

# Analysis of the Early Pleistocene Elephants from Buia (Eritrea)

L. Rook<sup>1</sup>, M.P. Ferretti<sup>1</sup>, Y. Libsekal<sup>2</sup>

<sup>1</sup> *Dipartimento di Scienze della Terra, Museo di Storia Naturale (Sezione Geologia e Paleontologia) Università degli Studi di Firenze, Firenze, Italy*

Marcoferretti@hotmail.com

<sup>2</sup> *National Museum of Eritrea, University of Asmara, Asmara, Eritrea*

yosief@arc.uoa.edu.er

**SUMMARY:** For the purpose of this work, we analyzed the most significant elephant specimens from Buia, a locality in the northern Danakil (Afar) depression of Eritrea (East Africa). At this site there are up to 500 meters of thick, well-exposed fluvio-lacustrine horizons, with a succession of five different vertebrate-bearing fossiliferous levels. One of these yielded, in addition to the abundant mammal fauna, a nearly complete *Homo* cranium, dated at about 1 million years on magnetostratigraphic and faunal evidence. Most of the Buia elephant material belongs to a derived form of *Elephas recki*, presenting intermediate characters between *Elephas recki ileretensis* and *E. r. recki*.

## 1. INTRODUCTION

In 1995 a new paleoanthropological site was discovered in the northern Danakil (Afar) depression near the village of Buia, 110 km south of Massawa, Eritrea. Field work in the area assigned to the project – delimited by Derawle Stream (to the North) and Wadi Mahabale (to the South) – is conducted under a joint collaborative research between the National Museum of Eritrea (NME), the Eritrea Department of Mines (DMA), the Dipartimento di Scienze della Terra (DSTF), and Museo di Geologia e Paleontologia (MGPF) of the Università degli Studi di Firenze. The Buia project has been definitely approved by the Eritrea University Research Committee and is currently fully operative.

The field surveys by the project components lead to the discovery of an almost complete *Homo* cranium associated with a rich early Pleistocene vertebrate fauna and with artefacts of both Oldowan and Acheulean character abundant and widespread in the area (Abbate *et al.* 1998; Rook *et al.* 1999).

The *Homo*-bearing level was dated at about 1 million years on magnetostratigraphic and faunal evidence. Among mammals, elephant remains are abundant and were recovered from many sites within the studied area.

## 2. METHODS

The systematic study of the Buia elephants was based on the morphological and metrical analysis of the cheek teeth, the most diagnostic and best represented skeletal parts.

Comparison with other African fossil elephants was based mainly on Maglio (1970, 1973) and Beden (1980, 1983, 1987), whose classification of *E. recki* we followed.

Six dental variables (width, height, enamel thickness, number of plates, plate frequency, and hypsodonty index; see below) were used in a canonical variate analysis (discriminant analysis) performed on the M3 data given by Beden (1983, 1987) for the Omo and Koobi Fora material, to summarize the information given by the univariate analyses.

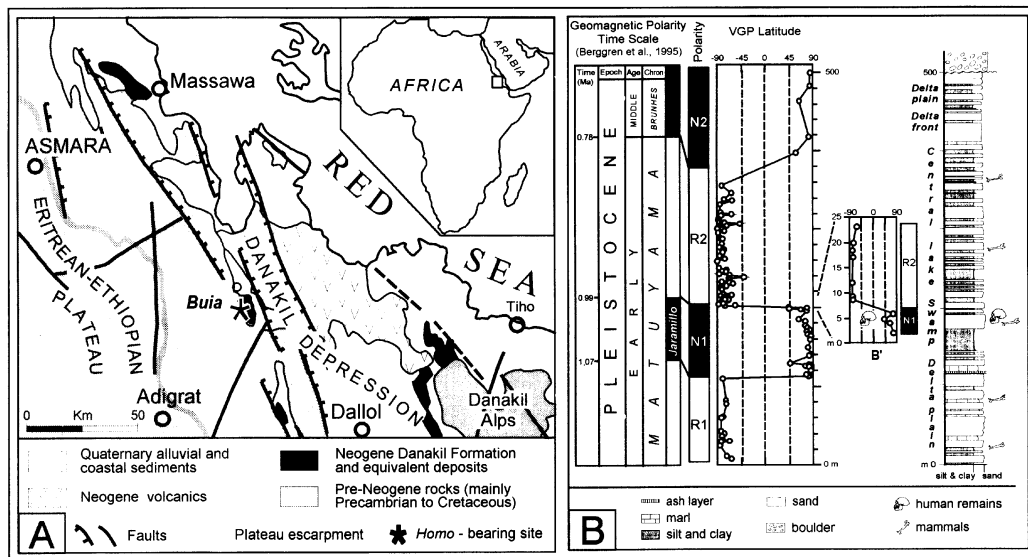


Fig.1 - A) Location map of the Buia area; B) chronostratigraphy, magnetostratigraphy, paleoenvironment reconstruction and location of vertebrate-rich fossiliferous horizons (from Abbate *et al.* 1998, modified).

### 3. MATERIAL

During the 1995 and 1997 surveys by the NME-DMA-DSTF-MGPF joint research project in the Buia region, a total of 109 elephant fossils, representing at least (MNI) 83 individuals, were recovered from sediments of the upper Danakil Formation outcropping in two main areas, Wadi Aalad and Dioli (Wadi Dandero). All the collected fossil material is housed at the National Museum of Eritrea.

At Aalad, from the *Homo*-bearing level (VL 3), several post-cranial elements, fragments of tusks and cheek teeth and an almost complete lower molar (UA 225), have been recovered. The lower deltaic level (VL 2), yielded isolated postcranials, some belonging to very large individuals, one tusk fragment and a deciduous premolar. An upper molar (UA 243; Fig. 2A-B) was retrieved from level VL 4, about 500 m south from the *Homo* site.

The elephant material from the main fossil level at Dioli includes, besides other specimens: a left and a right dP4 (DAN 74 and DAN 94); three isolated M3s (DAN 76, DAN 68 and DAN 208); a left maxillary fragment (DAN 98); the fragment of a lower molar (DAN 75);

an incomplete juvenile mandible (DAN 107); a right mandible (DAN 67); another right mandible (the left portion is still in situ) (DAN 223).

An almost complete mandible (DAN 176; Fig. 2C) was collected from an older level (Dioli lower), whose position in the general stratigraphical framework of the area is not yet defined.

### 4. COMPARISONS

All the Aalad and Dioli molars are consistent with *Elephas recki*, the most common elephant of the Plio-Pleistocene of East Africa (Maglio 1973; Beden 1987). The systematics and evolutionary history of this long-lived species was previously characterized in a number of works mostly by Arambourg (1942, 1947), Maglio (1970, 1973) and Beden (1979, 1980, 1987), on the basis of the very rich material derived from the deposits of the Omo basin (Ethiopia), Koobi Fora (Kenya), and Olduvai Gorge (Tanzania), which span in time Middle Pliocene to Early Pleistocene.

In his systematic synthesis, Beden (1987) recognized five time-successive stages or sub-

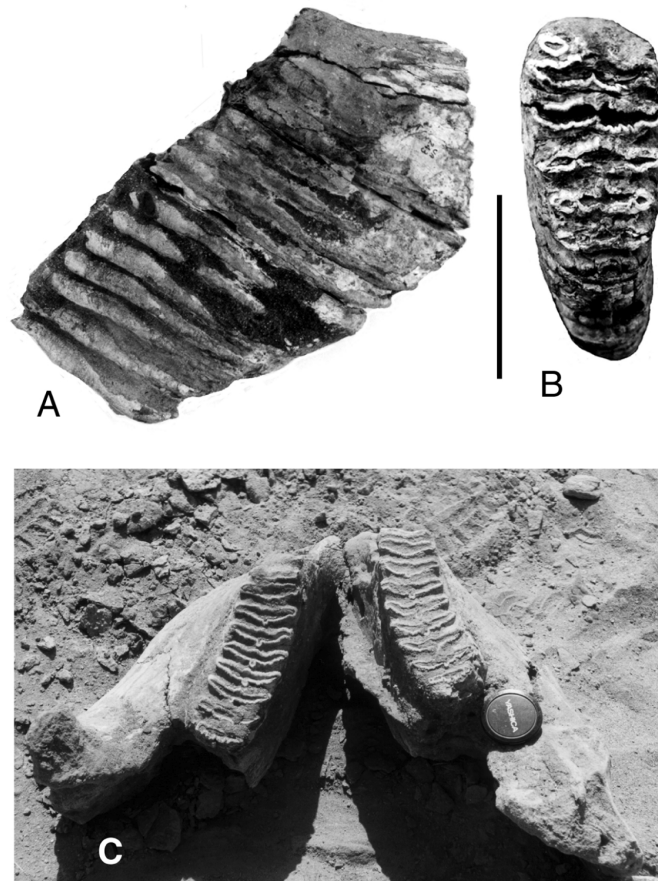


Fig.2 - *Elephas* remains from Wadi Aalad and Dioli (Dandero): UA243, upper molar in lateral (A) and occlusal (B) views (bar scale 10 cm); C) DAN 176, mandible in occlusal view (lens cap for scale, about 5.5 cm).

species of *E. recki*, characterized by a progressive specialization of the skull and teeth: *E. r. brumpti*; *E. r. shungurensis*; *E. r. atavus*; *E. r. ileretensis* and *E. r. recki*.

The morphometric parameters of the Aalad and Dioli elephant molars suggest a derived form of *Elephas recki*. On the average, the metrical (e.g. enamel thickness, number of plates, height) and morphological (e.g. moderately to finely wrinkled enamel, acute median enamel loops) characters of the Buia elephants are consistent with *Elephas recki ileretensis*, even though some specimens display values that bring them closer to *Elephas recki recki*. There are however also specimens with intermediate characters between these two subspecies, like

as DAN 243.

Beden (1987) described *Elephas recki ileretensis* based on material recovered from Ileret (East Turkana), just above the Okote Tuff. The temporal range of this subspecies span the end of the Pliocene to the base of the Early Pleistocene. *Elephas recki recki* Dietrich, 1915 represents the last and most derived of the five subspecies of *E. recki*. The type material is from Olduvai. The chronological distribution of this subspecies seems to range from late Early Pleistocene to early middle Pleistocene.

The characters state presented by DAN 176 (Fig. 2C) hint instead to a more primitive form than *Elephas recki ileretensis*, more like *Elephas recki atavus* Arambourg, 1947. This

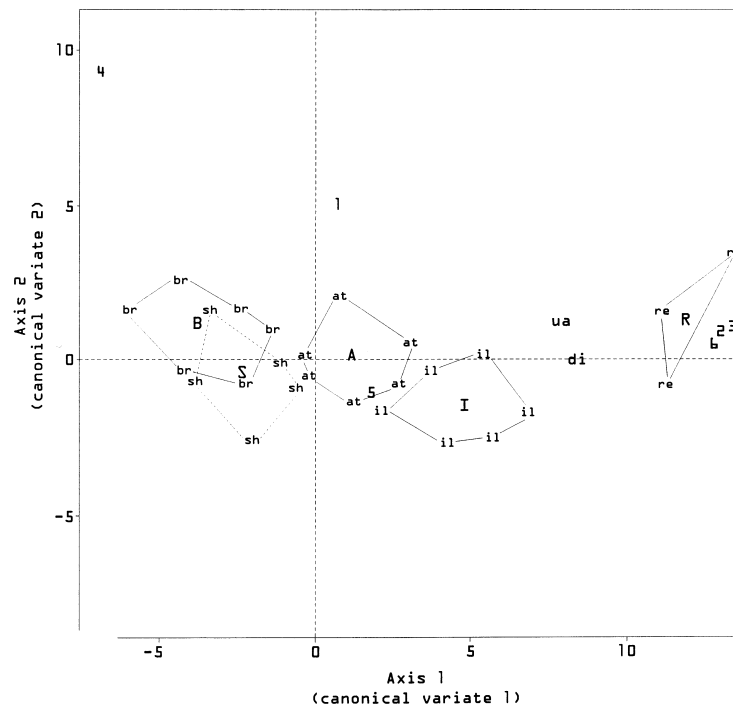


Fig.3 - Discriminant analysis biplot showing dispersion of groups (dotted lines), group centroids (capital letters) and correlation of variables with canonical variates (Ferretti *et al.* in press). Abbreviations: B (-br-), *E. recki brumpti*; S (-sh-), *E. recki shungurensis*; A (-at-), *E. recki atavus*; I (-il-), *E. recki ileretensis*; R (-re-), *E. recki recki*; ua: *E. recki* from Wadi Aalad (Buia); di, *E. recki* from Dioli (Dandero, Buia).

latter subspecies occurs in Member F (upper) and Member G of the Shungura Formation (Beden 1983, 1987). Its distribution covers the middle and late Late Pliocene and possibly the base of the Early Pleistocene. It cannot be ruled out, that the occurrence of this form represents the persistence of “primitive” or hold-over morphotypes within late *Elephas recki* populations.

#### 5. DISCRIMINANT ANALYSIS

The discriminant analysis conducted on the M3s data set of Beden (1983, 1987), separated the five *E. recki* subspecies along the first canonical axis, which correlates with height, hypsodonty index, and number of plates (Ferretti *et al.* in press). The second canonical axis has a significantly smaller discriminant power and correlates mainly with size (width).

Enamel thickness correlates with both the first and the second variates. By plotting the

scores according to the first two variates (Fig. 3), it is possible to see that *Elephas recki brumpti* and *Elephas recki shungurensis* are hardly separated and mostly by the second variates (width, enamel thickness). *Elephas recki atavus* and *Elephas recki ileretensis* form two well defined clusters. *Elephas recki recki* is separated by the first variate and isolated from all the other groups (Fig. 3). Two teeth from Dioli (DAN 76) and Aalad (UA 243) were included in the analysis. They locate between the *E. r. ileretensis* and *E. r. recki* clusters (Fig. 3), showing to possess intermediate metrical characters between these two subspecies.

#### 6. DISCUSSION AND CONCLUSIONS

The majority of the specimens examined here were recovered from the *Homo*-bearing level, (VL 3) while the remainder (except for DAN 176) come from VL 2 and VL 4. No significant differences were observed between the

samples from these three levels. Based on the estimated sedimentation rate Vertebrate level 3 is separated from either VL 2 and VL 4 by a relatively short interval of time (less than 0,2 Ma), apparently less time than exhibited in the sub-species of East African *Elephas recki*. Indeed, excluding the mandible DAN 176 (whose stratigraphic position is not fully clarified), the extent of variation presented by the elephants from Buia conforms to that of a single population. In most of the morphometrical features of the teeth, the specimens are similar to the sub-species *Elephas recki ileretensis*. Nevertheless, specimens possessing slightly more derived features also occur. Most likely the Buia sample represents a population whose evolutionary stage is intermediate between *Elephas recki ileretensis* from Koobi Fora and Ileret and *Elephas recki recki* from Beds III and IV at Olduvai. This conclusion is also supported by the results of the discriminant analysis conducted on the M3s and is consistent with the late Early Pleistocene age derived from the paleomagnetic analysis of the Buia succession (Abbate *et al.* 1998).

Presently we believe that the best interpretation is that the Buia elephant sample is referable to *Elephas recki* ex gr. *ileretensis-recki*.

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