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THE LATE EARLY PLEISTOCENE HUMAN REMAINS FROM BUIA, DANAKIL DEPRESSION, ERITREA

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Abstract. The Early Pleistocene sedimentary succession of the Dandiero (Buia) Basin (Danakil Depression, Eritrea) has preserved a rich paleontological, paleoanthropological, and archaeological record. Fieldwork undertaken between 1995 and 2003 on a site at Uadi Aalad (Abbate et al. 1998) led to the discovery of one-million-year-old human remains. They consist of a cranium in excellent preservation condition (UA-31), two permanent teeth (UA-222 and UA-369), and three pelvic portions (UA-173, UA-405 and UA-466, the latter recovered on 2003). The cranium and the postcranial remains represent a single adult individual, likely of female sex. The cranium evidences a blend of "*erectus*-like" and progressive morpho-architectural features, the latter more commonly found in the Middle Pleistocene. Preparation and restoration of the specimens (notably, of the virtually complete UA-31 face) were only completed on September 2003. The revision, refinement, and integration of our previous analytical and interpretative work (cf. Abbate et al. 1998; Macchiarelli et al. 2002) is in progress within the context of the paleoanthropological record currently available for the African Early to Middle Pleistocene.

Riassunto. La successione sedimentaria del Pleistocene inferiore del bacino del Dandiero (Buia, Dancalia, Eritrea) ha conservato numerose importanti testimonianze paleontologiche, paleoantropologiche e archeologiche. Indagini di terreno condotte tra il 1995 e il 2003 in un sito scoperto a Uadi Aalad (Abbate et al. 1998) hanno permesso il recupero di resti umani fossili datati 1 milione di anni da oggi. Essi includono un cranio in eccellente stato di conservazione (UA-31), due denti permanenti (UA-222 e UA-369) e tre elementi di bacino (UA-173, UA-405 e UA-466, quest'ultimo rinvenuto nel 2003). Il cranio e i resti postcraniali rappresentano un individuo adulto di probabile sesso femminile. Il cranio mostra un mosaico di caratteri morfo-architetturali di tipo "*erectus*" e progressivi, più comuni nel Pleistocene medio. Gli interventi di preparazione e restauro dei reperti (soprattutto quello della faccia di UA-31, che è virtualmente completa) sono stati ultimati soltanto nel settembre 2003. La revisione, l'affinamento e l'integrazione delle precedenti analisi (cf. Abbate et al. 1998; Macchiarelli et al. 2002) e l'interpretazione dell'insieme dei reperti sono attualmente in corso nel quadro comparativo della documentazione paleoantropologica disponibile per il Pleistocene Inferiore e Medio africano.

Introduction

Geological and paleontological field research carried out since 1994 in the northern part of the Danakil (Afar) Depression of Eritrea resulted in the discovery of several Early Pleistocene vertebrate and archaeological sites within a thick fluvio-lacustrine composite succession outcropping near to the village of Buia, about 100 Km south of Massawa (Abbate et al. 1998). The Pleistocene Dandiero sedimentary basin is predominantly composed of grey to whitish silty and sandy clayey deposits. Current reconstructions point to an alternate sequence in the investigated area of fluvio-deltaic, swampy, and lacustrine paleo-environments (Abbate et al. 2004).

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Fieldwork undertaken between late 1995 and 2003 in the Uadi (Wadi) Aalad area in the framework of the international geo-paleontological and paleoanthropological "Buia Project" (Rook et al. 2002) led to the discovery of a total of six cranial, dental and postcranial human fossil remains, all from a single 25 m thick outcrop (the so-called "*Homo* site"). The extensive magnetostratigraphic record indicates that the *Homo*-bearing layer, which falls near to the top of the Jaramillo paleomagnetic event (sub-Chron C1r.1n), is 1 Ma old (Abbate et al. 1998; Albianelli & Napoleone 2004). The fission-track dating of an intercalated tephra has recently confirmed this chronology (Bigazzi et al. 2004), which is also corroborated by the evidence from mammal biochronology (Abbate et al. 1998; Ferretti et al. 2003; Martínez-Navarro et al. 2004). Lithic tool assemblages (Oldowan and Acheulean modes) are also widespread at Uadi Aalad and surrounding areas (Martini et al. 2004).

The late Early Pleistocene human remains from Uadi Aalad, which include the magnificently preserved UA-31 cranium (Abbate et al. 1998), represent the very earliest evidence of human presence in the region and likely constitute one of the most striking paleoanthropological discoveries in the entire African record (cf. Wood & Richmond 2000; Asfaw et al. 2002; Dunsworth & Walker 2002; Smith 2002). Preliminary morphological and size description of UA-31 and assessment of its "*erectus*-like" status have been based on the analysis of the unrestored (Abbate et al. 1998; Rook et al 1999) or only partially restored specimen (Macchiarelli et al. 2002, 2004). Based on the currently available evidence, which was significantly enhanced in late 2003, a revision, refinement, and integration of our previous analytical work is currently in progress. Here we thus illustrate the advances and state of art of our ongoing work.

The human remains

The one-million-year-old human remains from Buia consist of cranial, dental, and postcranial elements, all from the same site at Uadi Aalad (UA). There is little doubt that the cranial and postcranial remains, originally distributed along an eroded sloping surface of a few square meters, belong to the same adult individual. This is supported by stratigraphy, contiguity of the finds, their kind and degree of fossilization, and by the comparative assessment of their age-at-death indicators. Nonetheless, even though it is reasonable, it is currently not yet possible to ascertain with enough confidence whether the two isolated teeth collected at the "*Homo* site" also belong to the same individual. Of course, the desirable discovery of the UA-31 mandible would solve the question.

In detail, the remains discovered so far consist of: i) a nearly complete, undistorted cranium lacking the mandible (UA-31), recovered in 1995; ii) two permanent teeth complete of crown and root: likely a LI^2 (UA-222), discovered in 1995, and a LI_1 (UA-369), found in 1997; iii) an incomplete right hip bone in two portions, consisting of the iliac blade (UA-173) and of the acetabulum and partial ischium (UA-405), discovered in 1995, and a partial left pubis including the symphysis (UA-466), recovered in 2003.

Based on morphological, morphometric, and taphonomic criteria, UA-31, UA-173, UA-405, and UA-466 are all assigned to the same adult individual, likely of female sex based on the hip morphology.

All specimens are permanently stored at the Geo-Paleontological Laboratory of the National Museum of Eritrea, Asmara, where their casts are shown within a permanent exhibition.

UA-31 (cranium)

The UA-31 cranium includes a well-preserved braincase, a large part of the facial skeleton (rather complete at the level of the upper and middle facial regions), and the base. It lacks the mandible and all of the dental crowns, although some roots are still preserved in the maxillary alveoli (the roots of RP3, RP4, RM1, RM2, RM3 [mesial], and of LP4, LM1, LM2).

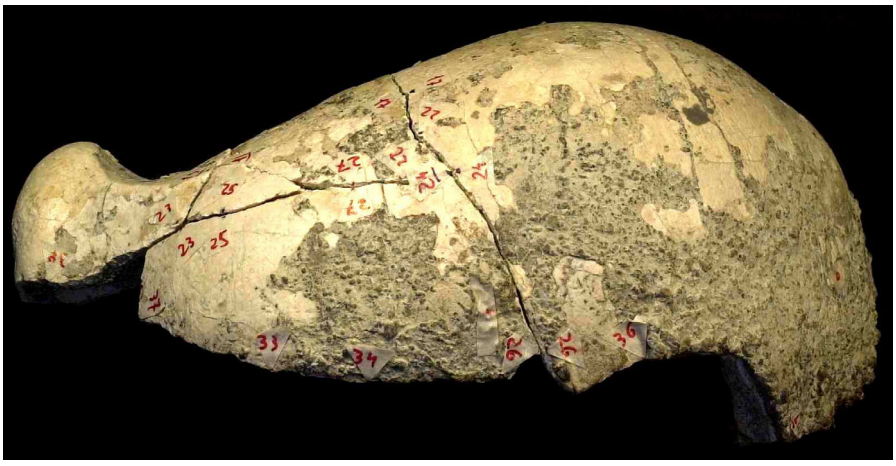

Fig. 1 - Superior view of the UA-31 right hemi-calotte during preliminary restoration and assembly of the original (from middle- to large-sized) articulating fragments. Large portions of the vault surface (notably, the frontal, parietal, and occipital bones) were still covered by a thin silty concretion. Note the anteroposterior projection of the supraorbital torus (to the left) and the rounded and laterally expanded parieto-occipital profile (to the right).

Before its final reassembling, the specimen originally consisted of five major separated portions: a mostly right hemi-calotte (UA-31/1); a mostly left hemi-calotte (UA-31/2); a large portion of the base and of the anterior cranial fossa (UA-31/3); a large portion (the entire left half) of the face (UA-31/4); and a partial maxilla with almost complete palate (UA-31/5). In turn, each unit consisted of a variable number of middle- to large-sized partially connected fragments.

At their discovery, most of the broken edges of the cranial portions were relatively clean, with little adhering sediment. Lack of deformation or structural alteration of the parts facilitated their preliminary joining (Fig. 1), thus allowing the first tentative reconstruction of an almost complete cranium.

Until recently, the major problem affecting the detailed description and reliable interpretation of the UA-31 cranial morphology as a whole has been represented by the persistence on the specimen of a diffuse limestone concretion obscuring a considerable amount of its morphology, notably the external neurocranial left aspect (including large parts of the occipital, temporal, sphenoid, parietal, and frontal bones) and the entire zygo-maxillary and orbital areas (Fig. 2), as well as large surfaces of the endocranial compartments (anterior, middle and posterior cranial fossae). Conversely, apart from limited portions pertaining to the occipital and parietal bones and to the upper facial skeleton, the right half of the cranium was found in rather good preservation and in a satisfactory degree of completeness (except for the middle and lower facial skeleton and minor portions of the frontal bone).

The host and interior concreted sediment mostly consisted of compacted grey silty calcareous mudstone. Microfacies analysis shows automorphic quartz, micas, and rare feldspars disseminated in a muddy limestone matrix (Fig. 3). Thus, until September 2003, the technical activity undertaken since 2001 at the Geo-Paleontological Laboratory set at the National Museum of Eritrea has primarily considered the cleaning, restoration, and reassembly of the cranium, still partially covered and filled by this hard and site-specific thick concretion. Since early 2002, these delicate and time-consuming interventions have been coordinated by M.C.

In order to make these activities easier and to best document the specimen before, during, and after its complete restoration. In July 2001 UA-31 was preliminarily investigated by conventional radiography at the Sembel Hospital of Asmara and, in early 2002, CT-scanned using Tomoscan ET Phillips equipment (2 mm slice thickness/spacing) (Fig. 4). Following its very recently performed final reassembly, a new set of calibrated radiographs was made in summer 2003 (on this occasion, high quality Agfa Structurix D4 DW ETE industrial films were used instead of conventional medical ones).

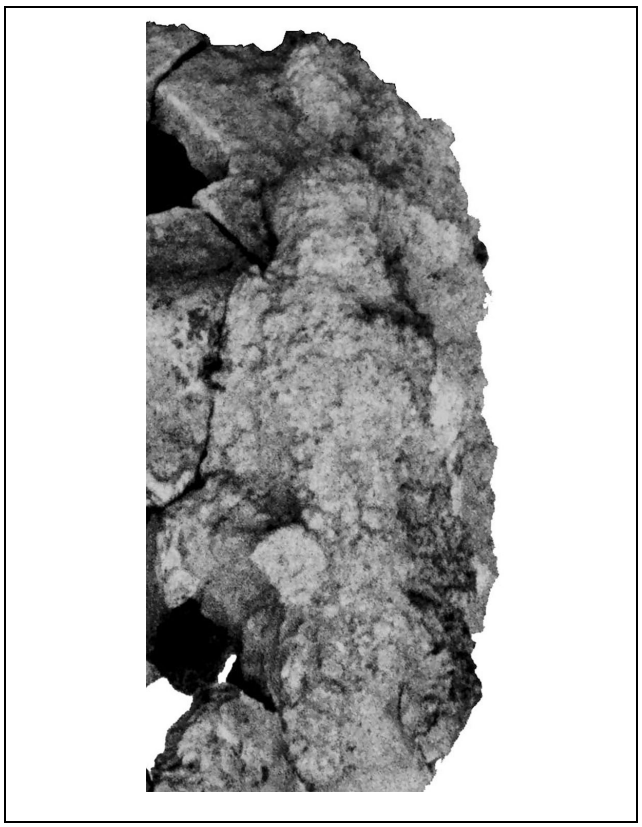

Fig. 2 - Frontal view of the UA-31 left half portion of the splanchnocranium completely covered by a massive hard concretion before cleaning and restoration. Only the original surface of the frontal bone (upper) was partially visible.

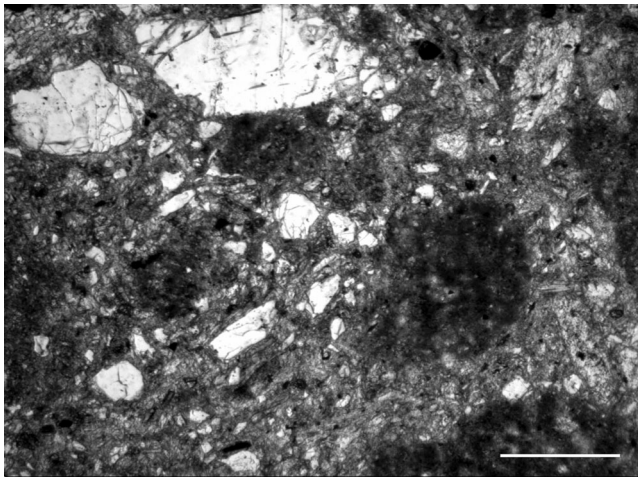

Fig. 3 - Thin section of the concreted sediment partially covering and filling the UA-31 cranium, showing quartz and micas in the mudstone matrix. This sample is from the middle-face region. Bar is 0.25 mm.

Combined with direct measurements performed on the non-articulated neurocranial and splanchnocranial portions, these noninvasive analyses of the inner cranial morphology have allowed a detailed morphological description and quantitative assessment of the topographic variation of the vault thickness in sagittal and

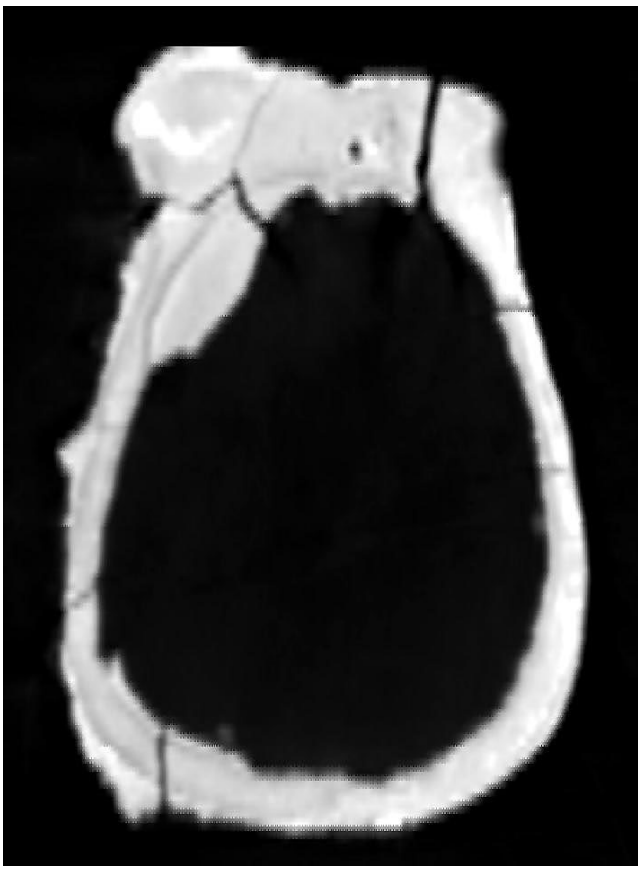

Fig. 4 - UA-31 axial CTs section across the supraorbital torus. The heterogeneous topographic distribution of the spread concretion is clearly traceable on both ecto- and endocranial bony surfaces.

coronal perspectives. When considered within the human fossil record available for the African late Early Pleistocene (Wood 1991; Rightmire 1993; Walker & Leakey 1993a; Anton 2003), current evidence supports the preliminary estimates offered by Abbate and coauthors (1998) pointing to a relatively modest frontal, parietal, and occipital bone thickness in the Eritrean specimen (Fig. 5).

On UA-31 the original external thickness of the concretion varied considerably topographically, showing a marked left/right asymmetry (the left half of the specimen being the most affected one). On UA-31/1, the concretion thickness reached 6.0 mm on the parietal. Before cleaning, about 70% of the UA-31/2 surface was masked by the sediment, with a maximum thickness of 16 mm recorded at the parietal eminence (UA-31/2 thickness at: parasagittal parietal = 5.0 mm; iniac area = 2.2 mm; ~lambda = 2.5 mm; lambdoid suture = 5 mm; frontal portion = 0.3 mm). The least coating was present on the UA-31/3 unit, which ectocranially covered portions of the right temporal and sphenoid bones and the basiocciput (comprising the area of the basion, the pharyngeal tubercle and foveola, and the medial walls of the right and left foramen lacerum). However, the thickest external concretion, which seriously affected our work until its final removal, was found on the splanchnocranium (i.e., on UA-31/4). In fact, the left facial portion of the cranium from Buia originally was entirely covered by a hard, several centimetre thick massive concretion (Fig. 2) masking the maxillary, the zygomatic, the nasal, and the frontal bones, as far as the left parietal bone (UA-31/2), where it made much thinner. Its lateral thickness measured at the level of the supraorbital torus reached 32 mm. Uninterruptedly extended on the left portion of the cranium along its anteroposterior axis, this concretion also completely filled the left temporal fossa. The same concreted sediment also filled the UA-31/5 maxillary sinus, but barely covered the palatal surface.

Despite the layer of compacted grey silty calcareous mudstone spread on the surface, portions of the coronal, sphenoparietal, sphenotemporal, sagittal, parietomastoid, lambdoid, and occipitomastoid sutures were already traceable before cleaning, while the frontosphenoid suture was completely obscured.

A heterogeneous distribution of the concreted sediment was also recorded on the endocranial surface (Fig. 5). On UA-31/1, a thicker concretion was present on the occipito-parietal region along the parasagittal plane (thickness at: cerebellar fossa = 2.5 mm; ~endinion = 4.5 mm; lambdoid suture = 3.0 mm; post-breg-

Fig. 5 - Inner view of a portion of the UA-31 right emi-calotte (same of Fig. 1) showing the thin concreted sediment adhering the endocranial surface. A darker, thicker concretion layer is also present on the external occipital bone surface (to the right). Note the relatively modest thickness of the vault bones.

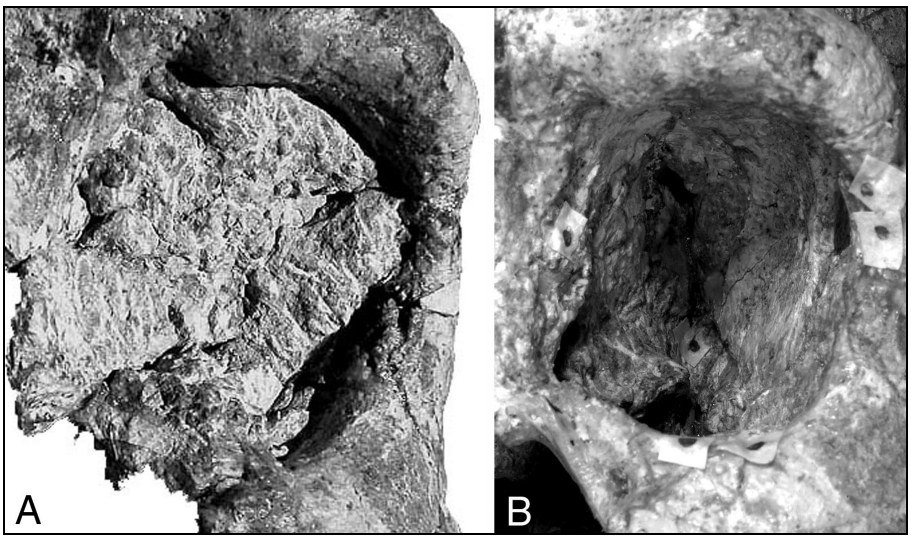

Fig. 6 - Frontal view of the UA-31 left orbital region. A) following almost complete removal of the massive concretion originally masking the splanchnocranium (compare to Fig. 2); B) following complete successful hollowing out of the orbit and display of its intact inner anatomy.

matic area = 1.2 mm; bregma= 0.8 mm; frontal portion= 1.5 mm). On UA-31/2, the endocranial thickness topographically varied at the frontal (0.6 mm), around the endinion (4.5 mm), and within the middle cranial fossa (8.7 mm). The least values were found on UA-31/3 (including key portions of the middle and anterior cranial fossae), while an average thickness of 5.0-6.0 mm was found on UA-31/4.

Before permanent articulation of the three major anatomical portions constituting the specimen (the neurocranium, the splanchnocranium, and the base), the limestone concretion was progressively removed from each (sub)unit using an engraving pen system (MK-Produkter AB WEN-Pen) equipped with extra-thin needles capable of a 500-600 calibrated strokes/sec. (vibration level <2.5 m/s^2). Ectocranially, the most demanding part of this work concerned the middle face topography, the left zygo-maxillary region and the orbit, which in September 2003 was successfully separated from the matrix (Fig. 6A-B). This extremely delicate intervention, likely having relevant implications in view of the ongoing morphological and morphometrical comparative analysis of the specimen within the Early- to Middle Pleistocene paleoanthropological African and Asiatic record (Rightmire 1998; Anton 2004), revealed the anatomy of the virtually complete middle face and allowed the assessment of the orbit volume (by means of teff seed).

The thinner but widely spread encrustations covering most of the endocranial morphology (Fig. 5) have also been successfully removed, revealing finely preserved details of the grooves created by the anterior and posterior branches of the middle meningeal artery on the lateral aspect of the vault bones, as well as the well preserved anatomy of the fossae (Fig. 7).

Following previous tentative estimations of the UA-31 endocranial volume made on the unrestored (Abbate et al. 1998: 750-800 cc) and on the only partially restored specimen (Macchiarelli et al. 2002: ~900 cc), this work has finally allowed a conclusive, reliable volumetric assessment by means of repeated measurements with teff seed (for cranial capacity chrono-regional variation in early *Homo*, see Anton 2003; Lee & Wolpoff 2003).

With the aim to document – for conservation, scientific study, and display purposes – the major stages and technical advancements in cleaning and preparation of the Eritrean cranium before, during, and following matrix removal and restoration, the specimen was moulded and reproduced in three different high-quality resin versions made in Asmara between February 2002 (Fig. 8) and September 2003. Before its final articulation as a hinge between neurocranium and splanchnocranium, the originally separated cranial base has also been casted as single unit in order to make the measurement

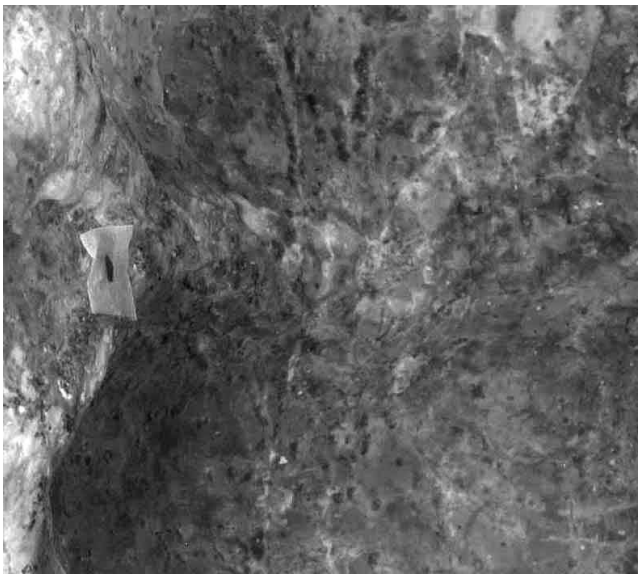

Fig. 7 - View of a parasagittal portion of the UA-31 posterior cranial fossa following complete removal of the thin concreted sediment originally adhering the endocranial surface (compare to Fig. 5). The landmark corresponds to the endinion.

Fig. 8 - The first cast in resin of the UA-31 cranium (as well as of the specimens UA-173, UA-222, UA-369, and UA-405 from Buia, to the right) made in February 2002 at the Geo-Paleontological Laboratory of the National Museum of Eritrea, Asmara.

of its flexion easier. Cranial base flexion is a variable of special relevance in the current debate on the evolution of the human cranial morpho-architecture across Pleistocene (cf. Baba et al. 2003; Lieberman et al 2003).

Freed of its original matrix, the UA-31 endocranial morphology, which shows marked asymmetry, has also been successfully moulded, and a high-quality resin model is currently available for detailed anatomical and paleoneurological comparative investigations (cf. Broadfield et al. 2001).

Final preparation of the specimen has recently allowed the systematic topographic record of the (micro)features present on the cranial surface by means of high-resolution translucent replicas for SEM and light stereo-optical transmitted microscope analyses.

Preliminary description and interpretation of the "*erectus*-like" Eritrean cranium has shown a blend of features in the neurocranium and face which document extensive morphological and size variation in Early-Middle Pleistocene *Homo* (Abbate et al. 1998; Rook et al. 1999; Macchiarelli et al. 2002, 2004). The UA-31 braincase is rather long, very narrow, and relatively high. Laterally, it shows marked development of the supraorbital torus, relative frontal dominance, and an opisthocranion coincident with inion. The lower face is moderately prognathic. Based on UA-173 and UA-405 associated pelvic fragments, UA-31 likely represents a female, in spite of its prominent, thick supraorbital tori. In coronal section, the braincase shows intercristal positioning of the greatest breadth, very modest lateral protrusion of the mastoid-supramastoid-auricular complex, high positioning of the most external parietal points, modest angulation along the midline (notably, with respect to the *H. erectus* s.s. Indonesian hypodigm), and modest parasagittal flattening, thin parietals, from sub-vertical to slightly downwards converging lateral vault walls. This progressive morpho-architecture characterizes UA-31 with respect, among the others, to the Sangiran sample (rev. in Anton 2003), to OH 9 (Rightmire 1993), KNM-WT 15000 (Walker & Leakey 1993b), and even to the penecontemporary Daka calvarium from the Bouri Formation, Middle Awash (Asfaw et al. 2002).

With reference to the splanchnocranium, there is an especially large zygomatic process filled by a voluminous maxillary sinus. The zygomatic root is in a rather low position and the height of the maxilla is probably the largest found in any known hominid from Early Pleistocene Africa.

There are few comparable specimens from this time period in Africa (Wood 1991; Walker & Leakey 1993a; Anton 2003), but considering earlier (e.g., KNM-ER 3733 and 3883, OH 9), contemporary (Daka, OH 12?), or later specimens (OH 12?, Bodo), UA-31 differs markedly. Its unique "mosaic morphology", a mixture of Early Pleistocene features and characteristics uncommon until the Middle Pleistocene, illustrates the great variation of late Early - early Middle Pleistocene *Homo* (Macchiarelli et al. 2004).

Because of its chrono-geographical position (1 Ma ago in East Africa) and degree of preservation (notably, of the extraordinarily representative facial skeleton), the cranium from the Eritrean Danakil Depression is of

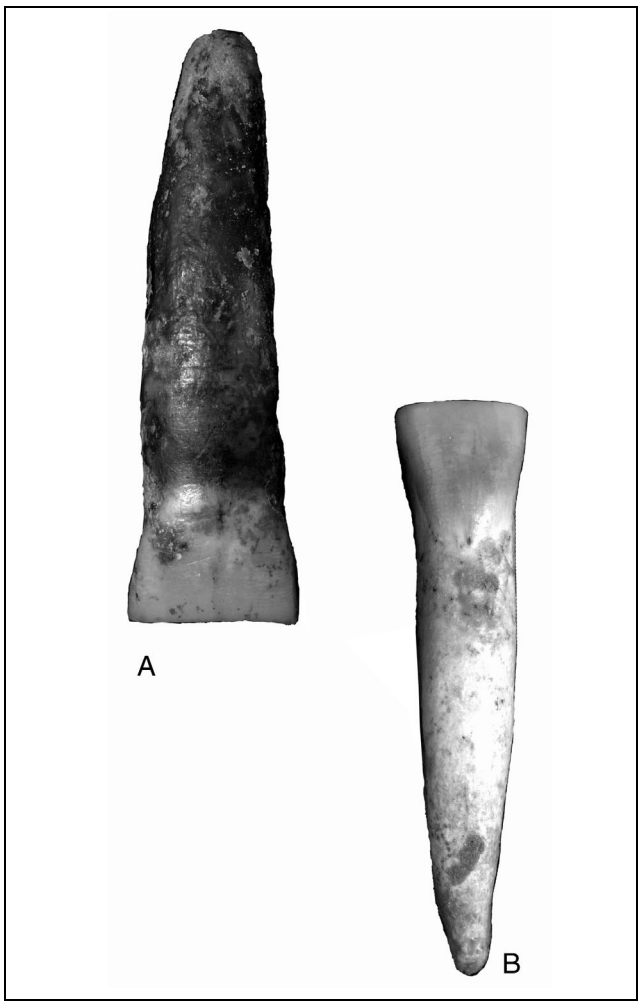

Fig. 9 - Labial view of the two permanent teeth from Buia: A) UA-222,?LI^2; B)UA-369, LI_1.

outstanding importance for its potential informative power on different aspects of human paleobiology and phylogeny. The ongoing elaboration of its only recently refined morphological and morphometric analytical record will significantly contribute the debate on human evolution at the Early-Middle Pleistocene transition.

UA-222 (?LI^2) and UA-369 (LI_1)

Two permanent teeth – UA-222, likely a ?LI^2, and UA-369, a LI_1 - were found at the *Homo*-site in 1995 and 1997, respectively. The uncertainty concerning UA-222 is due to the fact that the crown is very worn, thus increasing the common risk in dental (paleo)anthropology of confusing worn lower canines with upper incisors (Hillson 1996: 29). Both specimens preserve the crown – even if rather worn – and the root (Fig. 9). As previously stated, despite their stratigraphic position and contiguity to the cranial and postcranial remains (cf. Abbate et al. 2004) and morphodimensional characteristics, their belonging to the same female adult individual currently represented by UA-31, UA-173, UA-405, and UA-466 still remains unresolved.

According to our current microscopic work, both teeth show minimal weathering (enamel and cementum microfeatures) and their appearance as a whole suggests no, or only minimal, transport/displacement.

The root apex is complete and closed in both specimens. Both crowns show advanced occlusal wear, with functional enamel loss and extensive emerging dentine. More distinctly on UA-369, the residual occlusal enamel is thicker labially (0.95 mm vs. 0.38 mm lingually). Major wear directions are slightly labiolingual to mesiodistal on UA-222, and mesiodistal to labiolingual on UA-369, resulting in two flat- to weakly concave-shaped occlusal surfaces. On UA-222, the interproximal wear is more marked distally (where the facet almost reaches the cement-enamel junction), while the opposite is true on UA-369. On UA-222, the distal aspect of the root is more grooved than the mesial one.

Tab. 1 - Tooth metrics for UA-222 (?LI^2) and UA-369 (LI_1). Measurements in mm.

variables	UA-222	UA-369
max. mesiodistal diameter of the crown	6.7*	5.2*
max. labiolingual diameter of the crown	6.7	6.7
max. labiolingual diameter of the occlusal surface	4.3	3.7
mesiodistal diameter at the cervix	5.7	3.8
labiolingual diameter at the cervix	6.7	6.7
max. mesiodistal diameter of the root	7.6	3.6
max. labiolingual diameter of the root	7.5	7.0
total tooth height (crown + root)	23.9*	22.8*

* Underestimated because of occlusal wear.

No evidence for linear enamel hypoplasia, hypocalcifications or enamel macro-defects is found on either crown.

Tooth metrics for UA-222 and UA-369 are shown in Tab. 1.

UA-173 (right iliac blade), UA-405 (right acetabulum and partial ischium), and UA-466 (left partial pubis)

Shape and proportions of the reconstructed partial right hip bone from Buia, resulting from the articulation of the UA-173 almost complete iliac blade and of the UA-405 acetabulum and partial ischium (Fig. 10), suggest female sex for this adult individual. Together with the signals derived from the UA-31 suture closure status and the UA-173 auricular surface morphology, the analysis of the very recently discovered (on November 2003) UA-466 left pubic portion from the same pelvis, which includes a virtually complete and unaltered symphyseal face, should allow a reliable assessment of the individual age-at-death. To date UA-466 is still not described.

Fig. 10 - Posterolateral view of the reconstructed (in resin) adult right hip bone from Buia by joint of UA-173 (iliac blade) and UA-405 (acetabulum and partial ischium).

When compared to the morpho-dimensional characteristics shown by the only two rather complete adult human hip bones from the Early-Middle African Pleistocene, i.e., the likely male KNM-ER 3228 (Rose 1984) and the likely female OH 28 (Day 1971), the reconstructed hip bone from Buia (UA-173 + UA-405) shows a distinct external resemblance to the specimen from Olduvai Gorge, including a wider schiatic notch. Unfortunately, because of the specific fossilization dynamics that affected the Eritrean specimens, a reliable structural comparison of the trabecular pattern among the three African specimens (see Macchiarelli et al. 2001) is not yet possible because of the UA-173 rather noisy radiographic signal, as bone and infilling matrix have a similar radiopacity.

UA-173 consists of the postero-superior thick portion of a right ilium, including most of the auricular area. Despite the incompleteness of the region, the relatively small auricular surface is superoinferiorly expanded and anteroposteriorly short. In accordance with our sex attribution of the specimen, the post-auricular sulcus (between the auricular surface for articulation with sacrum and the rough surface for the sacroiliac ligament) is wide and well marked.

UA-405 is almost free from incrustations and preserves its original bone surface macroscopically intact. Interestingly, two parallel slightly arched "scratch lines" (A and B), similar to those resulting from the action of a lithic instrument (Fiore et al. 2004), were detected on its medial aspect during soft cleaning of the specimen (Fig. 11). The internal patina of these two microfeatures is comparable with the patina covering the entire bone surface, thus allowing considering both grooves as produced in antiquity, perhaps following human intentional manipulation of the body (Fiore et al. 2003).

The A and B features are 9.7 mm and 4.6 mm long, respectively. SEM and light stereo-optical transmitted microscope analysis of high-resolution translucent replicas revealed that UA-405's surface underwent post-depositional micro-events that partially altered its original nature. Erosion traces are evident at both ends of the grooves and sediment wear traces are visible in

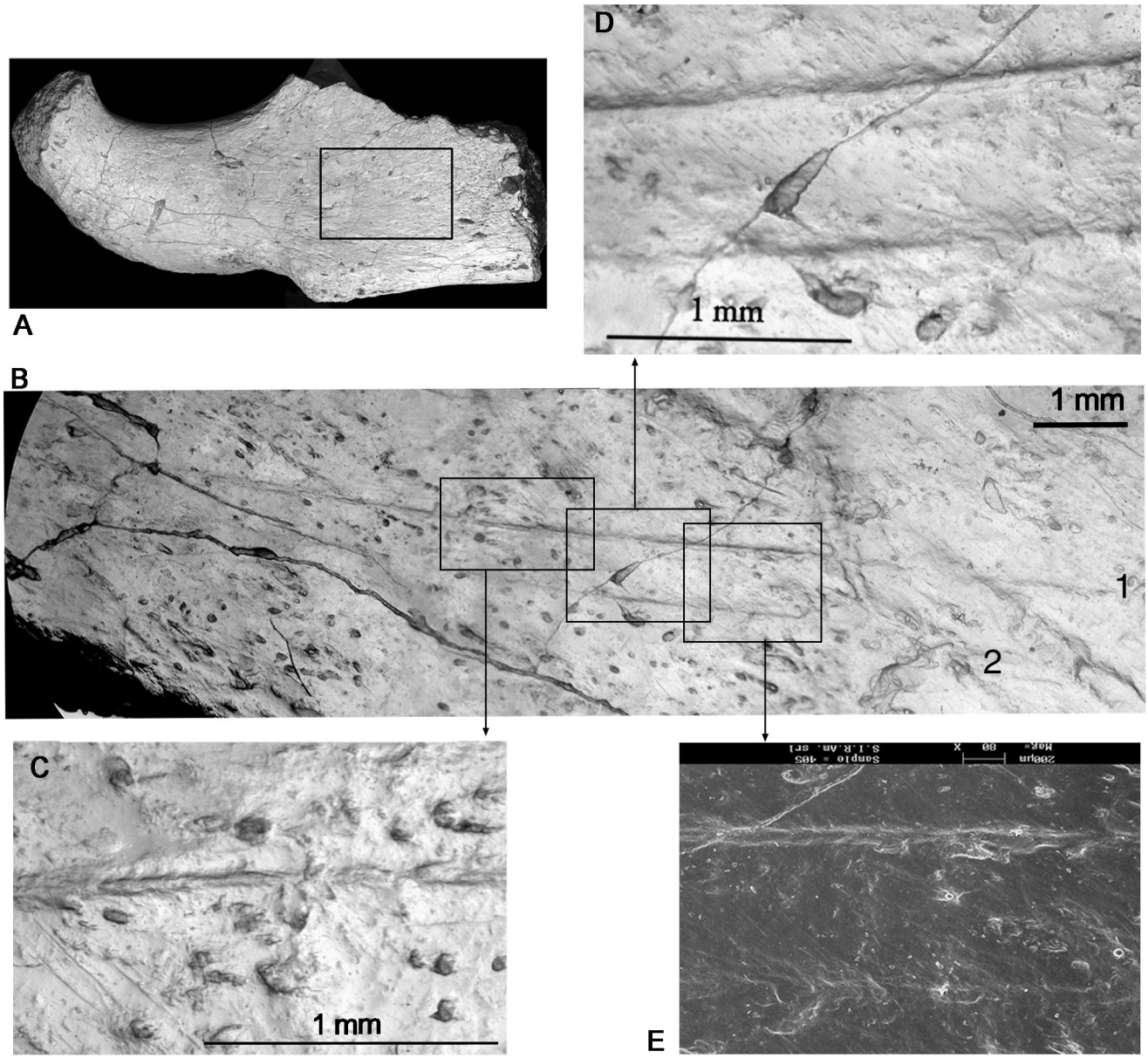

Fig. 11 - A) Medial aspect of UA-405 (right acetabulum and partial ischium) with indication of the region (framed) where two "scratch lines" have been detected. B) General morphology and extent of the 1 and 2 "scratch lines". With respect to three selected frames in the image B, some topographic characteristics of the 1 and 2 microfeatures are detailed in the images C, D and E. The micromorpho-

the middle portion of the lines. In some (micro)areas, the outermost part of the bone was removed.

Tab. 2 summarizes the major selected features (from Morlan 1984; Shipman & Rose 1984; Olsen & Shipman 1988; Lyman 1994; Fisher 1995) commonly used in discriminating lithic tool traces from grooves of natural origin. Because of the length, shape, and number of the detected striae, for the purposes of our analysis the differential diagnosis has considered vascular grooves vs. lithic tool traces.

Feature A shows a consistent morphological variability along its length and some anomalies in continuity. Its proximal portion is deep, rounded at the beginning; the walls are eroded and secondary striae are absent. The bottom is U-shaped and the width of the line varies. The distal portion is shallow, U-shaped, and the bottom shows a lamellar structure. A short V-shaped portion, with many secondary striae, characterizes the central part of mark A. The surrounding bone surface area is highly abraded (many abrasion striae are present). In its central part, the length and depth of this microfeature are not constant, and the secondary striae are short and discontinuous. Finally, two bony bridges are present in its central-distal portion.

Compared to A, feature B is shorter and shallower. Its details are badly preserved and hardly readable. At its proximal portion, a U-shaped section and lamellar bottom can be observed.

Tab. 2 - Comparison of the (micro)-morphological characteristics of the two "scratch lines" (A and B) recorded on the medial aspect of UA-405 (partial hip bone) and the features commonly used in discriminating lithic tool traces ("cutmarks") from grooves of natural origin (selected list derived from Morlan 1984; Shipman & Rose 1984; Olsen & Shipman 1988; Lyman 1994; Fisher 1995).

UA-405 (morphology of the A and B microfeatures)	**lithic ''cutmarks''**	**vascular grooves**
long course on A	long course	long course
linear shape on A and B	linear shape	linear shape
rectilinear course on A and B	rectilinear course	rectilinear course
multiple	multiple	multiple
Sub-parallel	Sub-parallel	Sub-parallel
rounded ends A	sharp ends	rounded ends
U-shaped sections on B and on most parts of A; V-shaped in a short portion of A	V- or polygon-shaped section	U-shaped section
bony bridges present on A; absence on B (erosion?)	bony bridges absent	bony bridges present
a possible Volkmann's canal outlet on A close to its end	-	associated Volkmann's canal outlet
A: lamellar structure of the bottom at some portions; B: lamellar structure of the bottom at the proximal portion	flat shoulders with secondary striae	lamellar structure of groove bottom
A and B localized on a region suitable for bearing cutmarks	localized on a region suitable for bearing cutmarks	no specific anatomical localization
A: secondary striae present in a small portion, but irregular and short; B: absent	secondary striae present	secondary striae absent

Comparative microscopic analysis of the A and B "scratches" found on UA-405 shows that while the central portion of groove A displays secondary striae in its central part – a feature suggesting the possible mechanical action of a lithic tool – most portions along both the A and B "scratch lines" distinctly show microfeatures which are more likely related to a vascular groove. Notably in the case of A, the presence of secondary striae could have resulted from the action of an abrasive particle channeled along the original natural furrow and responsible for its width variation.

In sum, according to the currently available record, the micromorphological analysis of the UA-405 partial hip bone does not support a diagnosis of "cutmarks" for the observed "scratch lines".

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