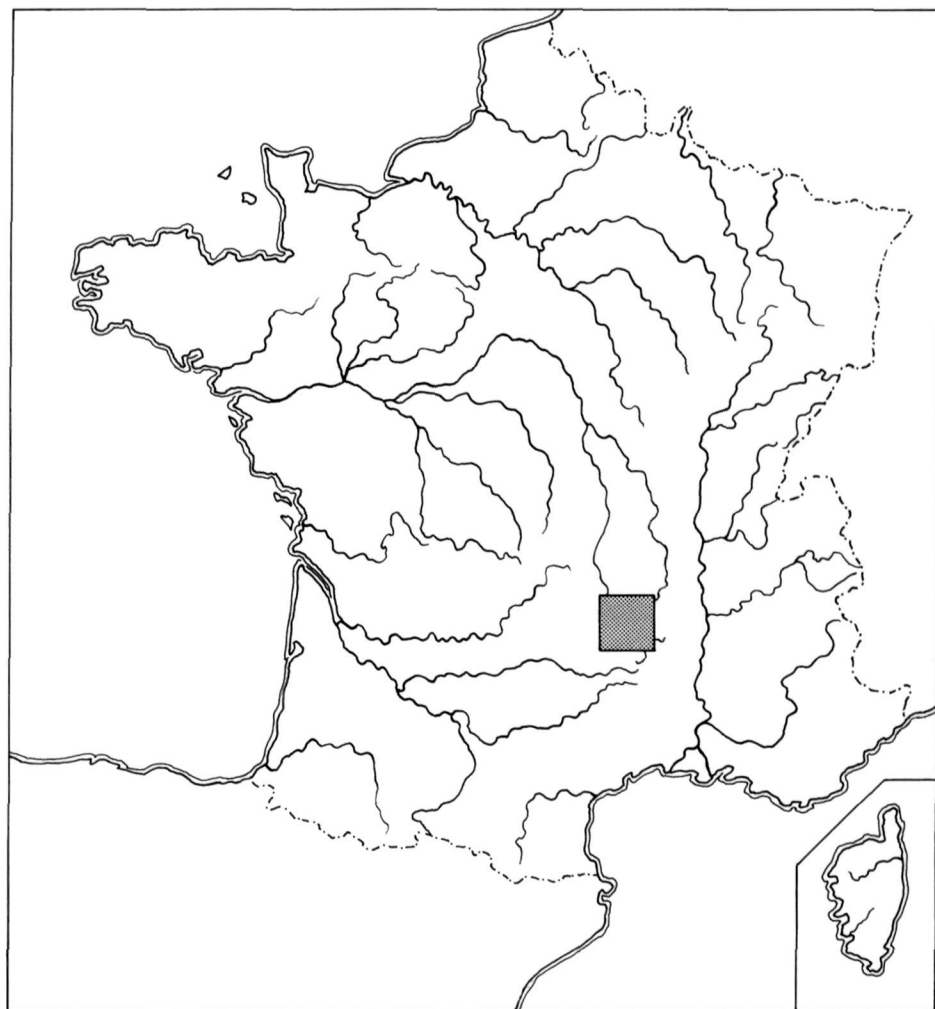


Fig. 1. Location of the study area.

the company of G. Bosinski in 1992. These tephrofacts superficially resemble artefacts and their differentiation from the latter is difficult when they are discovered outside of their primary volcanic context (Kulemeyer 1986).

In Velay, many Pleistocene maar tuff-rings (La Sauvetat, Les Farges, Saint-Eble, Soleilhac, Senèze, Blassac/Les Blanches), basanitic breccias (Sainte-Anne) and one strombolian cone have yielded tephrofacts with various petrological origins. Moreover, many other geofacts have been collected in a large number of volcanic sediments (Saint-Vidal, Vals, Brioude).

Among these are a number of flakes and some objects with multiple flake scars with a very regular pattern: none of them would be discarded out of hand if they occurred in solid archaeological contexts. *However, they are undoubtedly tephrofacts which have resulted from several*

mechanical and thermal actions during various different eruptive stages of volcanic events.

3. Petrography of the tephrofacts

The raw materials of the tephrofacts collected come from the regional basement or from the Plio-Pleistocene sedimentary formations which have been altered by the volcanic eruptions. Some of these materials still outcrop in the immediate environment of the volcanic formations investigated. The following diverse rocks have been identified: vein quartz, pegmatitic quartz, fine grained granite, oriented granite, migmatitic gneiss with sillimanite, lamprophyre and various basalts.

The Blassac-Les Blanches tuff-ring has yielded seventy-two tephrofacts. The distribution of petrographic types does not vary significantly between the chunks, flakes or pseudo-

artefacts (Fig. 2a). *A strong presence of materials of mediocre flaking quality (granites and gneiss) and the absence of flint is a distinct characteristic of this series.*

4. Natural flakes

In this paper we do not discuss the classic “pot-lid” flake form well known to occur as a result of thermally induced reduction sequences. We note however the absence in the literature of observations concerning the characteristics of these thermal fracture features when they occur adjacent to the edges of irregular chunks. The natural flakes derived from these situations exhibit a pseudo-striking platform produced when the fracture surface intersects an adjoining edge. Although these objects may be superficially identified as humanly produced flakes, this position can be readily discarded for flint when none of the other features of humanly produced flakes can be identified (point of percussion, ventral bulbar scar, radial stress marks, etc).

Fifty natural flakes were collected for study from the tuff-rings of Blassac-Les Blanchés, La Sauvetat and Soleilhac (Fig. 3). Some of them were in juxtaposition with the pseudo-core. They result from repetitive uni-directional stresses, both mechanical and thermal.

Of these, fifteen (30%) exhibit cortical striking platforms. These can be subdivided into those with a total or partial cortical dorsal surface extending to the edges (11 objects) and those with non-cortical edges (4 objects). In the case of a series produced by intentional flaking, these objects would be considered of primary and secondary generation.

Flakes without cortical striking platforms represent 70% of the total (35 objects) and this group is composed of those with cortical dorsal surfaces (8 objects) and those with non-cortical edges (27 objects). In a series produced by intentional flaking, these would be considered third generation flakes.

Pseudo-retouch sometimes appearing contiguous can be seen on numerous flakes and it is comparable with the utilized or retouched edges of humanly produced artefacts (Fig. 3).

The proportion of types of naturally produced flakes in this series is very different from that obtained from our experiments with quartz pebbles. They also differ from those of the flaked quartz assemblages collected from the upper and middle terraces of the Allier in Bourbonnais: *an assemblage of tephrofacts is characterized by an over-representation of flakes with non cortical striking platforms and non cortical edges and an under-representation of flakes with cortical striking platforms and edges totally or partially cortical* (Fig. 2b).

Pseudo-flakes have a weight below 150 g in more than 96 % of the cases and rarely exceed 500 g (Fig. 2c). A few exceptions exist, represented by very large pieces which weigh over 2000 g.

The weight criterion is not a discriminating factor between tephrofacts and artefacts. The distribution of weight ratios of pseudo-flakes and flakes manufactured and recovered in primary position (whether in eruptive breccias, archaeological layers, or by experimentation) is identical. This distribution differs from those observed on collections from surface sites: for the flakes collected in Bourbonnais on the surface of the upper and middle terraces of the Allier for example, the weight ratio distribution can be explained by the removal of the smaller flakes through natural processes and selective collection (Fig. 2c).

5. Natural objects with multiple flake scars

Events leading to the natural flaking of fragile source rocks are diverse in nature and may result in an apparently organized series of flake scars. The order in which these flakes are removed largely determines the morphology of each tephrofact. The organization of the natural flake scars on the blocks parallels the morphology of objects recognized among prehistoric archaeological assemblages.

The number of flake scars on the tephrofacts (between 1 and 22) is comparable with that observed on prehistoric objects and their random organization is comparable to the sequences observed on manufactured objects. However, contrary to what is evident on prehistoric objects, the detachment points of flakes observed on tephrofacts are very often impossible to determine and most flake scars occur in random arrangements.

On 34 faces of objects with multiple flake scars (9 uniface and 26 bifaces) there is a linear system of “working” arranged from right to left for three flake scars in two cases and in the remaining cases the working system is non-linear with a maximum number of seven flake scars originating from one edge. In general, pseudo-working identified on the tephrofacts is mainly non-linear in arrangement.

The associations of flake scars on edges are shown in the following table:

Number of flake scars	1	2	3	4	5	6	7	Sample
Unifacially “flaked” objects	1	2	1	3	0	2	0	9 faces
Bifacially “flaked” objects*	2	3	6	5	4	3	4	27 faces

* (each face is considered separately)

Some natural objects appear similar to unifacially flaked choppers and bifacially flaked chopping tools in that they exhibit the transformation of a natural edge with at least two adjacent flakes (Fig. 4, n° 1, 2, 4, 5; Fig. 5, n° 1; Fig. 6, n° 5; Fig. 8, n° 2).

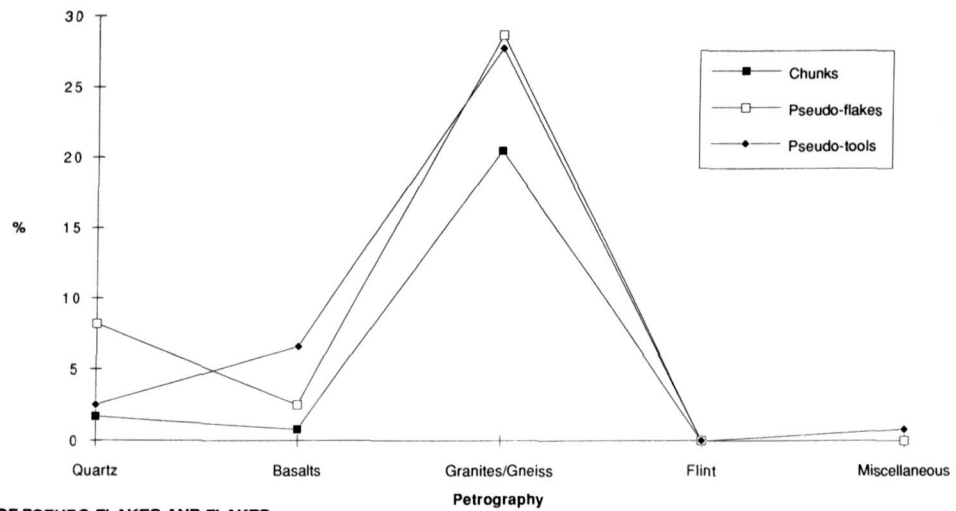
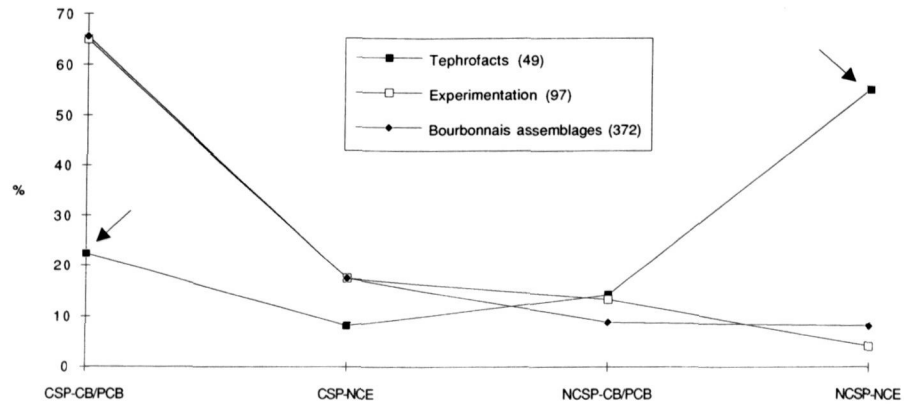
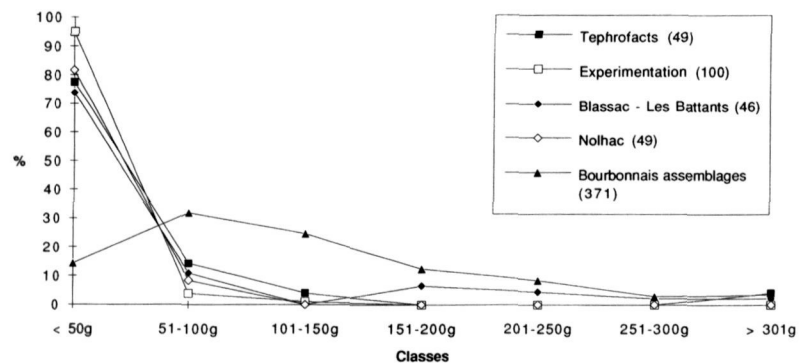
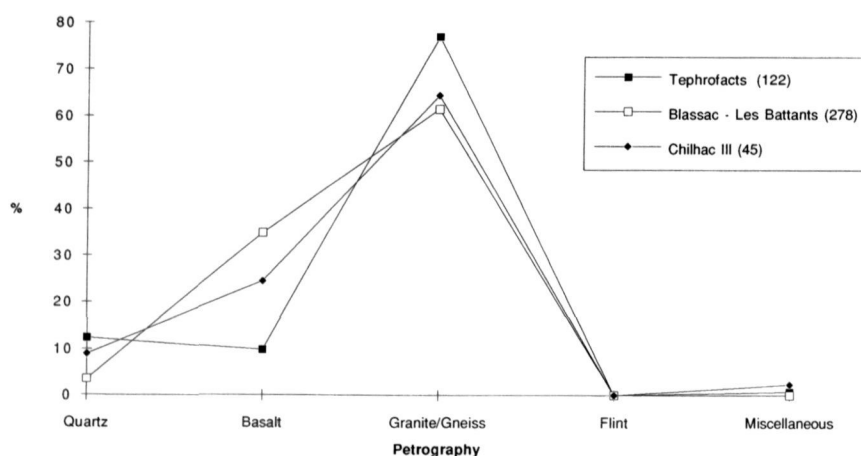
2A TEPHROFACTS (122)**2B TYPES OF PSEUDO-FLAKES AND FLAKES****2C WEIGHT OF PSEUDO-FLAKES AND FLAKES**

Fig. 2. 2a: Petrography of tephrofacts.

2b: Types of pseudo-flakes compared to flakes from archaeological and experimental series. CSP: cortical striking platform. CB: cortical back. PCB: partially cortical back. NCE: non-cortical edges. NCSP: non-cortical striking platform.

2c: Weight of pseudo-flakes compared to those of archaeological and experimental series.

2D COMPARISON WITH ASSEMBLAGES FROM TWO REPUTEDLY ANCIENT SITES



2E COMPARISON WITH THREE ARCHAEOLOGICAL ASSEMBLAGES

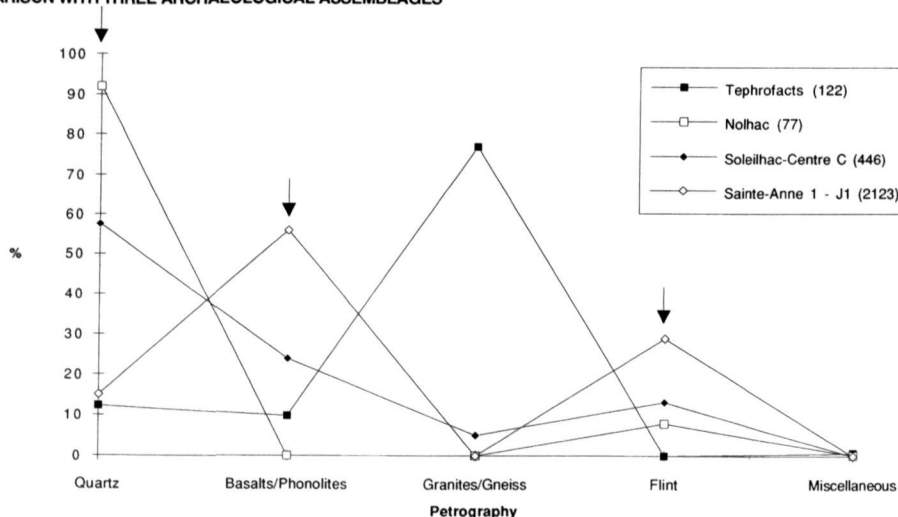


Fig. 2. 2d: Comparison of tephrofacts with lithic assemblages from two "archaeological" ancient sites.
2e: Comparison of tephrofacts with lithic assemblages from three archaeological series.

Natural multidirectional flaking around the periphery of various chunks and pieces produces objects which are similar to invasively flaked tabular cores and discoidal cores (Fig. 5, n° 3; Fig. 8, n° 3; Fig. 7, n° 1, 2). Sometimes the natural morphology is similar to that seen on bifacially flaked artefacts (Fig. 4, n° 3; Fig. 6, n° 1; Fig. 7, n° 3; Fig. 8, n° 1).

Other tephrofacts look similar to flaked polyhedrons. These globular objects have a large number of scars from flakes with a high number of non-cortical striking platforms (Fig. 7, n° 2, 4; Fig. 6, n° 3, 4; Fig. 8, n° 4; Fig. 9).

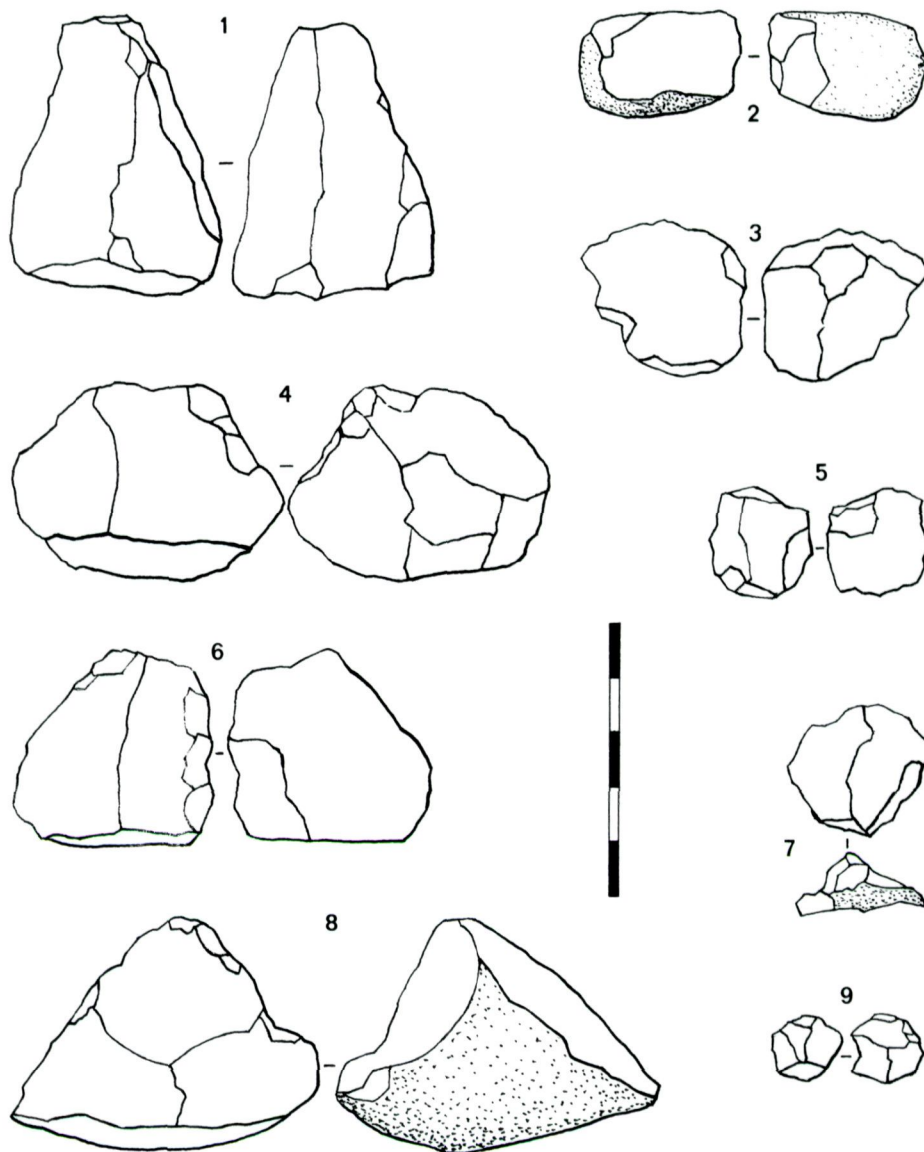
As if the distinction between tephrofacts and intentionally manufactured objects is not difficult enough, the case is

further complicated by the poor raw materials in which they occur. This observation has already been discussed in other works attempting to distinguish between geofacts and artefacts (Watson 1968), even though some progress has been made in the case of flint (Peacock 1991), a raw material for which there is today a considerable amount of information on its flaking properties.

6. Distinguishing between tephrofacts and humanly produced objects

We have had recourse to a statistical approach to solve this problem, the details of which will be presented elsewhere. Between 24 and 62 tephrofacts, according to the

Fig. 3. Examples of tephrofacts (scale in cm) - Blassac-les Blanches Haute-Loire, pyroclastites - 1: Partially cortical backed pseudo-flake and non cortical striking platform, fine grained granite. 2: Partially cortical backed pseudo-flake and cortical striking platform, quartz. 3: Partially cortical backed pseudo-flake and non cortical striking platform, fine grained granite. 4: non-cortical backed pseudo-flake and non cortical striking platform, fine grained granite. 5: Partially cortical backed pseudo-flake and cortical striking platform, pegmatitic quartz. 6: pseudo-flake with non cortical edges and cortical striking platform, fine grained granite. 7: pseudo-flake with non cortical edges and non cortical striking platform, pegmatitic quartz. 8: Partially cortical backed pseudo-flake and cortical striking platform, fine grained granite. 9: pseudo-flake with non cortical edges and non cortical striking platform, quartz.



number in each sample, have been added to a series of humanly produced lithics. The criteria used for describing the two groups were published by J. Collina-Girard (1975; 1986). We have discarded some of those criteria, calibrated some of his non-metrical observations and added some of our own (weight and number of flake scars).

Factorial analysis of correspondences reveals that the inclusion of the tephrofacts destroys the coherence of the assemblage. The presence of two discrete and distinct groups is readily observed in each series.

In the case of a principal component analysis, taking all the characteristics except the number of flake scars into account, no true distinction can be made between tephrofacts and humanly produced objects. The natural trend in tephrofacts is towards a spherical or sub-spherical shape, which most effectively resists further natural attrition. Human intervention interrupts this trend towards a globular form. However, industries containing a preponderance of polyhedrons cannot be discarded out of hand as having a natural origin and should be studied according to the scheme suggested above.

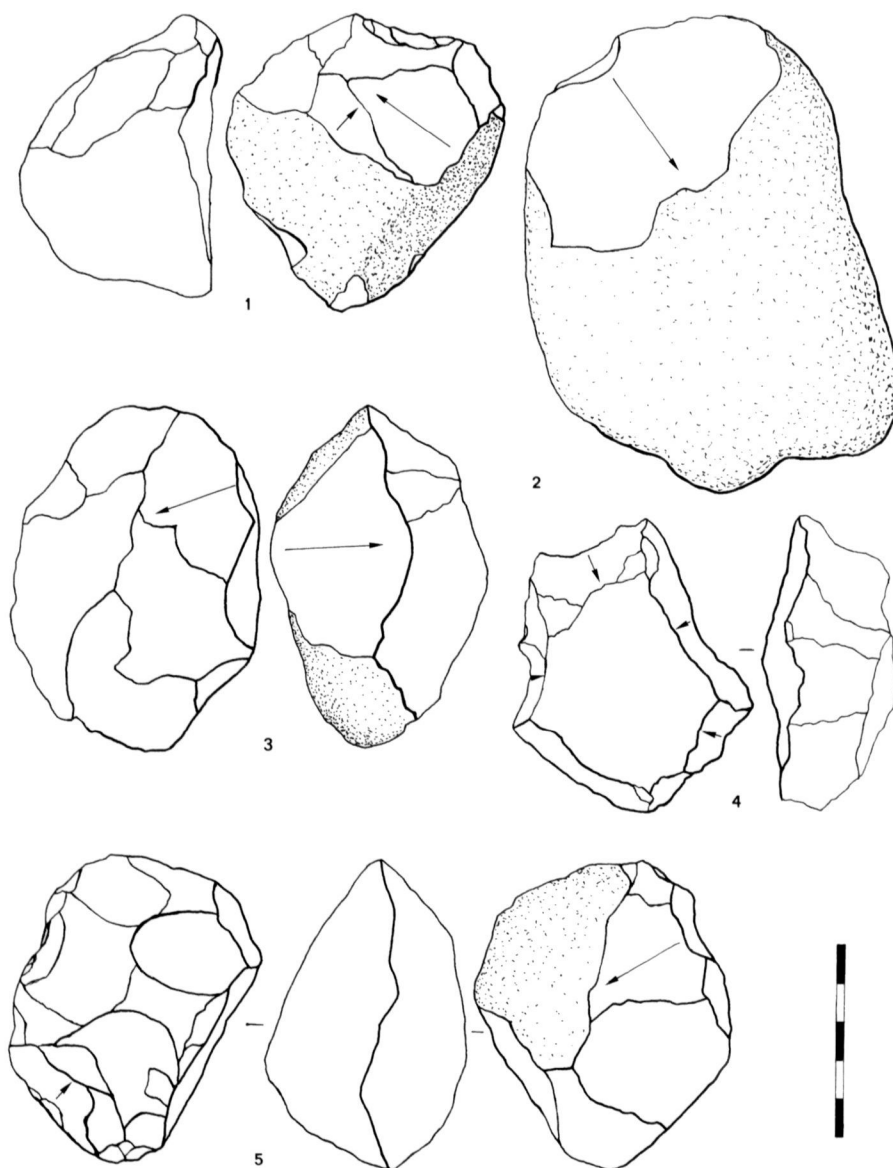


Fig. 4. Examples of tephrofacts (arrows indicate clear directions of flaking), scale in cm - Miscellaneous from Haute-Loire - 1: pseudo-chopper, basalte, Blassac-les Blanchés pyroclastites. 2: pseudo-chopper, lamprophyre, Blassac. 3: pseudo-biface-like piece, basalte, Blassac-les Blanchés pyroclastites. 4: pseudo-chopper, basalte, Blassac-les Blanchés tuff-ring. 5: pseudo-chopping-tool, migmatitic gneiss, Senèze tuff-ring inférieur.

Parametric characteristics often used for studying a humanly produced lithic assemblage, when applied to tephrofacts, do not permit any distinction between the two. Rather than showing the differences, the results confirm the similarities between tephrofacts and manufactured objects, rendering the method useless.

7. Remarks on two reputedly ancient sites

7.1. BLASSAC-LES BATTANTS.

A series collected at Les Battants by F. Carré (1978; 1983; 1991) is dated by a number of Potassium/Argon

determinations of the basaltic lava-flow overlying the assemblage, which indicate an age around or beyond 2 Myr BP. However, the fauna of Blassac-La Girondie, in an analogous stratigraphic position, seems to be much more recent, belonging to the Peyrolles biozone and probably dating from around 1.2-1.4 Myr BP (Couthures 1982; Carré and Couthures 1982; Couthures and Pastre 1983; Fouris 1989; Bonifay 1991; Carré 1991).

A series of 278 lithic objects has been examined. This study is incomplete, however, because the matrix has been left on several objects. Observations to date are as follows:

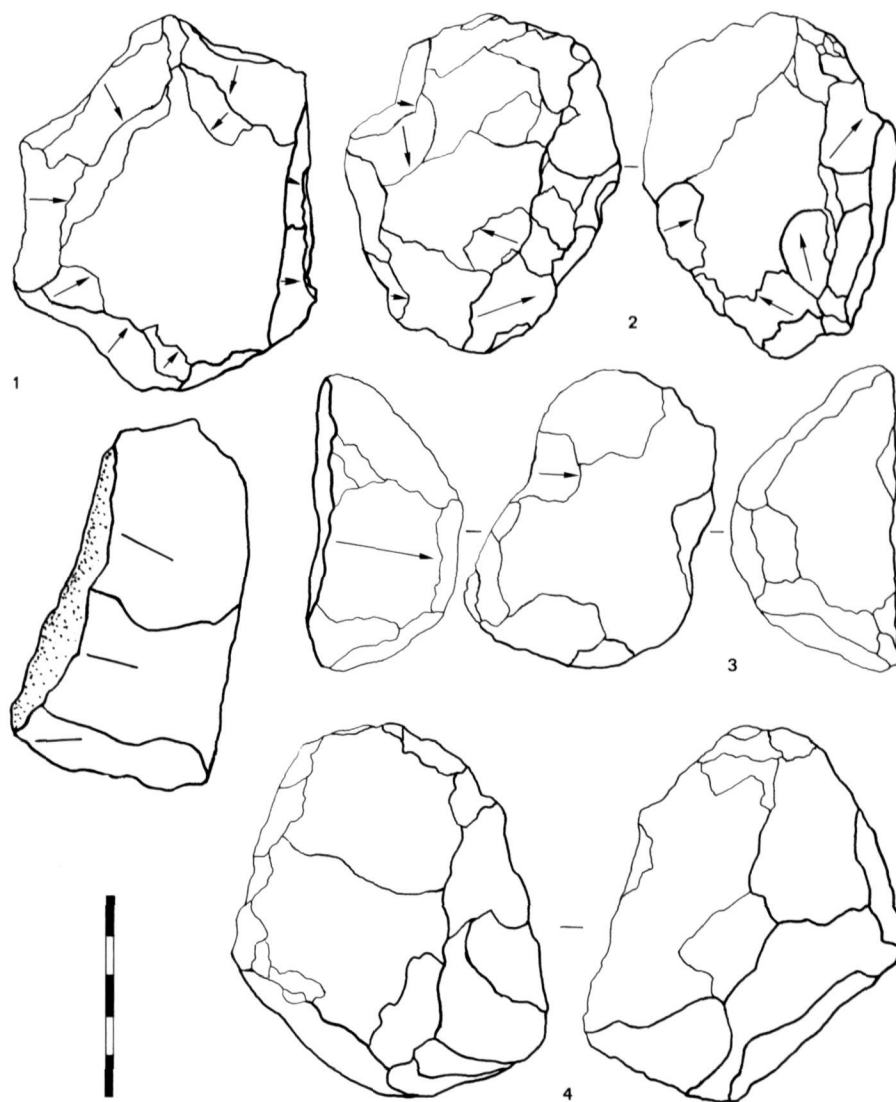


Fig. 5. Examples of tephrofacts (arrows indicate clear directions of flaking), scale in cm - Miscellaneous from Haute-Loire - 1: peripherally flaked pseudo-chopper, granite, La Sauvetat tuff-ring. 2: pseudo-polyhedron, pegmatitic quartz, Blassac-les Blanches pyroclastites. 3: pseudo-invasively flaked tabular piece, granite, La Sauvetat tuff-ring. 4: pseudo-polyhedron, granite, La Sauvetat tuff-ring.

- Most objects are on crystalline rocks with natural cleavage planes and the fractures in general follow these planes. This gives the pieces an appearance of being partly or intentionally flaked debitage. However, most of the flakes do not have normal feathered terminations.
- From the evidence of the flake scars, the angle of detachment approaches 90° , which is not usually encountered in intentional flaking.
- Several objects have gross crystalline irregularities which render them inappropriate raw materials for flaking.
- Flakes do not exhibit clear points of percussion.
- Some objects exhibit obvious thermal fractures.
- On many objects, the flake scars appear to originate from

well outside the remaining volume. Objects of similar form, and the flakes removed from them by thermal action, have been collected from the tuff-ring of Blassac-Les Blanches. In several cases, these pseudo-nuclei and their conjoining flakes were found in primary position within the tuff with the flakes barely removed from the parent chunk.

- Several objects of very poor flaking quality show a number of repetitive flake scars, which is an unlikely occurrence even in a primitive series of intentionally flaked objects. Moreover, within the same stratigraphic level, materials with far better flaking properties are present.

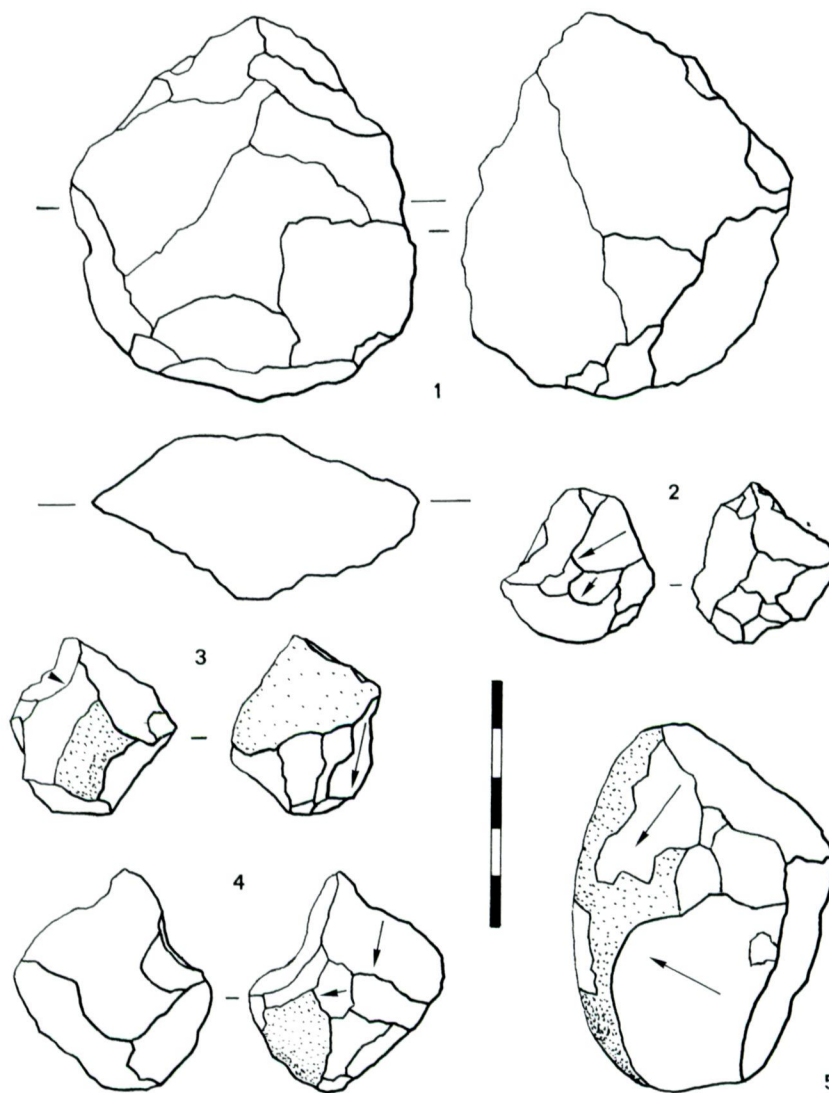


Fig. 6. Examples of tephrofacts (arrows indicate clear directions of flaking), scale in cm - Blassac-les Blanches Haute-Loire, pyroclastites - 1: pseudo-partially bifacial discoid piece, migmatitic gneiss à sillimanite. 2: regular pseudo-polyhedron, quartz. 3: regular pseudo-polyhedron, quartz. 4: regular pseudo-polyhedron, oriented granite. 5: pseudo-chopper, fine grained granite.

– Finally, the petrographic nature of the series presents a distribution comparable to that of tephrofacts (Fig. 2d).

The geological characteristics of the site of Blassac-Les Battants deserve a full scale discussion too extensive for this paper. *We simply note here the undeniable inclusion of naturally fractured objects and the resemblance to the petrographic suite occupied by tephrofacts.*

7.2. CHILHAC III

The fossil locality of Chilhac III is known for a rich Villafranchian fauna (Boeuf 1983) and lithic objects (Guth 1974; Guth and Boeuf 1977; Guth and Chavaillon 1985)

which occur in a level whose age is presumed to be in the vicinity of 1.8-1.9 Ma, a date arrived at through palaeontological comparisons and extrapolation from absolute dates on a lava flow close to the site.

The stratigraphic sequence exhibits deformations interpreted as resulting from solifluxion (Texier 1985) or soil slips (Chavaillon 1991). Many visits to the site during the excavations have convinced us of the existence of syn-sedimentary slumpings and removals. This clearly demonstrates dynamism of a kind known to occur on the margins of lacustrine systems and we postulate the likelihood of the existence here of an ancient phreato-magmatic structure. In this dynamic situation, the presence

of relatively recent tools on quartz cobbles in adjacent localities (Le Gall and Raynal 1986) renders likely a mixture of such objects with the ancient fauna.

We have not examined closely the complete series of objects discovered in a stratigraphic context (ensembles B to K) apart from those published by Chavaillon (1991). Except for the resemblance between retouched flakes and some tephrofacts (Fig. 3), *we note that the petrographic nature of the objects offers a distribution identical to that of tephrofacts and of the series of pseudo-artefacts recovered at Blassac-Les Battants* (Fig. 2d).

A detailed examination of the site and its environment would clarify without doubt the archaeological and geological processes which resulted in the production of these objects and their association with the faunal remains.

8. Comparison of three archaeological series

We have chosen three archaeological series to illustrate the fundamental differences which exist between the petrography of tephrofacts and that of prehistoric tools from Velay. In the latter, the petrography clearly demonstrates human selection.

- At Nolhac, apart from exceptional flint objects, quartz was the principal material chosen (Rio Carra 1991; Bonifay 1991)
- In Soleilhac-Centre, quartz, basalt and flint are in that order the three dominant materials (Bracco 1991)
- In level J1 in the cave of Sainte-Anne 1 at Polignac, provisionally reported to OIS 6, basalts, phonolite, flint and quartz were in that order the materials worked.

The petrography of tools from the prehistoric sites is clearly different from that of the tephrofacts and *is characterized (outside the constant presence of flint) by a choice of materials which does not include those with poor flaking characteristics like granites and gneiss* (Fig. 2e).

9. Conclusions

9.1. TEPHROFACTS ARE WIDELY DISTRIBUTED

It is more than reasonable to assume that tephrofacts were produced in great numbers in the Massif Central during the numerous volcanic episodes which occurred since the Miocene. Without doubt, they were subsequently eroded out of their primary position and widely dispersed in the environment on numerous occasions.

The discovery in geological layers of some broken or apparently flaked pieces, flakes or objects exhibiting a more complex pattern of flake scars is therefore not considered a sufficient criterion for characterizing human activity, particularly in this region.

9.2. NECESSARY RE-EXAMINATION OF SITES

Sites considered indicative of human activity as demonstrated by the presence of a series of supposedly humanly worked pebbles and cobbles demand a close scrutiny of all the available evidence, especially in the case of Blassac and Chilhac III.

Sites which have yielded a limited number of doubtful artefacts, tephrofacts or geofacts need further detailed discussion. This is the case for Perrier-Etouaires in Puy-de-Dôme (G.U.E.R.P.A., 1984), Saint-Eble (Bonifay 1989a), le Coupet (Bonifay 1989a) and La Roche-Lambert (Bonifay 1981) in Haute-Loire.

For some sites, association of lithic objects with fragmented faunal remains is not decisive. The various models of fragmentation and preservation of the bones do not give at present sufficient evidence to identify any human involvement.

From the evidence, it must be recognized that there is considerable doubt concerning a very ancient human presence in the Massif Central.

In addition to this taphonomic approach, it is necessary to consider the following points carefully and systematically for all localities:

- Is there a possibility of pseudo-artefacts being produced?
- If so, what are the likely characteristics of these objects?
- Is there a geological explanation for the introduction of naturally flaked objects into the site?
- Are lithic objects preferentially distributed in the supposed archaeological layer? Is there a natural explanation for this?
- Do conjoinable objects exist in the site, and do they occur adjacent to each other?
- Are the flake scars observable on the objects arranged in a technologically “logical” sequence?
- Are natural objects mixed with artefacts?
- Are the faunal remains and the associated objects both in primary position?
- Does the taphonomic history of the site provide any explanation for possible association of numbers of objects of different ages, for example reflecting periglacial phenomena?

9.3. OPPORTUNISTIC EXPLOITATION?

Can we discard out of hand sites where only a few objects have been found? The utilization of materials of poor flaking quality in these sites may simply be an example of human opportunism according to the law of least effort. Additionally we have the complicating factor among ancient assemblages of the likelihood of opportunistic exploitation of naturally fractured pieces which will occur anyway as a part of the site’s assemblage. *While these questions have already been discussed for several African archaeological sites, it is no doubt useful to consider the*

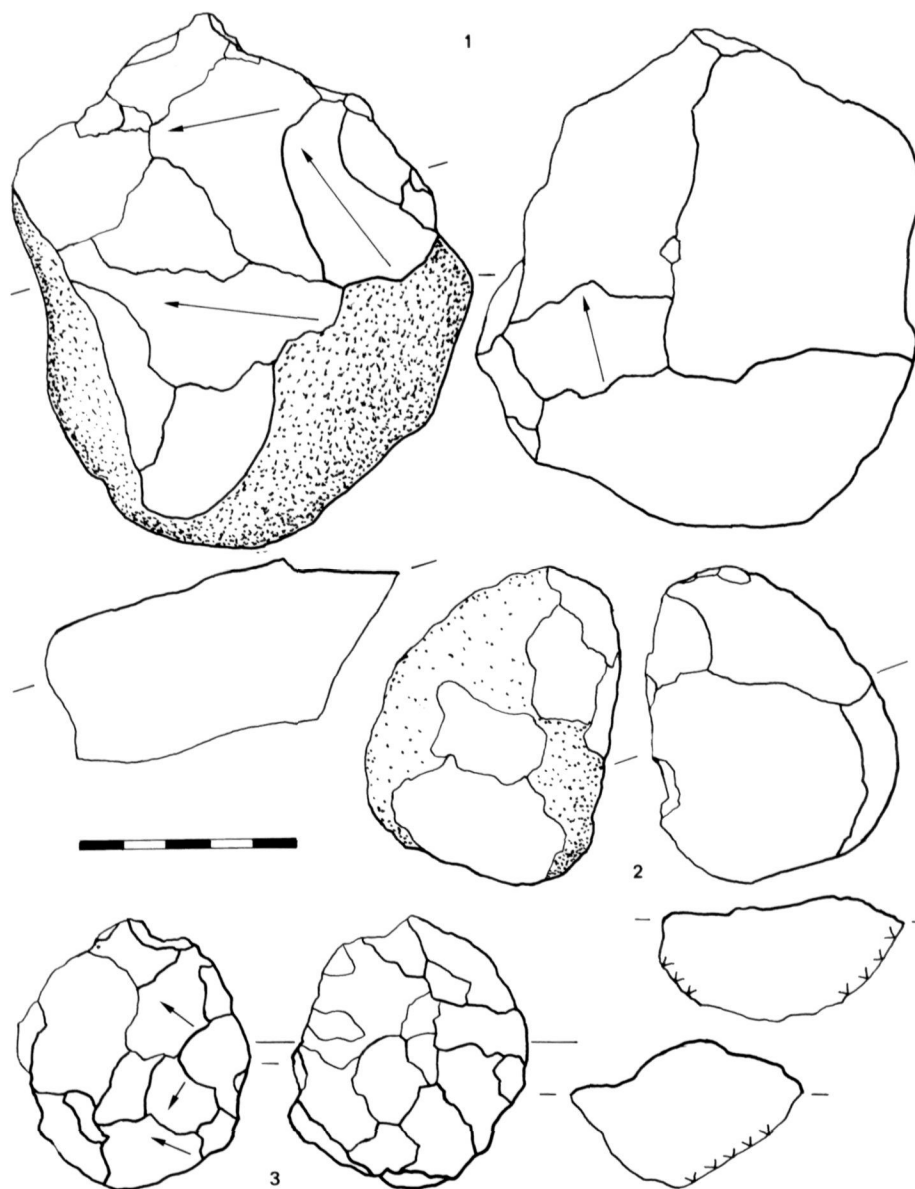


Fig. 7. Examples of tephrofacts (arrows indicate clear directions of flaking), scale in cm - Miscellaneous from Haute-Loire - 1: pseudo-invasively flaked tabular piece, granite, Blassac-les Blanches pyroclastites. 2: pseudo-invasively flaked tabular piece, basalte, Blassac-les Blanches tuff-ring. 3: pseudo-bifacially flaked discoïdal piece, basalte, Blassac-les Blanches tuff-ring.

"advantage of thinking small as archaeology explores the most ancient spans of prehistory" (G. Isaac et al. 1981).

9.4. THE TIME OF FIRST HUMAN OCCUPATION

Only the sites where unquestionable archaeological elements have been discovered in a well documented long sequence should be considered to elucidate this problem. In the absence of precise dating elements for the site of Nolhac, only Soleilhac "the most recent of the very Lower Palaeolithic sites" (Bonifay 1991) remains to give an idea

of the temporal remoteness of the human presence in Velay.

The age of Soleilhac has been established by biostratigraphic criteria (Bonifay and Bonifay 1981), palaeomagnetic determinations (Thouveny 1983; Thouveny and Bonifay 1984) and morphostratigraphy (Bonifay and Mergoil 1988). Soleilhac-Centre has also been studied from a sedimentological and palynological point of view (Raynal 1987 and unpublished). However, the fauna of Soleilhac belongs to the "transition fauna" which covers a broad time spectrum

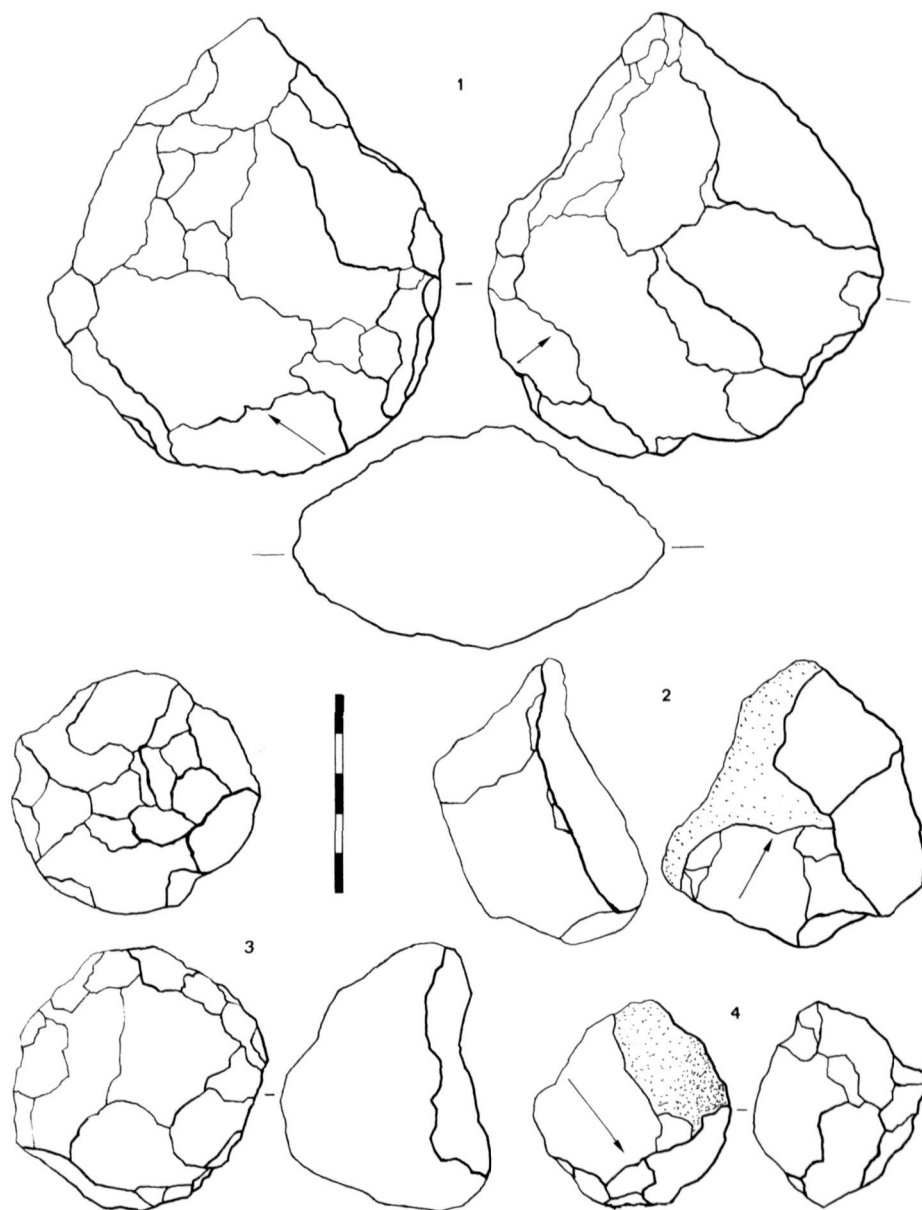


Fig. 8. Examples of tephrofacts (arrows indicate clear directions of flaking), scale in cm - Miscellaneous from Haute-Loire - 1: pseudo-biface-like piece, granite d'anatexie, La Sauvetat tuff-ring. 2: pseudo-chopper, basalte, La Sauvetat tuff-ring. 3: pseudo-invasively sub-discoid flaked tabular piece, oriented granite, Blassac-les Blanches pyroclastites. 4: regular pseudo-polyhedron, fine grained granite, La Sauvetat tuff-ring.

(Bonifay 1987). Furthermore, the sedimentological and palynological data do not allow reliable dates to be determined and the palaeomagnetism of the complete sequence has not been studied because of the unsuitability of some layers for the application of this method (Thouveny 1983: 81). Most interest has been generated by the tephrostratigraphy reported by Teulade (1985; 1988; 1989) and determined from cores (Bonifay and Mergoill 1988).

A direct pumice ash-fall has been identified in the lake series underlying archaeological layer C. These tephra correlate with the "upper pumices of Sancy" (Cantagrel and Baubron 1983) and most particularly with the pumice of Neschers. A number of dating methods place the Neschers pumice around 0.8 Myr BP (Teulade 1989: 145). More recently, however, a $^{40}\text{Ar}/^{39}\text{Ar}$ age of 0.58 ± 0.02 Myr BP has been obtained (Lo Bello *et al.* 1987), which has been confirmed by a thermoluminescence date of 0.52 ± 0.04

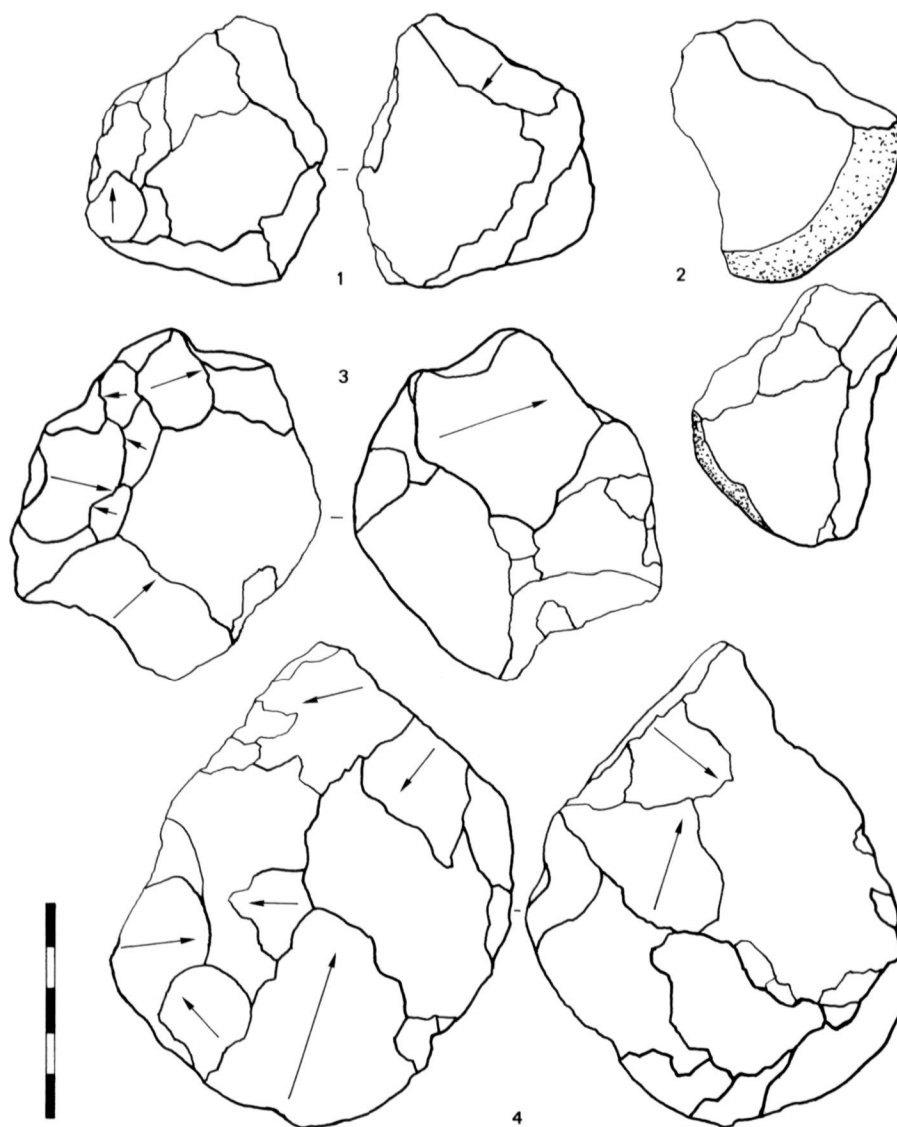


Fig. 9. Examples of tephrofacts (arrows indicate clear directions of flaking), scale in cm - Miscellaneous from Haute-Loire - 1: pseudo-polyhedron, granite, La Sauvetat tuff-ring. 2: pseudo-polyhedron, granite, Blassac-les-Blanches pyroclastites. 3: pseudo-polyhedron, granite, Blassac-les-Blanches tuff-ring. 4: pseudo-polyhedron, granite, La Sauvetat tuff-ring.

Myr BP obtained by the quartz red peak TL method (Pilleyre 1991). Thus, the tephrostratigraphy contradicts the palaeomagnetic data and necessitates consideration of a date around 0.5-0.6 Myr BP for Soleilhac-Centre. This last date is in agreement with a late Cromerian age for the fauna, as suggested by Van Kolfshoten (Roebroeks and Van Kolfshoten, this volume).

9.5. DIRECTIONS FOR FUTURE RESEARCH

If we discard all the doubtful ancient sites occurring in the Massif Central, the earliest settlement history of the region must be rewritten. However, all is not lost yet. The

evidence for the earliest occupation of Auvergne and Velay can be revisited, evaluated and carefully dissected avoiding the traps of their geological context. Paradoxically, in the final analysis it would be this last which furnishes a detailed chronology of the human presence in the region. Directions for future research are clear. Parallel to an examination of the physical and biological characteristics of the palaeoenvironment, the close study of pseudo-tools will doubtless provide much discussion and food for thought. *But clearly for each supposedly ancient site a multidisciplinary and broadly based study is absolutely necessary, and not only for the region discussed here.*

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