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ARSINOITHERIUM (EMBRITHOPODA) AND OTHER LARGE MAMMALS AND PLANTS FROM THE OLIGOCENE OF TUNISIA

MARTIN PICKFORD

Sorbonne Universités – CR2P, MNHN, CNRS, UPMC – Paris VI, 8, rue Buffon, 75005, Paris, France; e-mail: martin.pickford@mnhn.fr.

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Abstract: Palaeogene large mammals are poorly represented in Tunisia, in contrast to Morocco, Algeria, Libya and Egypt, where abundant and diverse faunas are known. Oligocene proboscideans have been recorded from four localities in Tunisia (Djebel Bou Gobrine, Oued Bazina, Bled Mellaha and Djebel Touila) but little else from this period is known from the country. For this reason it is worth recording the discovery of an arsinoithere tooth fragment from the divide between Oued Cherichera and Oued Grigema, Central Tunisia. This discovery confirms the presence of continental Oligocene strata in the region, and the palaeodistribution of *Arsinoitherium* 1,300 km to the north-northwest of its previously established range. Arsinoitheres are now known to have been widespread throughout the Afro-Arabian continent. Although palaeoclimatic data for the Oligocene of Tunisia is still scarce, fossil plants suggest that, during the Oligocene, the country enjoyed a tropical to sub-tropical humid climate, in accordance with the presence of *Arsinoitherium*, *Phiomia* and an anthracothere, taxa that are also present in the classic Fayum faunas of Egypt and the Ashawq faunas of Oman.

Key words: Tunisia, Africa, Oligocene, *Arsinoitherium*, biogeography, palaeobotany

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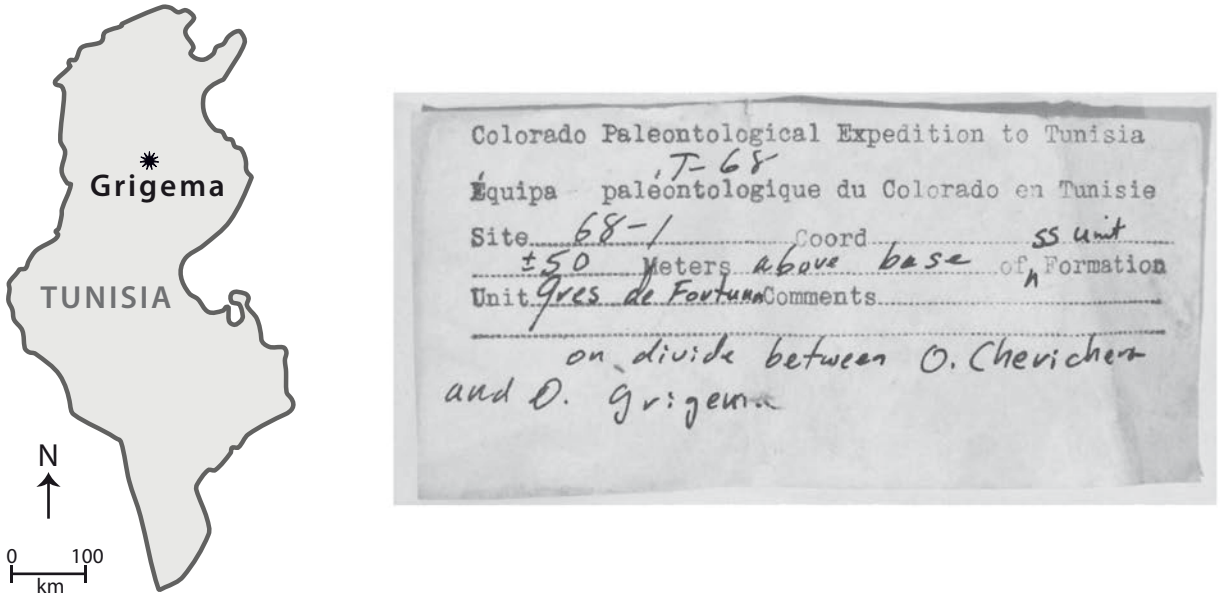
Introduction

In 1968, the Colorado Paleontological Expedition to Tunisia collected a tooth fragment from Site 68-1, the divide between Oued Cherichera and Oued Grigema, Central Tunisia (Text-fig. 1). The specimen, labelled T-68, is curated at the Museum of the Office National des Mines (ONM), El Charguia, Tunis. A label accompanying the fossil (Text-fig.



Text-fig. 1. Location map and original field label of T 68, fragment of arsinoithere upper molar from Oued Grigema, Tunisia.

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1) explains that it was collected from ± 50 metres above the base of the SS unit of the Grès de Fortuna.

Examination of the specimen reveals that it belongs to an arsinoithere, previously recorded from Tunisia (Bir Om Ali) on the basis of fragmentary material (Vialle et al. 2013). The aim of this short note is to describe and interpret the fossil from Oued Grigema and to discuss its stratigraphic, biogeographic and palaeenvironmental context.

Note on transliteration of place names

The literature on North African palaeontology is replete with alternative spellings of place names. This usually reflects the mother tongue of the persons transliterating the names from the Arabic. For example, the Arabic for "Mountain" is usually rendered "Jebel" in English, "Gebel" in Italian and "Djebel" in French. Thus many place names in Tunisia, Algeria and Morocco have the spelling Djebel, whereas in Libya, they are often spelled Gebel, Jebel or Jabal. In this contribution I employ the names as published rather than trying to standardise them to the English transliterations. Due to the history of study diverse spellings exist in the Latin alphabet for the same place (for example: Jebel Zelten, Gebel Zelten and Djebel Zelten).

The following list is far from being exhaustive.

Ayn, Aïn, In – Spring (Source of water) e.g. In Tafidet, Aïn Cherichera.

Bou – Place of (literally Father of) e.g. Djebel Bou Gobrine (also Jabal Bū Qubrīn, Jebel Bou Gobrine, Jabal Bu Qubrin, Jabal Bū Qubrīn).

Dor, Dur, Dûr – Home e.g. Dor el Talha (literally Home of the *Acacia*) (= Dûr at Talhah; Dor-El-Talha and other variants) (Abouessa 2013).

Oued, Wadi – Valley (e.g. Oued Grigema, Wadi Moghra).

Zella, Zellah, Zallah (alternative transliterations of the name of the oasis).

Systematic palaeontology

Order Embrithopoda Andrews, 1906
Family Arsinoitheriidae Andrews, 1904

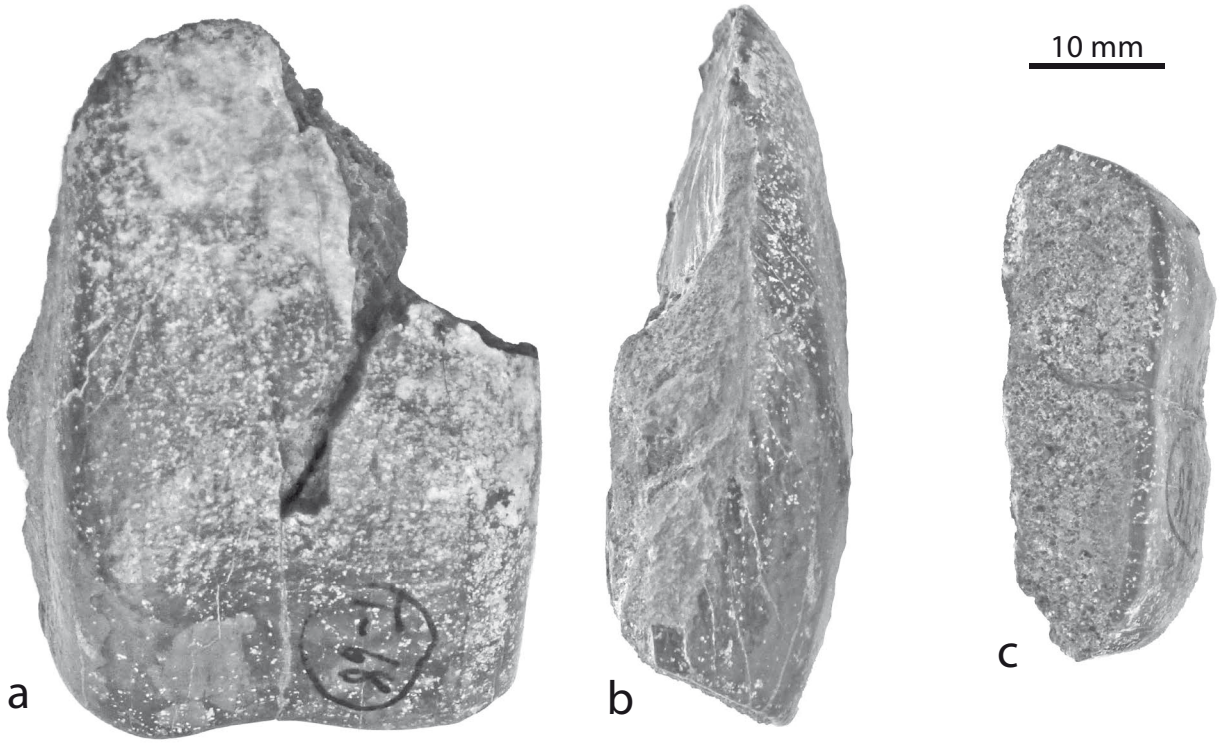
Genus *Arsinoitherium* Beadnell, 1902

***Arsinoitherium* cf. *zitteli* Beadnell, 1902**

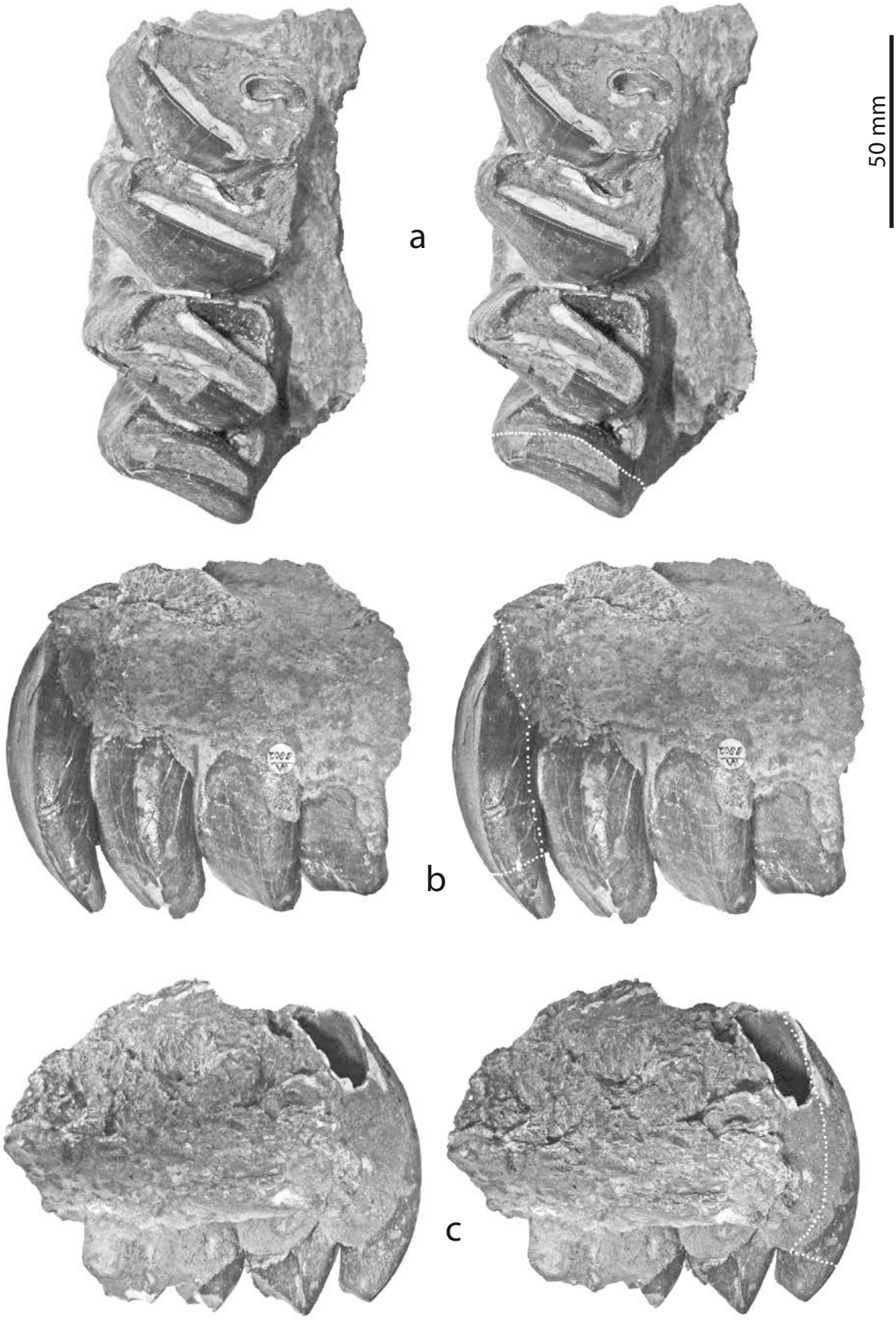
M a t e r i a l . ONM T-68, part of distal loph of a right upper molar of *Arsinoitherium* comprising the lingually expanded metacone which extends across to the lingual side of the crown (Text-fig. 2).

L o c a l i t y . Site 68-1, ± 50 metres above base of SS unit, Grès de Fortuna, on divide between Oued Cherichera and Oued Grigema. In order to distinguish this locality from a site called Cherichera that yielded a mandible of a gomphothere (Errington de la Croix 1877, Gaudry 1891a, b) I will refer to it as Grigema.

M e a s u r e m e n t s . Breadth of tooth – 34 mm; mesio-distal thickness of loph – 14 mm; preserved height of fragment – 55 mm; difference in height between the cervix on the distal and lingual sides of the crown – 46 mm.



Text-fig. 2. ONM T-68, *Arsinoitherium* cf. *zitteli* right upper molar fragment from the divide between Oued Cherichera and Oued Grigema, Central Tunisia. a) distal view (apical part towards bottom of page), b) lingual view (apex down, distal surface to right of page) (note the almost vertical enamel-dentine junction), c) occlusal view (lingual part towards top of page).



Text-fig. 3. Right maxilla of a young adult individual of *Arsinoitherium zitteli* from the Fayum, Egypt (M 8802, NHM collection, London). The dotted lines indicate the homologous part preserved in the specimen from Grigema, Tunisia. a) stereo occlusal view, b) stereo buccal view, c) stereo lingual view.

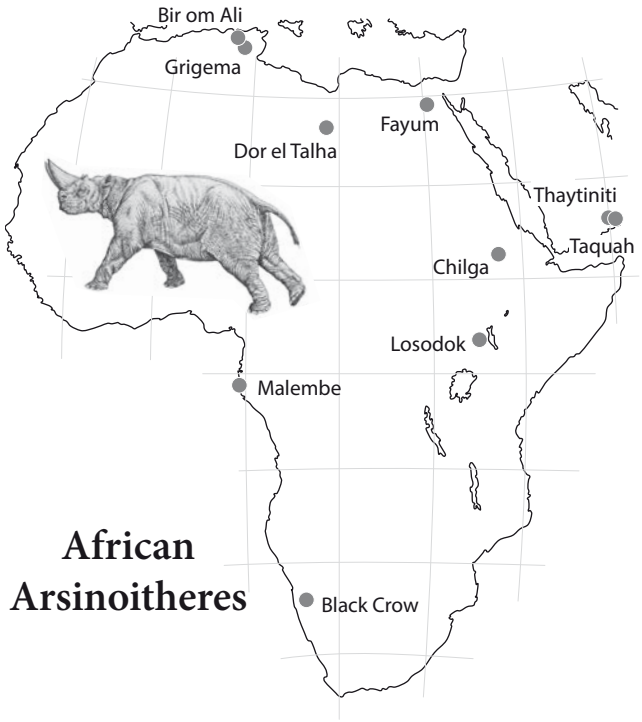
Description. Tooth T-68 from Grigema is partly coated in a ferruginous matrix, especially adherent on the dentine. The tooth is deeply worn, to the stage where the lingual part of the cervix is just beneath the occlusal wear facet. In occlusal view the enamel is thin (ca. 1.3 mm). In distal view, the tooth is slightly convex from cervix to apex and lightly concave from buccal to lingual (Text-fig. 2). It possesses a shallow distal furrow that curves gently lingually as it goes from the apex towards the root. The enamel surface is marked by closely spaced horizontal striations (perikymata) and where unworn or unabraded the enamel is lightly rugose or pitted with shallow depressions. On the lingual side, the enamel-dentine junction is observed to run almost vertically from the distal surface towards the occlusal surface (Text-fig. 2b), revealing that the tooth had an extremely hypsodont distal surface accompanied by an extremely brachyodont lingual side. The broken anterior side of the specimen retains a small zone of enamel which corresponds to the fossette which separates the mesial and distal lophs from each other. The loph is 14 mm in mesio-distal thickness. In buccal view the enamel is observed to curve from the rather flat distal surface, first anteriorly and then lingually to form a loph-like structure.

Discussion. The tooth fragment from the interfluve between Oueds Cherichera and Grigema, despite its limited nature, retains enough morphology to indicate with little doubt that it belongs to an arsinoithere. The enamel-dentine junction is almost vertical on the disto-lingual corner of the tooth, revealing that the crown had an extremely hypsodont distal part and an extremely brachyodont lingual side. Such a combination is highly unusual among mammals, the best example known being *Arsinoitherium zittelli* from the Fayum, Egypt (Andrews 1906, Court 1992a) (Text-fig. 3c). Other features of the tooth underline the arsinoithere-like morphology of the specimen, including the double curvature of the distal loph (concave bucco-lingually; convex cervico-apically), the layout of the perikymata and the thin enamel.

Eocene arsinoitheres such as *Palaeoamasia* from Turkey (Sen and Heintz 1979), and *Namatherium* from Namibia (Pickford et al. 2008), possess molars in which the cervix is horizontal all the way round the tooth. *Arsinoitherium* is the only known genus in which the distal and buccal surfaces of the molars are extremely hypsodont at the same time that the mesial and lingual sides are brachyodont (Andrews 1906, Court 1992a). It is therefore reasonable to suggest that this is the genus represented by the Grigema tooth. In terms of dimensions, the specimen falls within the range of metric variation of *Arsinoitherium zitteli*, but considering its fragmentary nature, it is referred to *Arsinoitherium* cf. *zitteli*.

Arsinoitherium is best known from the Fayum in Egypt (Andrews 1906, Court, 1992a, b), but has also been reported from Malembe (Angola north of the Congo River) (Pickford 1986), Dor el Talha (Libya) (Wight 1980), Chilga (Ethiopia) (Kappelman et al. 2003), Losodok (Kenya) (Rasmussen and Guttierez 2009) and Oman (Pickford 2015a). Al-Sayigh et al. (2008) recorded the presence of *Arsinoitherium* at Aydim (Oman), but the specimen (an isolated ulna) could belong to the barytherioid *Omanitherium* (Seiffert et al. 2012) (see also Pickford 2015b). All these localities are of Oligocene age, and this is the most likely age of the tooth from Oued Grigema. Arsinoitheres of Eocene age (Lutetian) are known from Turkey (*Palaeoamasia* and *Hypsamasia*), Romania (*Crivadiatherium*) (Radulesco et al. 1976) and Namibia (*Namatherium*) (Pickford et al. 2008) but these genera do not have the combination of hypsodont buccal and distal crown surfaces and brachyodont mesial and lingual ones, making it unlikely that the Oued Grigema specimen is as old as Lutetian.

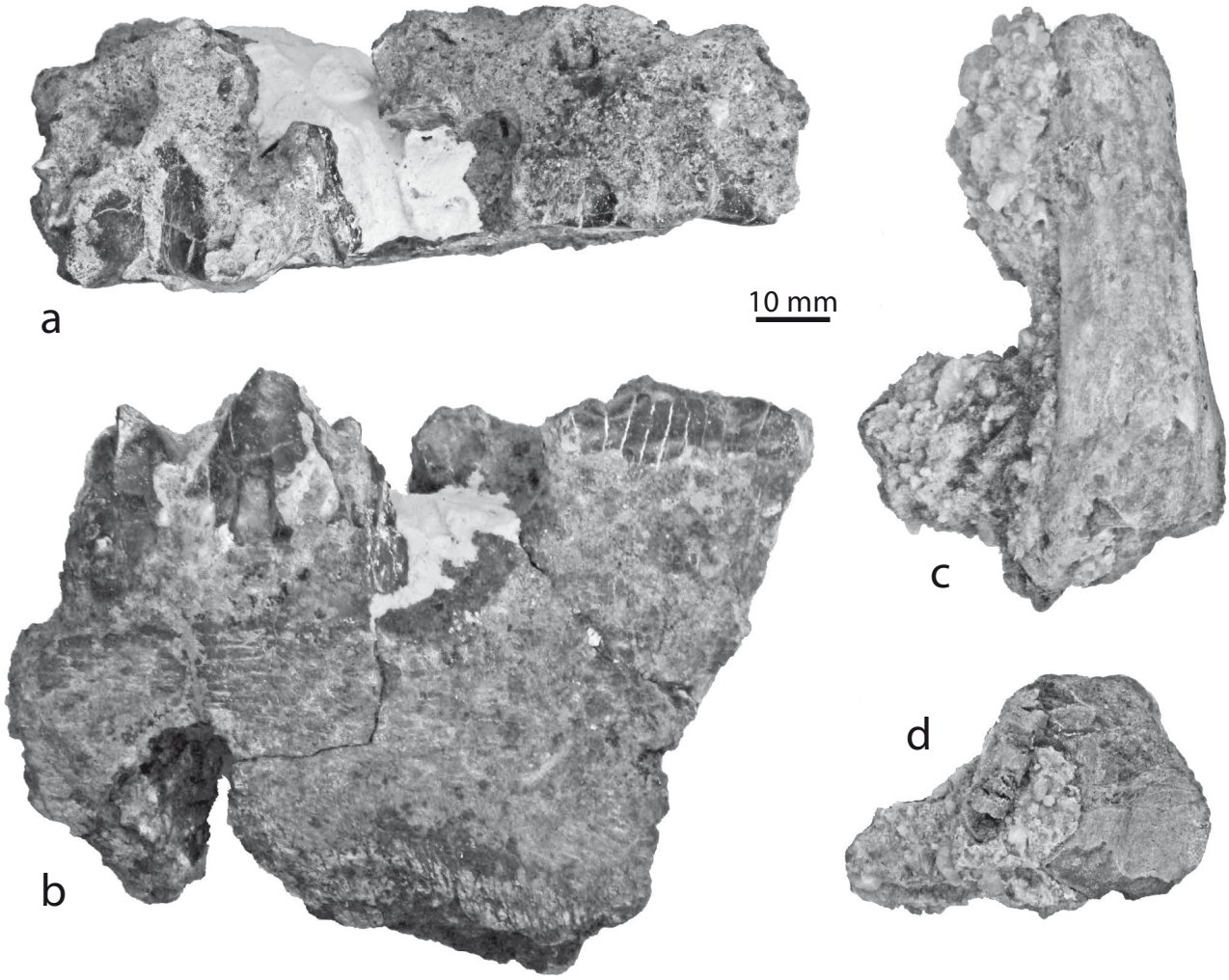
The Tunisian specimen, even though fragmentary, is important as it shows that arsinoitheres were widespread in the zone immediately south of the Tethys (Text-fig. 4). Vialle et al. (2013) reported the possible presence of *Arsinoitherium*(?) at Bir Om Ali, not far from Chambi, Tunisia. The present paper removes the residual doubt that might remain concerning the presence of the genus in the country.



Text-fig. 4. Distribution of arsinoitheres in Africa. Reconstruction of *Arsinoitherium* is adapted from Pomerol (1973) (the body in the image is probably too similar to that of an elephant, but the reconstruction gives an idea of the dimensions and possible body plan of *Arsinoitherium*).

Palaeogene mammals in Tunisia

The recognition of an arsinoithere tooth in the Oligocene continental deposits at Oued Grigema, Tunisia, focusses attention on the potential for further discoveries of Palaeogene mammals in the country. Neighbouring countries in North Africa (Morocco, Algeria, Libya, Egypt) have all yielded important quantities of Palaeogene mammals, both large and small (Pickford et al. 2008). Tunisia is well known for its Middle Eocene Chambi fauna (Kasserine) (Crochet 1986, Hartenberger 1986, Hartenberger et al. 1985, 1997a, b, 1998, 2001, Hartenberger and Marandat 1992), but this locality has yielded few large mammals such as *Megalohyrax* (Tabuce et al. 2011).



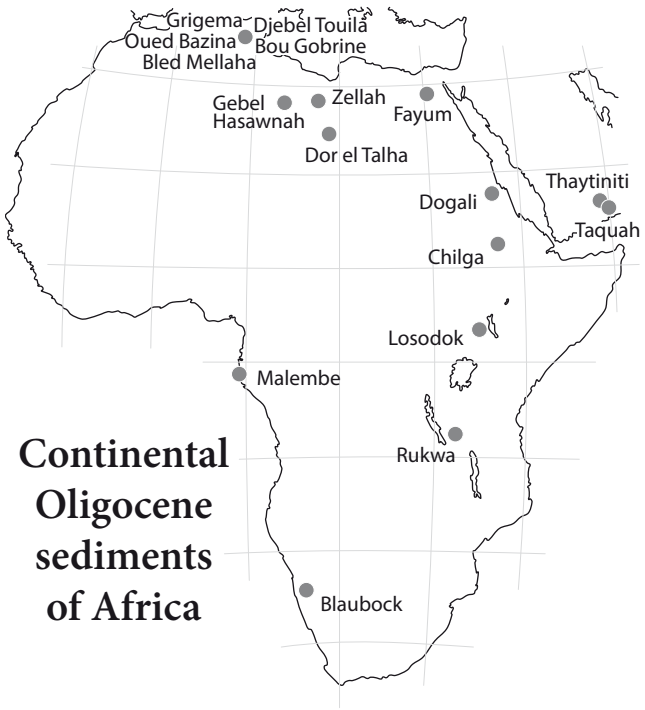
Text-fig. 5. Fossil mammals from the Oligocene of Djebel Bou Gobrine, Tunisia, stored in the ONM Museum, El Charguia, Tunis. a–b) (?)*Phiomia* sp. maxilla containing parts of two upper molars (probably M1/ and M2/) (a – occlusal view, b – buccal view); c–d) anthracothere distal tibia in coarse sand matrix (c – plantar view, d – distal view) (all in scale).

In Tunisia, a few Palaeogene large mammal fossils have been reported from Oligocene deposits at Djebel Bou Gobrine (*Phiomia osborni* and an artiodactyl) (Arambourg 1951, 1963, Arambourg and Burrollet 1962 – fossils in the MNHN, Paris) and Oued Bazina and Bled Mellaha (Jeddi et al. 1991) (*Phiomia*), Djebel Touila (Batik and Fejfar 1990) and Bir Om Ali, not far from Chambi, which yielded large mammal remains attributed tentatively to *Arsinoitherium*(?) (Vialle et al. 2013). The material from Bir Om Ali is reported to be larger than fossils previously included in the genus and it is not out of the question that it might belong to a different large mammal. Herein, large mammals are reported from the Fortuna Sandstone near Grigema (*Arsinoitherium*).

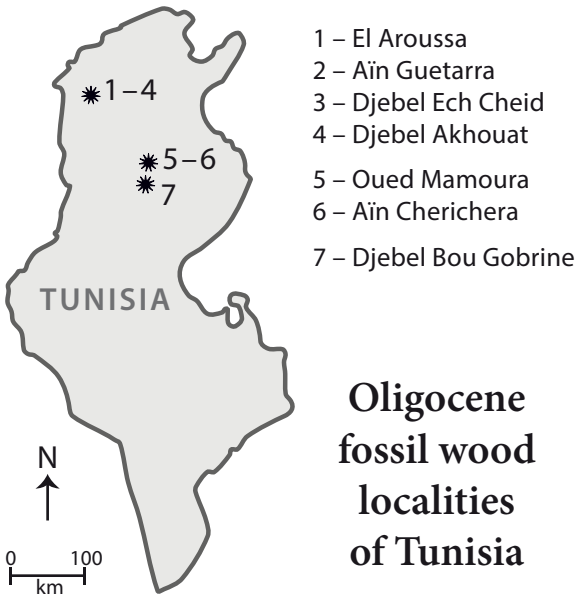
Searches in the collections of the ONM Museum at the Geological Survey of Tunisia, revealed the presence of additional material of Oligocene vertebrates, including a tooth fragment from Bou Gobrine that resembles an incisor of *Barytherium* (Court 1995) but which is too fragmentary for confident identification. The same area also yielded a vertebra of a large crocodile, a proboscidean maxilla fragment containing two damaged trilophodont molars (Text-fig. 5a, b), the dimensions and bunodont crown morphology of which indicate affinities with *Phiomia* rather than with *Palaeomastodon*. There is also a distal tibia of an anthracothere (Text-fig. 5c, d), similar in dimensions and morphology to specimens from the Fayum, Egypt, attributed to *Bothriogenys gorringei* (Andrews and Beadnell 1902, Andrews 1906). The evidence indicates that more focussed surveys might well yield additional vertebrate material.

Palaeobotany

The Oligocene sandstones of Tunisia, especially those at Bou Gobrine, are known for the large quantities of fossil wood that they yield (Text-fig. 7) (Castany 1952, Burrollet 1956). Palaeoxylological research has already yielded impressive results, indicting the former presence in Tunisia of a diverse palaeoflora of tropical to sub-tropical affinities (Tab. 1) (Fliche 1888, Prakash and Boureau 1968, Gottwald 1969, Dupéron-Laudoueneix 1973, Delteil-Desneux and Fessler-Vrolant 1976, Fessler-Vrolant 1976, 1977, 1978, 1979, 1980, Delteil 1981, Biondi et al. 1985, Fessler-Vrolant and Dupéron-Laudoueneix 1986). The sandstones



Text-fig. 6. Distribution of Oligocene continental sediments of Africa, revealing the patchy and incomplete coverage of the occurrences. The Tunisian sedimentary outcrops represent an important resource for the north-western part of the continent.



Text-fig. 7. Oligocene fossil wood localities of Tunisia.

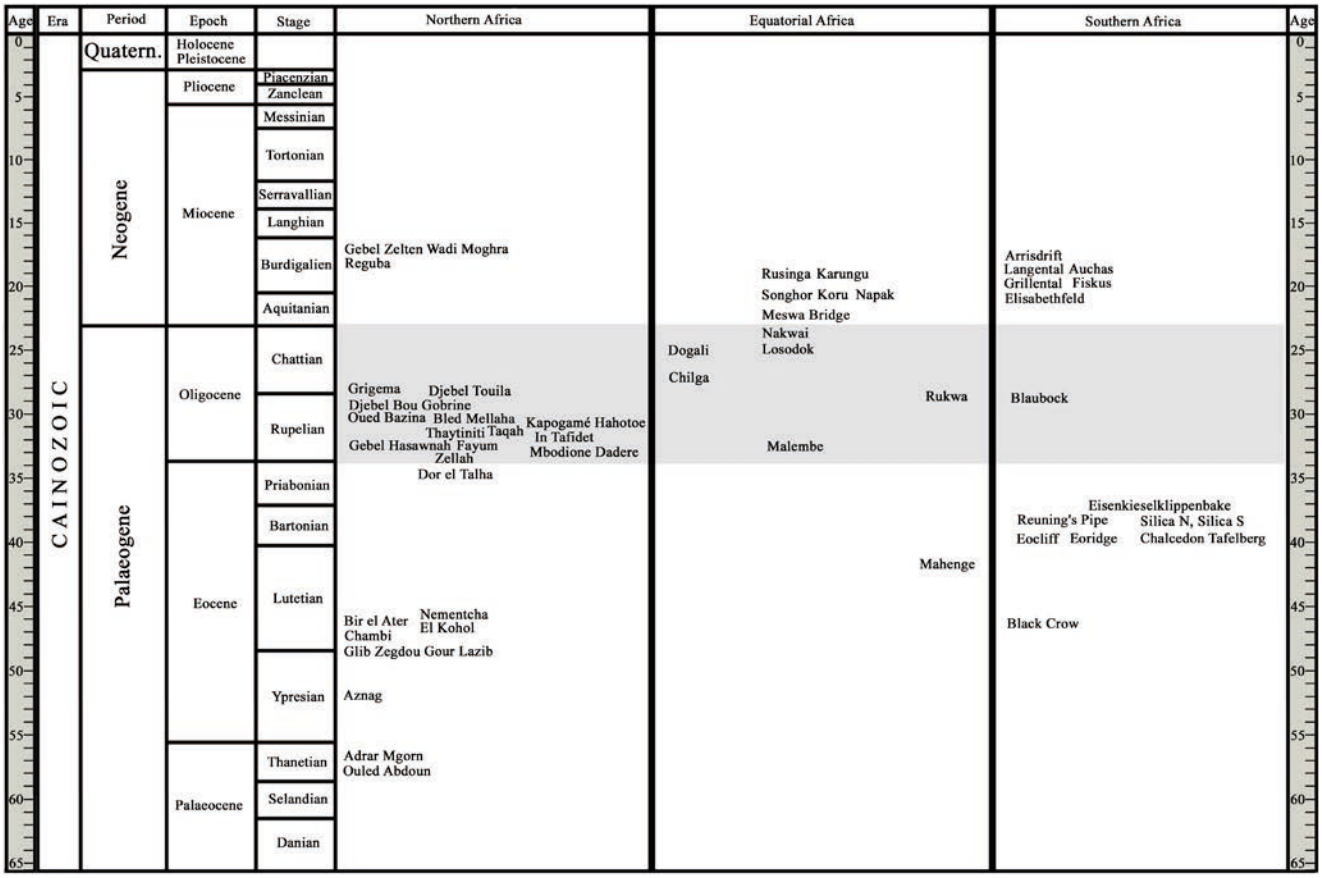
at Grigema have yielded silicified trunks of the fig tree, *Ficoxylon cretaceum* (Castany 1952, Fessler-Vrolant 1979).

Concluding remarks

A programme of study combining palaeobotany and vertebrate palaeontology of the continental Oligocene deposits of Tunisia would be important to undertake because terrestrial deposits of this age are generally poorly represented in the continent (Text-figs 6, 7, 8). This results from the fact that, for much of the Oligocene, sea-level was considerably lower than it is now, resulting in a seawards shift of marginal marine deposition, which as a consequence means that most Oligocene terrestrial deposits of Africa are now well offshore. Neogene Atlasic tectonic activity has brought these strata to the surface in Central Tunisia. The fact that the Tunisian continental Oligocene deposits are underlain and overlain by marine strata (Castany 1952) is important for providing the essential stratigraphic envelope for constraining their age. Castany (1952) considered that the sandstones at Grigema, which yielded fossil wood, were late Oligocene. This suggestion is not impossible, given that arsinoitheres have recently been reported in middle and latest Oligocene deposits elsewhere in the continent (Kappelman et al. 2003, Rasmussen and Guttierez 2009). Clearly, the best way forwards will be to conduct new field work aimed specifically at locating fossil mammals within a well constrained stratigraphic context.

Table 1. List of Oligocene fossil woods described from Tunisia.

Locality	Flora	Reference
Oued Mamoura (near Feriana)	*Bambusites thomasii* Fliche, 1888 *Palmoxylon cossonii* Fliche, 1888	Fliche 1888 Prakash and Boureau 1968
Aïn Cherichera	*Araucaryoxylon aegyptiacum* Kräusel, 1939 *Ficoxylon cretaceum* Schenk, 1883 *Acacioxylon antiquum* Schenk, 1883 *Ebenoxylon* (= *Jordania*) *ebenoides* (Schenk, 1883) *Ebenoxylon tenuetanum* (Fliche, 1888)	Fliche 1888 Fessler-Vrolant 1979
El Aroussa	*Bombacoxylon owenii* (Carruthers, 1870) *Pseudolachnostyloxylon weylandii* Gottwald, 1969	Gottwald 1969
North Tunisia	*Ficoxylon guettarense* Fessler-Vrolant, 1976	Fessler-Vrolant 1976
Djebel Ech Cheid	*Terminalioxylon tunesense* Dupéron-Laudoueneix, 1973 *Terminalioxylon cheidense* Fessler-Vrolant, 1980 *Copaiferoxylon copaiferoides* Fessler-Vrolant, 1977 *Tetrapleuroxylon* aff. *acacia* (Kräusel, 1939) *Hypericoxylon vismioides* Fessler-Vrolant et Starostin, 1979	Dupéron-Laudoueneix 1973 Delteil-Desneux and Fessler-Vrolant 1976 Fessler-Vrolant 1977 Fessler-Vrolant 1980
Djebel Akhouat	*Hypericoxylon vismioides* Fessler-Vrolant et Starostin, 1979	Fessler-Vrolant 1980



Text-fig. 8. Palaeogene terrestrial fossiliferous deposits of Africa. Note the position of the Tunisian Oligocene deposits, and their obvious interest in terms of geographic position and age (data for the Palaeogene of North Africa are from Tabuce et al. 2000, 2001, 2011, Delmer et al. 2006, Coster et al. 2012, Yans et al. 2014, Solé et al. 2016). Note that Nakwai (Kenya) is no longer considered to be Oligocene.

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