

## Current events

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## A critical re-evaluation of the evidence for the presence of hominids in Lower Pleistocene times at Venta Micena, Southern Spain

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### Introduction

New findings and evidence which suggest that the first arrival of hominids in Europe and Asia took place at the beginning of the Middle Pleistocene or even earlier, during Lower Pleistocene times, have been published in the last few years. Examples are the absolute ages of human remains from Java obtained using the  $^{40}\text{Ar}/^{39}\text{Ar}$  method (Swisher *et al.*, 1994), which it is claimed indicate 1.6–1.8 Ma for them, as well as the recent finding of both human remains and stone tools in the karstic site at the Gran Dolina of Atapuerca (Burgos, Spain), with an age of 0.78 Ma (Carbonell *et al.*, 1995; Parés & Pérez-González, 1995). In addition there is the finding of a human mandible associated with lithic artefacts in Lower Pleistocene deposits from Dmanisi (East Georgia, Caucasus), originally reported to be 1.6–1.8 Ma (Dzaparidze *et al.*, 1992; Gabunia & Vekua, 1995), but according to geologic studies just completed not necessarily older than ca. 1 Ma.

The fossil remains possibly attributable to *Homo* sp. and lithic objects, both associated with African species of large mammals, in the Lower Pleistocene sites from the Orce-Venta Micena sector (intramontaneous basin of Baza, Granada, South East Spain) has thus a particular relevance for this emerging picture about the first human dispersal from Africa to Europe (Lavick & Ciochon, 1996).

### African species in the Lower Pleistocene of Southeast Spain

The systematic study of the assemblage of large mammals found in Venta Micena (Martínez-Navarro, 1991) has shown a faunal break at the Plio-Pleistocene boundary, marked by the arrival to Europe of both African and Asian species. Immigrants originating in Asia are basically ruminant species (six bovids and two cervids, a study of which is currently in progress), while African immigrants include a megaherbivorous species (*Hippopotamus antiquus*), an equid with slender metapodials (*Equus altidens*=*Equus numidicus*) similar to those of both modern zebra *Equus grevyi* and hemionus *Equus kiang*, well adapted to open and dry plains (Guerrero-Alba *et al.*, 1997), and three species of carnivores, including the large hyaenid *Pachycrocuta brevirostris* (Howell & Petter, 1980), the dirk-toothed smilodontini *Megantereon whitei* (Martínez Navarro & Palmqvist, 1995), and the wild dog *Canis (Xenocyon) falconeri*, of which a comparative morphometric study is currently in progress. *M. whitei* is also present both at Dmanisi and in the Lower Pleistocene site at Apollonia-1 (Mygdonian basin, Macedonia, Greece) (Martínez Navarro & Palmqvist, 1995, 1996a). Morphofunctional analyses of this African machairodont (Martínez-Navarro & Palmqvist, 1996a; Palmqvist *et al.*, 1996a) indicate that it was a medium-sized ambush predator, with a great killing capability in relation to its fresh-meat requirements, thus leaving large amounts of carrion for both hyaenids (which

behaved at Venta Micena as strict scavengers; Palmqvist *et al.*, 1996a) and hominids. The arrival of this carnivorous species in Eurasia at the beginning of the Lower Pleistocene may then have played a very significant role in facilitating the first dispersal of *Homo* outside Africa (Martínez-Navarro & Palmqvist, 1996b).

### Fossil hominids from Orce

Systematic excavations made at the Venta Micena quarry from 1982 onwards have provided more than 15,000 fossils of large mammals, of which three were tentatively classified as *Homo* sp. These problematic fossil remains include a small bone skull fragment (VM-0), a complete humeral diaphysis (VM-1960) of a juvenile individual, and a humeral fragment of an adult individual (VM-3691) (Gibert *et al.*, 1994), whose hominid attribution is even more difficult.

Cranial fragment VM-0 measures between 7.5 and 9 cm in diameter, and comprises part of the two parietal bones and the upper occipital squama; anatomically oriented, it occupies the area of the obelion. The curvature of this skull fragment, the length of the sagittal suture, its shape at the most posterior end (S4), and the angle formed by this suture and the lambdoid sutures, suggested to Gibert *et al.* (1983) that the fossil belonged to a juvenile individual of *Homo* sp. However, this conclusion was reached initially on the basis of these anatomical features only because the inner surface of the fossil was covered by a very cemented calcareous sediment. The subsequent cleaning of the endocranium revealed well-developed digital impressions and a sagittal crest on the inner surface of the occipital bone. These atypical characteristics led Agustí & Moyà-Solà (1987) to consider the possibility that the fossil might have belonged to an equid of 3–4 months of age, although Gibert *et al.* (1989a,b) reaffirmed its hominid attribution after comparative anatomical study. In any case, it is interesting to highlight that an inner sagittal crest is also present in other conclusively identified human fossils like the cranium KNM ER-3733 from Koobi Fora (Kenya), attributed to *Homo ergaster*, and the holotype of *Homo erectus* from Trinil (Java), as shown by Martínez-Navarro (1996). Given the limitations of conventional anatomy to determine the affinities of this fossil, other more precise methodological approaches were used, including the morphometric analysis of cranial sutures, and the detection and characterization of preserved proteins.

### Fractal analysis of VM-0 sutures

Complex and intricate sutures like those present both in ammonite shells and in mammalian skulls show two characteristics that allow us to consider them as fractal curves: first, these sutures usually have long perimeters in relation to the area of shell/bone that they join; second, they exhibit self-similarity (at least in statistical terms) when observed at varying scales of magnification. As a consequence, the fractal dimension ( $D$ ) value of a given suture can be used as a morphometric descriptor of its relative complexity (for further details, see Gibert & Palmqvist, 1995; Lutz & Boyajian, 1995; Olóriz & Palmqvist, 1995, and references herein).

In an attempt to solve the issue concerning the assignment of VM-0, Gibert & Palmqvist (1995) used the methods of fractal analysis in a comparative study of the complexity of skull sutures of several mammalian families and orders. Given my own training in the field of quantitative palaeontology and multivariate morphometrics, but lacking previous experience

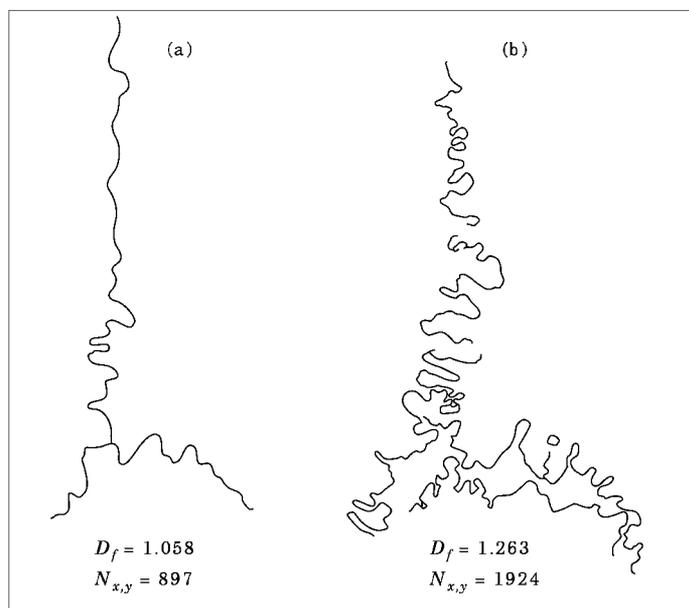


Figure 1. Drawings of the sagittal and right lambdoid sutures on the ectocrania surface of the Orce skull fragment (VM-0) made by Dr Josep Gibert (a), and by Dr Salvador Moyà-Solà (b).  $D_f$ =fractal dimension value of each suture drawing,  $N_{x,y}$ =number of cartesian (x,y) coordinates in which each drawing was digitized.

in palaeoanthropology, I asked Dr Josep Gibert for an accurate drawing of those cranial sutures that were preserved in VM-0, to enable me to calculate their  $D_f$  value. The drawing provided by Gibert is shown in Figure 1(a) (redrawn from Gibert & Palmqvist, 1995, figure 3; also published in Gibert *et al.*, 1989a, figure 23), in which the contours of the sagittal and right ectocranial lambdoid sutures are shown as nearly linear. The value of  $D_f$  obtained from this tracing was thus very low (1.058), close to its euclidean or topological dimension (1). This value fell within the estimated range of variation for both modern and Plio-Pleistocene infant and adolescent hominids (1.047–1.173; Gibert & Palmqvist, 1995, Table 1), and well outside the lower limit of the range of  $D_f$  values obtained for equids (1.123–1.374), which appeared to support the attribution of VM-0 to the hominids (Gibert & Palmqvist, 1995).

However, some months after the publication of the article by Gibert & Palmqvist (1995), Dr Salvador Moyà-Solà kindly supplied me with an accurate drawing of the ectocranial VM-0 sutures, obtained from several detailed photographs of the fossil. The new tracing is shown in Figure 1(b), in order to facilitate comparison with the one used in the previous morphometric analysis. As can be easily appreciated in this figure, the drawing of the sagittal and right lambdoid sutures of VM-0 made by Gibert is substantially simplified, which explains its low value of  $D_f$ . On the contrary, the correct drawing made by Moyà-Solà, in which all the fingerings of the sagittal and lambdoid sutures were accurately recorded, provides a much higher fractal dimension value ( $D_f=1.263$ ), which lies well above the highest value obtained by Gibert & Palmqvist (1995) for an infant or juvenile individual of *Homo* (1.173), but within the range of variation of equids. More specifically, the revised value for VM-0 falls halfway between the value estimated in Gibert & Palmqvist (1995) for an equid of 3–4 months of age (1.249) and that of a horse 5 months old (1.322).

## Detection and characterization of fossil proteins

Borja (1995) detected fossil proteins (i.e., albumin and G-immunoglobulin) in samples from VM-0, VM-1960, and VM-3961, as well as from several equid fossils, using enzyme-linked immunoabsorbant assay (ELISA) and dot-blotting. Antisera and monoclonal antibodies against human and horse albumin (which do not cross-react with each other) were tested. VM-0 and VM-1960 yielded positive reactions for human albumin, and extracts from both VM-1960 and VM-3961 were positive for human immunoglobulin. These results are still unpublished, but Borja & García-Olivares (1995) reported on them in the *International Congress of Human Palaeontology* held at Orce during September 1995. Similarly, Lowenstein (1995) has analyzed samples from these fossils, provided by Gibert, using the method of radioimmunoassay (RIA) for the presence of identifying proteins, and he has obtained species-specific reactions in several of them (Zilhman & Lowenstein, 1996). VM-0 gave much stronger reactions with antisera to human albumin, whole serum, transferrin, and collagen than it did to equid, bovine or ursid proteins (4 ng/ml human albumin concentration in the fossil extract, and 0 ng/ml for horse, bison and bear albumin). VM-1960 gave a similar reaction to human albumin (4 ng/ml) but it also provided a weak signal (1 ng/ml) for bison albumin. VM-3961 was negative for all reactions. Most of the equid and bovid test samples gave reactions that agreed with those expected from their species attribution, but surprisingly one horse metacarpal (VM-79) provided a stronger reaction for human albumin (34 ng/ml detected) than for equid albumin (10 ng/ml).

These results seemed to support the supposed human affinities of VM-0, and probably also of VM-1960. However, they should not be accepted without reservations, because Fiedel (1996) has recently published a cautionary note on the contradictory results obtained in many studies of proteins recovered from fossil bones and blood residues from prehistoric artefacts, using ELISA, RIA and crossover immuno-electrophoresis (CIEP). Fiedel classifies the contradictions revealed in these studies in two groups: incompatibilities between the laboratory results and the archaeological record, and differences between the results provided by the various biochemical and immunologic techniques. The former group includes the detection of preserved proteins from species that are not represented in the palaeontological assemblages, either because they had become extinct in the region studied at the time the assemblage was formed, or because they had never even inhabited it. In most cases, these inconsistent findings can be explained by cross-reactions between species, but in some of the case studies reviewed by Fiedel (1996) the results provided by the immunological methods put a serious doubt on the credibility of the techniques; a good example is provided by the analysis of a red substance contained within a Maya ceremonial shell: Lowenstein found that it yielded a weak human signal using RIA, yet it was subsequently identified as copal incense! The latter group of methodological and interpretive problems outlined by Fiedel (1996) include contradictory results obtained in several blind tests conducted by independent analysts, who did not expect a particular outcome, when they studied the same archaeological and palaeontological samples: the results from different immunologic techniques showed, in general, good agreement for modern blood samples, but the archaeological blood residues could not be identified reliably, as no two methods produced the same result for any single sample.

However, the most severe reservations on the published reports about protein survival arise from the study of Cattaneo *et al.* (1993), who buried bone fragments and flint flakes coated before burial with sun-dried cow blood, and then tested them for blood residues, after

exhumation, using the ELISA method. Only one out of 12 buried tools retained bovine albumin after 1 year, and none of them had preserved immunoglobulin. Two human bone fragments, exhumed after 2 months and 2 years, respectively, tested positive for human albumin, but not for immunoglobulin (detected by Borja & García Olivares in VM-1960 and VM-3961, fossils with an age of approximately 1.2–1.4 Ma). Similar results have been obtained recently by Tuross *et al.* (1996) using ELISA for protein identification of blood residues on experimental stone tools: albumin was identified as part of the protein fraction remaining on the tools, but immunoglobulin was not preserved at nanogram levels of detection.

### Conclusions

The finding in 1982 of the skull fragment VM-0 during systematic excavations in Venta Micena enabled Gibert *et al.* (1983) to propound the hypothesis of a first human arrival in Europe during the Lower Pleistocene. This new paradigm about the timing of hominid dispersal out of Africa appeared subsequently to be reinforced by (1) the discovery in Fuente Nueva-3 and other sites in the Orce-Venta Micena sector of lithic artefacts of evolved Oldowan type, composed of limestone cobbles and knapped flint (Tixier *et al.*, 1995; Turq *et al.*, 1996), and found associated with several species of large mammals originating in Africa (Martínez-Navarro & Palmqvist, 1995); (2) the discovery of a human phalanx in the Lower Pleistocene karstic site at Cueva Victoria (Murcia, Spain) (Palmqvist *et al.*, 1996*b*); (3) as well as by the finding of both human remains and stone tools in Lower Pleistocene deposits at Dmanisi (Gabunia & Vekua, 1995), where they are found associated with several African species which are also present at Venta Micena and Fuente Nueva-3 (Martínez-Navarro & Palmqvist, 1995, 1996*a*).

However, the weak anatomical evidence on the human nature of VM-0 does not allow it to be fully distinguished from other large mammals, particularly equids (Agustí & Moyà-Solà, 1987). The immunologic analyses of this and other presumably hominid remains from Venta Micena are far from being conclusive, given the detection of very high amounts of proteins (unexpected in such old fossils), and the positive reactions for human albumin obtained in one of the test samples from equid bones. The strongest support (and the only one published in a peer-reviewed journal) for the *Homo* affinities of VM-0 came from the morphometric analysis of the preserved sutures, using the method of fractal geometry (Gibert & Palmqvist, 1995). The results obtained in this study indicated an important and statistically significant difference in suture complexity patterns between juvenile hominids and young equids, as reflected in their respective  $D_f$  values. However, as regards VM-0 the analysis was made using a simplified drawing of the sutures made by Gibert, in which many details of the suture fingerings were omitted, which explains the low value of  $D_f$  estimated for it in the study of Gibert & Palmqvist (1995). The result presented here, obtained by a new fractal analysis on an accurate drawing of VM-0 sutures made by Moyà-Solà, shows that this skull fragment has cranial sutures more complex than those observed in infant and adolescent hominids, and similar—in suture design complexity—to those of very young equids. As a consequence, it may now be recorded that the hominid attribution of VM-0 is not supported on the basis of this character.

This fossil has been the subject of a strong polemic, one of the undesirable consequences of which is that it has distracted many opinions of the scientific community from appreciating the true heritage of Orce, which is undoubtedly its very rich, diverse and well preserved macromammalian assemblages of Lower Pleistocene age (Martínez-Navarro & Palmqvist, 1995; Palmqvist *et al.*, 1996*a*). The objectives of future research and systematic excavations at

Orce should thus not be exclusively focussed in the search for new hominid remains, as in the past decade, but adopt a broader palaeontological and archaeological perspective.

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