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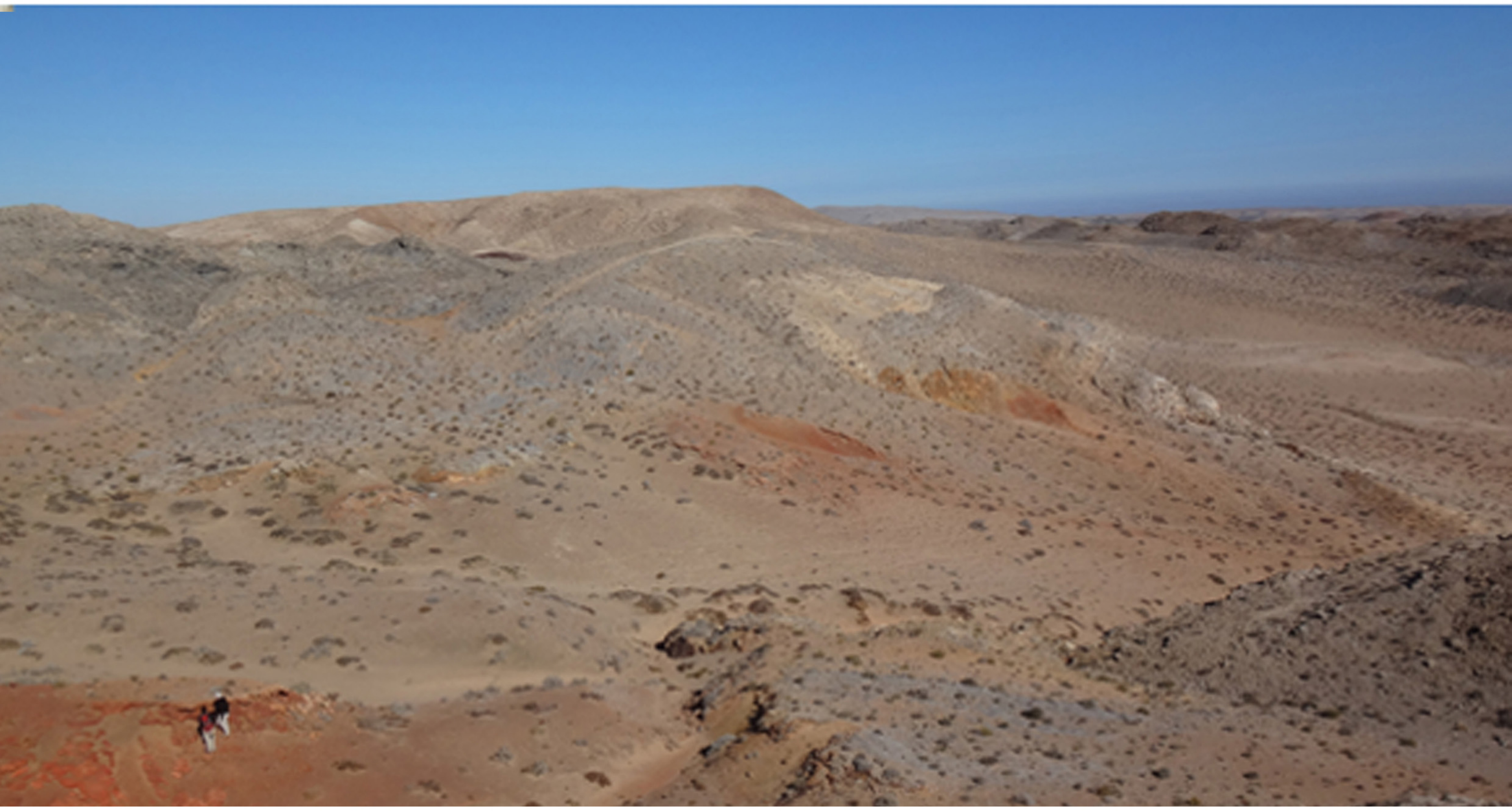

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PAPERS

Cover Image : Geologists studying the Bo Alterite in the type outcrops 1 km north of Chalcedon Tafelberg (in the background), Sperrgebiet, Namibia

Bothriogenys (Anthracotheriidae) from the Bartonian of Eoridge, Namibia

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Abstract: Until recently Palaeogene anthracotheres of Africa were known only from Eo-Oligocene localities in Northern Africa, notably the Fayum, Egypt, and Lokone, an Oligocene locality in Kenya. The discovery of a maxilla of *Bothriogenys* in the Sperrgebiet, Namibia, greatly extends the geographic representation of the family more than 6000 km south of the Fayum. Despite the vast geographic distance between the African occurrences, the Namibian fossil represents the same species that is common in the Priabonian-Rupelian succession of Egypt, and the same genus as the one which occurs as far East as China. The Bartonian age of the Namibian fossil indicates that this record could well represent the initial wave of dispersion of the family Anthracotheriidae into Africa.

Key Words: Anthracotheriidae, *Bothriogenys*, Sperrgebiet, Namibia, Eocene

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Submitted in 2015.

Introduction

Fossiliferous freshwater carbonates were first described in the Sperrgebiet, Namibia, by Kaiser & Beetz (1926) but the age of the deposits remained unclear because the only taxa found comprised molluscs and plants (Du Toit, 1954). The deposits were eventually correlated to the Cretaceous on the erroneous grounds that they were lateral equivalents of the silcretes of the African Surface (King, 1949). However, the discovery of fossil mammals at several localities in 2007 revealed that the strata were Middle to Late Eocene in age (Pickford *et al.* 2008a, 2008b, 2013).

Continued palaeontological surveys of the carbonates resulted in the discovery of large mammals at Eoridge, 1.5 km east of the immensely rich locality of Eocliff. The importance of the Eoridge carbonates is that they yield large mammals associated with some of the same micromammals as Eocliff, meaning that the two outcrops are the same age.

Geological context

The carbonate outcrops at Eoridge (Fig. 1) comprise freshwater palustral marls which accumulated in a small depression 1.5 km east of Eoridge, which was a hardwater spring that formed an impressive tufa mound more than 15 metres thick (Pickford *et al.* 2014). Water from this spring flowed towards the Eoridge area and accumulated in a shallow swampy area rich in algal mats and aquatic vegetation, of which there are abundant fossil remains, usually silicified. There are also many freshwater gastropods (*Lymnaea*, *Hydrobia*, *Planorbis*) and a few land snails (*Dorcasia*). Vertebrate fossils comprise turtles and anurans, as well as terrestrial forms such as the rodent *Silicamys*, the tenrecoid *Sperrgale*, a large hyracoid (*Rupestrohyrax palustris*) and an anthracothere which is the subject of this note.

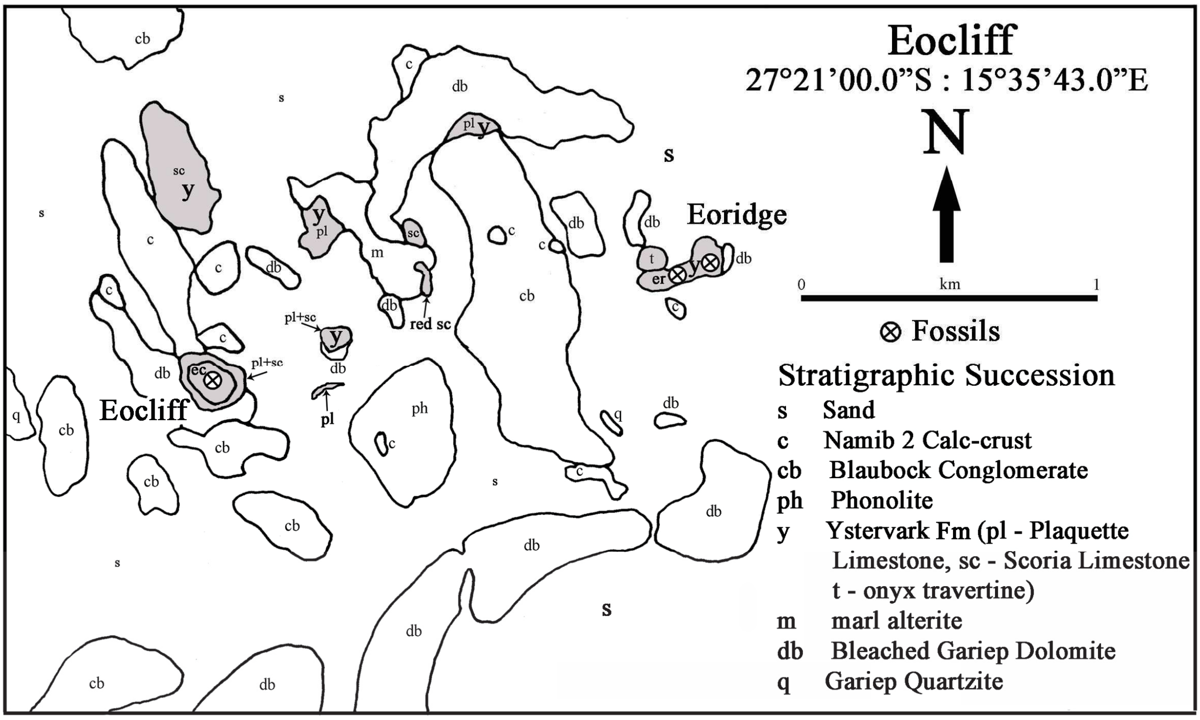

Figure 1. Geological sketch map of the Eocliff-Eoridge area, Northern Sperrgebiet, Namibia. The anthracothere maxilla is from the eastern end of Eoridge where the Bartonian freshwater carbonates overlie Precambrian Basement dolomites.

Material and methods

GSN ER 2'15, left maxilla containing P3/-M3/, curated at the Geological Survey of Namibia Museum, Windhoek.

Dental nomenclature is based on Lihoreau & Ducrocq (2007) and Pickford (in press) (Fig. 2). The specimen was measured with sliding calipers to the nearest 0.1 mm. Images were captured with a Sony Cybershot 14.1 megapixel camera, and treated with Photoshop Elements 3 to remove background and to enhance the contrast. The scale was added manually.

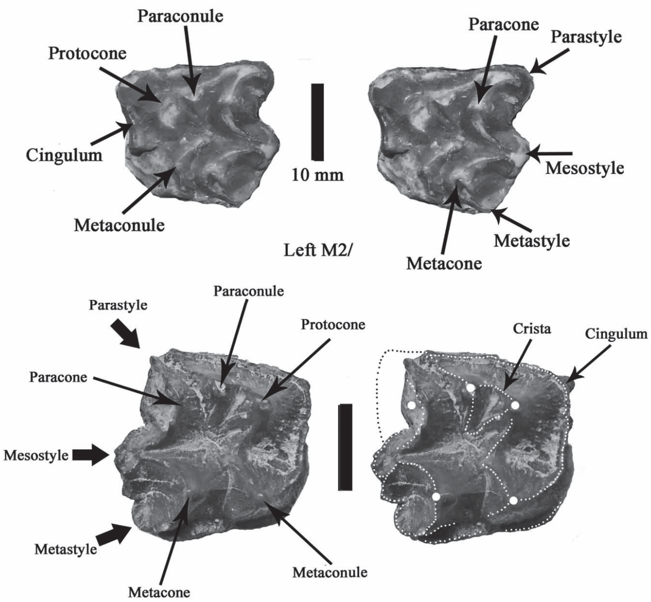

Figure 2. Nomenclature of upper molar of *Bothriogenys gorringei*. Top image – left upper molar from the Fayum, Egypt, Bottom image – right upper molar from Oman.

Systematic Description

Order Artiodactyla Owen, 1848

Family Anthracotheriidae Leidy, 1869

Genus *Bothriogenys* Schmidt, 1913

Species *Bothriogenys gorringei* (Andrews & Beadnell, 1902)

Diagnosis.- See Lihoreau & Ducrocq (2007) and Holroyd *et al.* (2010).

Description

The anthracothere specimen from Eoridge comprises a left maxilla containing a damaged P3/, complete P4/-M2/ and the M3/ lacking the metastyle (Fig. 3). The M1/ is heavily worn, but the P4/ and M3/ are lightly worn, indicating that the individual was a young adult when it died.

The palate is extremely shallow and flat. The P3/ was partly destroyed by plant roots which dissolved the roots and base of the crown. The main cusp is tall and the crests emanting from it sharp. The ectoloph is preserved and is bent in its middle, the anterior crest being in line with the tooth row, while the distal half is angled disto-buccally. A silicified pedotubule fills the disto-lingual fossette, obscuring the dental morphology (arrow in Fig. 3).

The cheek teeth are selenodont, but extremely brachyodont.

The P4/ is bicuspid, both cusps of which are selenodont, with pre- and postcrista which point buccally. Behind the paracone there is a diminutive metacone. The parastyle is small, posed between the mesial and buccal cingula. The lingual cingulum is well developed and surrounds the protocone mesially, lingually and distally. In the centre of the distal cingulum, there is a short, low style leading into the median valley.

The M1/ is heavily worn, so many of the details of cusp morphology have been eradicated. However, it is possible to observe that the crown was pentacuspidate with the paraconule applied closely to the protocone, the other cusps well separated from each other. The parastyle is large and has anterior and posterior crests. The mesostyle is swollen, strongly joined to the precrista of the metacone, but weakly to the postcrista of the paracone. It has anterior and posterior crests, the latter leading obliquely backwards to the small metastyle. The protocone, paracone, metacone and metaconule are strongly selenodont, with the pre- and post-crista pointing towards the buccal side of the crown, and there is a lingual cingulum.

The M2/ is in medium wear and shows the morphology of the crests better than in the M1/. The tooth is basically an enlarged version of the M1/. The preprotocrista leads antero-buccally directly to the paraconule which is triangular with an oblique preprotoconule crista and a low postprotoconule crista. The postprotocrista is broad and short, barely encroaching into the transverse valley. The pre-protoconule crista reaches the mesial cingulum in line with the paracone, stopping well short of the buccal edge of the crown. The paracone has a strong buccal barrel, the parastyle is large and has a swollen curved distal crest, but its postcrista is short stopping low down, well before reaching the mesostyle forming a low wall blocking the median transverse valley. The metaconule is damaged, but the premetacrista is seen to run obliquely forwards and buccally but not blocking the transverse valley. Its postcrista is short and broad. The metacone has a strong buccal barrel, and there is a well developed mesostyle at the end of the oblique premetacrista. The mesostyle is swollen with curved anterior and posterior crests, but it is not itself looped. The metastyle is weakly developed and low, barely distinguished from the postmetacrista. There is a strong lingual cingulum, damaged posteriorly and a complete mesial cingulum.

The M3/ is similar in morphology to the M2/, but its metacone is missing, meaning that details of metastyle strength and shape cannot be determined.

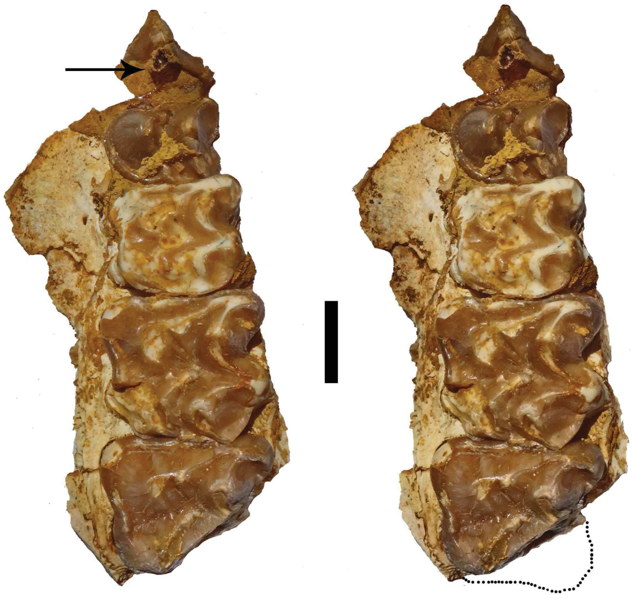

Figure 3. GSN ER 2'15, left maxilla of *Bothriogenys gorringei* from Eoridge, Sperrgebiet, Namibia, stereo occlusal view. Arrow points to a silicified pedotubule stuck to the P3/ (scale: 10 mm).

Table 1. Measurements (in mm) of the cheek teeth of GSN ER 2'15.

Tooth	Length	Breadth	Comment
P4/ left	11.8	15.6	
M1/ left	15.6	17.6	
M2/ left	20.3	22.0	
M3/ left	22.0	23.0	length estimated

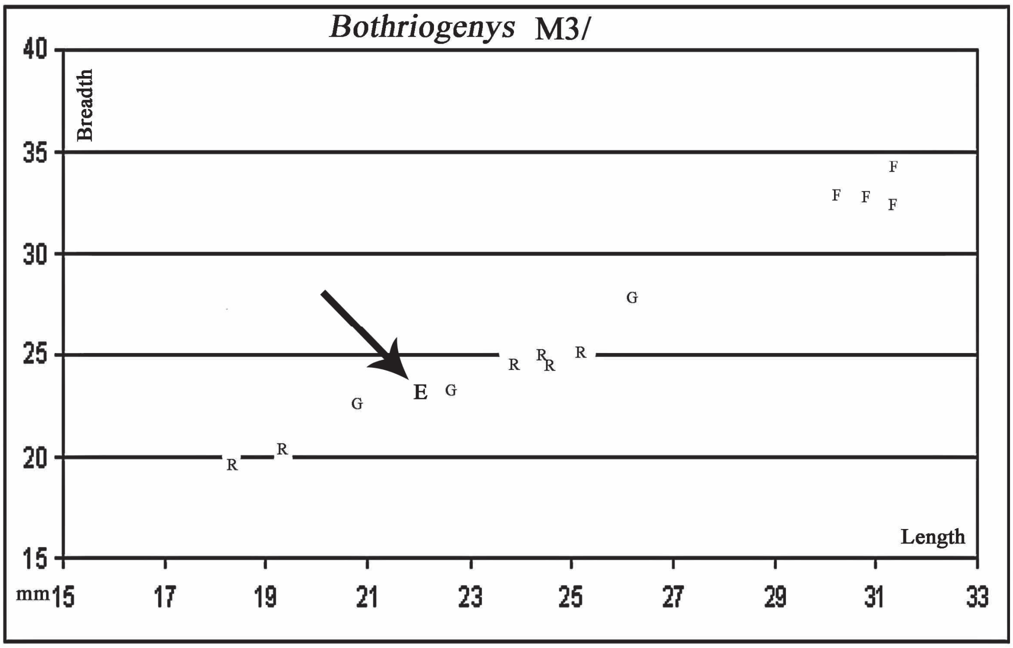

Figure 4. Bivariate plot of M3/ of *Bothriogenys* species. The Eoridge specimen accords in dimensions and morphology with *Bothriogenys gorringei*. R – *Bothriogenys rugulosus*; F – *Bothriogenys fraasi*; G – *Bothriogenys gorringei*; E – Eocliff specimen.

Discussion

The maxilla from Eocliff represents a medium-sized bothriodont anthracothere (Fig. 4). The brachyodont cheek teeth, with well developed lingual cingulum, non-looped mesostyle, and selenodont molar cusps are typical of the genus *Bothriogenys*. The dimensions of the cheek teeth accord with the species *Bothriogenys gorringei*, a well known taxon from the Fayum, Egypt (Fig. 5). The upper cheek teeth are quite close morphologically to *Epirigenys lokonensis* Lihoreau *et al.* (2015) from the Oligocene of Kenya, the main differences between this genus and *Bothriogenys* being observed in the lower molars, which have not yet been found in Namibia.

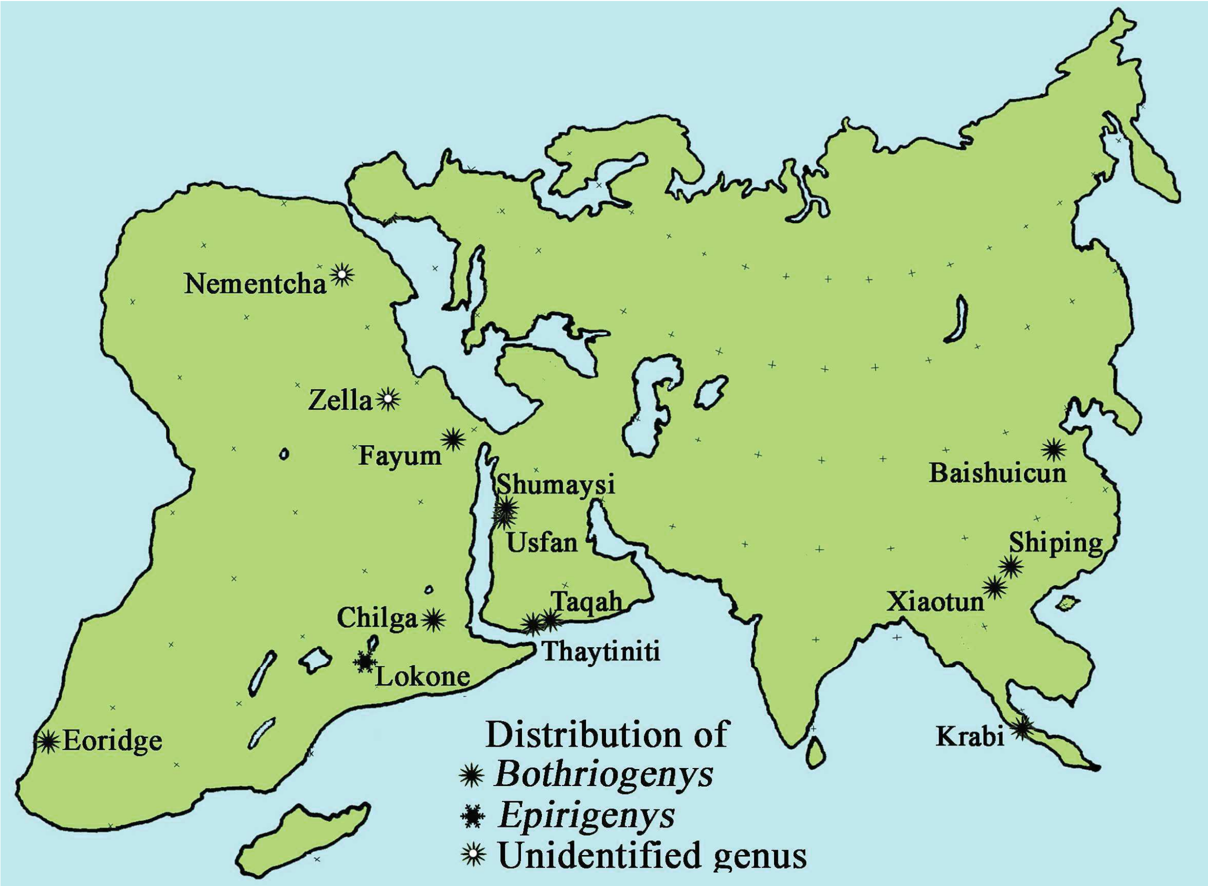

Figure 5. Distribution of *Bothriogenys* and related Eo-Oligocene bothriodont anthracotheres in Africa and Asia. Data from Andrews, 1906; Ducrocq, 1997; Kappelman *et al*, 2003; Pickford (in press); Zalmout *et al.* 2010, 2012.

Bothriogenys gorringei is common in Priabonian and Rupelian deposits of the Fayum, Egypt (Ducrocq, 1997). On the basis of the rodent fauna which indicate a Bartonian correlation, the Eoridge occurrence is somewhat older than the Fayum specimens (Fig. 6). An age of ca 39-38 Ma would make the Namibian fossil one of the earliest anthracotheres known in Africa but the difference in age from the previous oldest known occurrence is not excessive. Holroyd *et al.* (2010), for example, estimated an arrival of anthracotheres in the continent ca 38 Ma.

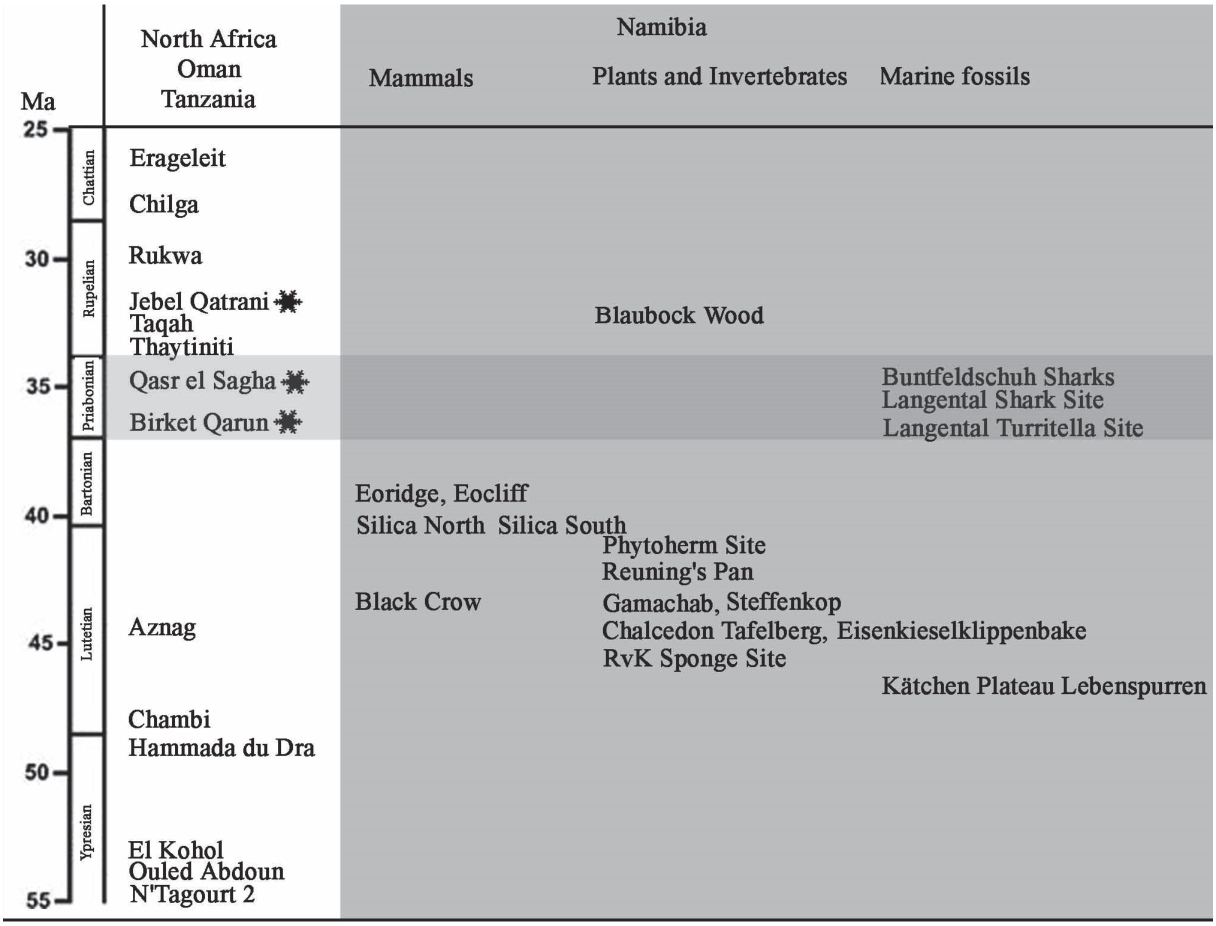

Figure 6: Biostratigraphy of African Palaeogene fossil localities. Stars are Fayum deposits which have yielded *Bothriogenys gorringei*.

Available data indicate that bothriodonts originated in Asia during the Middle Eocene and dispersed to Africa during the Bartonian, the Eoridge specimen providing crucial evidence of this early dispersal phase.

Conclusions

The discovery of an anthracothere in the Bartonian of Namibia is important for a number of reasons. Firstly, it greatly extends the Palaeogene geographic distribution of the family, which is now known to span the entire latitudinal extent of the continent, and being an anthracothere, the fossil represents the initial dispersal of the Artiodactyla into Africa. Secondly, the Eoridge specimen is potentially the oldest anthracothere known from the continent. Thirdly, it and the associated microfauna provide confirmation that the Eocliff Limestone is Eocene.

Acknowledgements

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