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The HOMME project – *Human Origins in Mozambique and Malawi Environments:* looking for our origin in the Mozambican karst

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Abstract

Mozambique is a crucial area for unravelling our evolutionary history, during the early phases of the Quaternary. Indeed, located at the southern end of the Great Rift between Southern and Eastern Africa, this area plays a key-role in our understanding of the paleobiogeography of fauna documented in the fossil record of East and South Africa. The Human Origins in Mozambique and Malawi Environments – HOMME – project aims to identify evidence of early hominins in this area, which is under-studied as compared to eastern and southern African regions, as well as to characterize the paleoenvironmental contexts in which the genus *Homo* emerged. This paper presents the results obtained during our first field season. We explored various karstic cavities located along the Buzi river and the Cheringoma Plateau (west and north off Beira). Our explorations reveal the potential of the Mozambican karst systems for providing new Plio-Pleistocene paleontological evidence. In particular, we report various endokarstic deposits containing paleontological remains. These promising findings reveal the richness of this area and the fundamental role of the karst in trapping and preserving fossils. Accordingly, this project will certainly fill in a number of gaps in the paleobiogeography and paleobiology of early hominins.

Résumé

Le projet HOMME - Human Origins in Mozambique and Malawi Environments : à la recherche de notre origine dans le karst mozambicain. Enclavé entre l'Afrique australe et l'Afrique de l'Est, le Mozambique est un secteur essentiel à la compréhension de notre histoire évolutive et ce en particulier pour les phases anciennes du Quaternaire, entre 2,6 et 2 Ma. Le Mozambique, par sa situation géographique comprenant la partie terminale du Grand Rift, apparaît comme la clef des problématiques paléobiogéographiques entre les deux grandes aires est- et sud-africaines. Le projet HOMME – Human Origins in Mozambique and Malawi Environments – vise à identifier, dans ce secteur encore trop peu étudié, les traces du passage des Homininés anciens (Australopithécinés et premiers *Homo*) ou, tout du moins, à caractériser les paléoenvironnements au sein desquels ils ont pu évoluer. Nous présentons ici les premiers résultats de nos premières campagnes de terrain. L'exploration de plusieurs cavités karstiques, à l'ouest (secteur de la Buzi River) et au nord (secteur de Cheringoma Plateau) de la ville de Beira, nous a permis de reconnaître l'importance et les potentialités archéo-paléontologiques des réseaux karstiques mozambicains. Des reliques de brèches endokarstiques riches en matériel paléontologique (dont porc-épic, hyène, phacochère) ont d'ailleurs été identifiées. À l'issue de cette campagne, le matériel osseux et la présence de brèches fossilifères laissent entrevoir la richesse du secteur qui nous permettra, à terme, de combler nombre de lacunes concernant la paléobiogéographie des Homininés anciens.

1. Introduction

For decades, the Great East African Rift has been considered the cradle of humankind. Indeed, it has delivered numerous fossils and stone tools of ancient hominins, covering the emergence of *Homo* genus, in addition to the oldest *Australopithecus*. Equally important is another area located in South Africa, that can also claim to be a cradle of humankind. Here, over the last 80 years, a large number of fossils of *Australopithecus*, *Paranthropus* and *Homo* and stone tool artefacts have been found in palaeokarsts, 50 km

Northwest of Johannesburg. However, complications with dating the fossils and artifacts have led most to believe the South African cradle fossils are significantly younger than those in East Africa, limiting the awareness of the potential antiquity of this area's fossils.

Very recently, the dating of the almost complete *Australopithecus*, nicknamed 'Little Foot', produced an age of 3.67 Ma. This date, supported by other stratigraphic and faunal evidence, demonstrated that South Africa has a

hominin fossil record almost as old as East Africa, placing it in an ideal time period to yield the earliest evidence of the evolution of the genus *Homo*. If we consider that in both cases, the hominin fossils and artifacts are preserved in geological traps (i.e., the rift valley and the caves), what about the rest of Africa? Shouldn't we consider the whole of Africa as a potential cradle of humankind, with fossils preserved in natural sediment traps all over the continent?

2. Materials et methods

During the survey mission of the HOMME project in 2019, we explored several karstic cavities distributed on two distinct areas, around the Buzi River on the one hand and on the Cheringoma Plateau on the other. Our vision of the archeo-fauna has been built around two complementary aspects. First it was necessary to recognize the elements of breccia that were preserved and containing bone material. A first *in situ* examination has allowed a preliminary identification. Then, whenever possible, the reworked paleontological material (the material naturally extracted from the eroded breccia) has been analyzed more in details (osteology, morphometry) in order to define the taxonomic attribution of these specimens.

The different paleontological series presented here come from two distinct cavities (fig.1): Dimba 2, along the Buzi River, and Ninga Miriango in the Cheringoma Plateau area. These two sites yielded samples from ancient phases of the Quaternary. We hereby present the preliminary results of our paleontological approach regarding the different areas visited and the knowledge brought to the Plio-Quaternary Mozambican's context on one side and more generally in the frame of the relations between these two eastern and southern African wide areas.

3. Résultats

3.1. Dimba 2 (Buzi river area)

Dimba 2 cavity is located near the city of Estaquinha in the Sofala Province, along the Buzi River (100 kilometers west of Beira). During the survey, material was found in two areas: the South Junction and the Aval Diverticulum.

Within the Aval Diverticulum, we saw and collected a lot of odontoskeletal material. These remains, spread on the surface (and not encased in a hardened breccia matrix) seem to represent two different events. Part of the fauna seems quite recent and could result from the current activities of the local fauna. The other part grabbed our attention. The specimens exhibit a patina that appears to be ancient, with some degree of fossilization and smooth bone surfaces indicating that they have been transported by flowing water. Among these apparently "ancient" elements, we found warthog teeth (n=8), a baboon tooth and a hyena mandible (cf. *Crocuta*; fig.2).

The South Junction is also interesting. The remains of the South Junction are still in a primary position in a breccia matrix. At least three taxonomic groups can be recognized: porcupines, suidae and equidae.

On this idea, an interdisciplinary team built the Human Origins in Mozambique and Malawi Environments project to search for fossil sites in the karsts that surround the southern end of the Great East African Rift. This geomorphologically promising region provides an opportunity to link the Great East African rift sites of East Africa and the karst sites of South Africa.



Figure 1: Location of the explored cave sites.



Figure 2: Hyena mandible from Dimba 2. Photo. A. Beaudet.

A fragment of mandible shows the typical morphological traits of a large-sized rodent attesting of the presence of a porcupine. Unfortunately, since the specimen was not extracted from the breccia, it is not possible to establish a more precise diagnosis. We thus attribute it to the Hystricidae, likely to the genus *Hystrix*.

A mandible fragment bearing a molar (m3?) attests to the presence of a suid. The specimen was not extracted during our survey. The tooth that is visible exhibits a high degree of

hypso-donty, excluding an attribution to *Potamochoerus*. Such degree of hypso-donty is typical of the *Metridiochoerus-Phacochoerus* lineage. In absence of more morphological data, this specimen can be attributed to either *Metridiochoerus* or *Phacochoerus*.

Finally, a maxillary molar and a fragment of premolar/molar still encased in the breccia indicate the presence of an equid (the family of horses, zebras, donkeys). At the moment, it is not possible to establish if the specimens belong to a single individual or more. It could be attributed to a large equid (genus *Equus/Eurygnathohippus*).

3.2. Ninga Miriango (Cheringoma plateau)

Ninga Miriango is a long cave (about 600 m long; see LAUMANN 1998), located near Codzo. Survey in this cave was limited by the presence of large bat colonies of several thousands of individuals. Our observations were mostly limited to the entrance, representing a survey area of 40-50 m. The preliminary observations are indicative of the paleontological potential. It was possible to detect some breccias. Some of the breccia holding fossil material is attached to the walls of the cavity (at a height of 1.60-1.80 m from the ground). Together with the fossils contained in the hard breccia, there are also some large charcoal fragments (of cm size). The main question regards the contemporaneity of these charcoals with the fossils since the deposits are scattered, as well as with a second deposit found close (at around 5 m from the wall breccia) which deposit represents a remaining mound of sediment accumulation, hardened and containing large pieces of rock. The exposed paleontological material is scarce but brings useful information to reconstruct the sedimentary history and the chronology of the deposits.

It is noteworthy that, together with a vertebra of a large bovid, a well-preserved sub-complete suid mandible has

been found and is compatible with an attribution to the warthog *Phacochoerus* or to the ancestral form *Metridiochoerus* (fig.3). The specimen is broken in four parts. The symphysis (anterior area of the mandible where the incisors and canines are inserted) is partially preserved. The mandibular bodies, right and left, still bear second and third molars. The first molars are lost post-mortem, the socket of the right one being filled by sediment. The occlusal surfaces of the preserved molars show advanced wear; the cusps are heavily worn, showing large enamel islands, in particular on the third molars. The overall morphology and the dental formula (0p / 3m) are typical of warthogs (and of all the calde relatives). A more detailed morphometric analysis should be undertaken to clarify the taxonomic attribution of this specimen. In the meantime, we attribute it to the *Metridiochoerus-Phacochoerus* lineage.



Figure 3: Suid mandible (*Metridiochoerus/Phacochoerus*) from Ninga Miriango. Photo. A. Beaudet.

4. Bio-chronological implications

The paleontological remains that were discovered during the 2019 expedition are promising for the future. Establishing a chronological frame was one of the aims and the taxonomic identification of the uncovered fossil remains opens toward several hypotheses.

Regarding the suids, the oldest fossils attributed to *Phacochoerus* come from the Shungura Formation Mb. C in Ethiopia, toward 2.8-2.5 Ma (SOURON 2012). The recent species *Ph. africanus* is quite frequent in the South African Late Pleistocene sediments (AVERY 2019). It is noteworthy that the presence of *Ph. antiquus* was reported in the Early Pleistocene site of Gladysvale, as well as at Sterkfontein and Swartkrans (review in AVERY 2019). *Ph. antiquus* appears to represent an intermediate morph between the ancestral species *M. modestus* (found between 2.2 and 0.7 Ma) and the modern taxa of *Phacochoerus* (SOURON 2012). Concerning material from Dimba 2, it seems very similar to *Phacochoerus*, but a detailed analysis will be needed to exclude the hypothesis that it could belong to the older genus *Metridiochoerus*, known to have existed between the Pliocene and the Pleistocene. While there is a clear phyletic relationship between *Metridiochoerus* and *Phacochoerus*,

the evolutionary history of the two genera remains to be elucidated further (SOURON 2012). *M. modestus* is one of the most recent species of *Metridiochoerus* and is recorded in all the African continent between 2.2 and 0.7 Ma, thus limiting its biochronological value. Conversely, earlier forms of *Metridiochoerus* enable establishing the *terminus ante quem* of a fossil assemblage. It is the case of *M. andrewsi* that is found in Malawi (Chiwondo Beds) and South Africa (Makapansgat), disappearing just after 2 Ma, succeeded by other species (TURNER & ANTÓN 2004; BISHOP 2010). The discovery of porcupine remains in the breccia at the South Junction from Dimba 2 is of interest. The oldest occurrence of *Hystrix* in southern Africa dates to the Pliocene of Langebaanweg (HENDEY, 1984) and Makapansgat (DE GRAAFF 1960). Even if the phylogeny of porcupines remains a matter of contention, the South African Pliocene species *H. makapanensis* (= syn. *H. major*) precede the Early Pleistocene taxon *H. africae australis*. It is noteworthy that the large-sized porcupine *Xenohystrix crassidens* is recorded in the Pliocene sediments of Makapansgat, likely related to the lineage of the crested porcupine *H. cristata*, currently absent from southern

African environments (GREENWOOD 1955). Porcupines are major accumulators of bones in caves and are known for their ossiphagous behavior in both extant and fossil taxa (BRAIN 1981). In fact, porcupines collect bones in the environment or from assemblages accumulated by carnivores (e.g., hyena) and bring them in caves, creating accumulations of odontoskeletal remains. Studying such accumulations made by porcupines allows reconstructing paleoenvironments in details.

For the equids, the identification of species is critical, especially when searching for ancient paleontological assemblages, about the Neogene-Quaternary boundary. There is a consensus regarding the first occurrence of *Equus* (from the Equinini tribe, representing real horse) in Africa

around 2 Ma. *E. capensis*, a large-sized horse, seems to appear in South Africa only after this date and persists until the end of the Pleistocene. Before 2 Ma, only members of the Hipparionini tribe (archaic horses) are recognized in southern Africa. Two species of *Eurygnathohippus* are identified in South Africa: *Eu. hooijeri* from the Pliocene of Langebaanweg (BERNOR & KAISER 2006) and *Eu. cornelianus*, that appears around the Neogene-Quaternary boundary and persists until the Middle Pleistocene, about 500 ka (BERNOR *et al.* 2010). The detailed study of the tooth from Dimba 2 should be done in order to characterize the taxonomic affinity.

5. Conclusions and perspectives

Paleontological potential of the karstic cavities of the Buzi River and Cheringoma Plateau has been confirmed by the 2019 expedition. Dimba 2 shows the high potential for fossil discoveries. While it accumulates the remains of at least three taxa (from the South Junction breccia) on a limited exposed surface, the identification of these taxa can bring relevant information regarding the chronology of the sedimentary filling:

- i) for the suid, the identification at the genus level.
- ii) from a taphonomic point of view, the role of porcupines in the accumulation should be elucidated; the phyletic relationship between *H. makapanensis* and *H. africae australis* should be questioned.

iii) the equids represent the third element whose study could help understanding the chronological frame.

It is the association of the three identified taxa that will enable assessing the age of the Dimba 2 assemblage to the Neogene-Quaternary boundary. In parallel, the specimens from Ninga Miriango confirm the high potential for the recovery of ancient fauna from Mozambique. These expeditions of the HOMME project open toward promising prospects setting the bases for solid research and revealed promising perspectives, either for fieldwork or for the analysis of new fossil specimens.

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