

Evidence of iguanodontian dinosaurs from the Lower Cretaceous of Tunisia



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ABSTRACT

The fossil record of ornithischian dinosaurs from Africa is particularly scarce and limited to a few historic localities. In this study we describe new ornithischian remains from the Albian deposits of southern Tunisia (Tataouine Governorate), represented by isolated teeth of large-bodied iguanodontians. Teeth display a wide, diamond-shaped crown with a primary ridge dividing the occlusal surface in two unequal parts and two or more secondary ridges. Hook-like denticles are present on both mesial and distal crown margins and do not display mammillae. In overall morphology, specimens are comparable to those of many Early Cretaceous basal hadrosauriforms, including isolated ornithopodan teeth from comparably-aged levels of Niger. Transversal sections of the crowns permitted identification of dental tissues, which include a thick enamel, and well developed longitudinal and transverse giant tubules. Their relative extents appear to be related to the size, thus developmental age, of the tooth. Teeth are representative of the Oum ed Diab Member, a unit characterized by coastal deposits accumulated under arid to xeric climatic conditions and dominated by fish, crocodylians, and hydraulically transported rebbachisaurid and spinosaurid remains. Sedimentological data and preservation bias strongly support selective taphonomic causes for the fossil distribution of ornithischians in southern Tunisia questioning the purported geographic and paleoecologic distribution of isolated Saharan dinosaurs.

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1. Introduction

The Cretaceous fossil record of the dinosaurian clade Ornithischia underlines remarkable disproportion between Northern and Southern hemispheres: such bias is related to a number of factors, including historical collections and major differences in ecosystems and associated taphonomic parameters. Within Gondwanan landmasses, South America bears the richest diversity of ornithischian taxa, whereas they are surprisingly scarce in Africa (Taquet, 1976; Cooper, 1985; Taquet and Russell, 1999; Weishampel et al., 2004; Maidment et al., 2008; Galton, 2009; Contessi, 2013). Specifically, the mid-Cretaceous record of ornithischians dinosaurs from northern Africa is limited to three taxa discovered in the Echkar

Formation of Niger: the dryosaurid *Elhrazosaurus nigeriensis* (Galton, 2009), the large-bodied ankylopollexians *Lurdusaurus arenatus* (Taquet and Russell, 1999), and *Ouranosaurus nigeriensis* (Taquet, 1976). Here, we describe new iguanodontian teeth from the Lower Cretaceous of the Tataouine Governorate (Fig. 1), adding further information on the diversity and distribution of North African ornithischians. The integration of detailed stratigraphic and sedimentological data for the mid-Cretaceous of Tunisia provide pivotal tools to discuss the paleoecological significance of isolated remains in the Saharan regions.

2. Comparative material

Isolated ornithopod teeth and jaw fragments are relatively common in the Lower Cretaceous beds of Gadaofaoua, Niger, although the literature lacks detailed and comprehensive analyses on the dentition of the recovered taxa. Furthermore, as the vast majority of these specimens were surface collected, pivotal information as detailed stratigraphic occurrence, taphonomy of localities, and co-occurrence of other taxa, is missing. The sole

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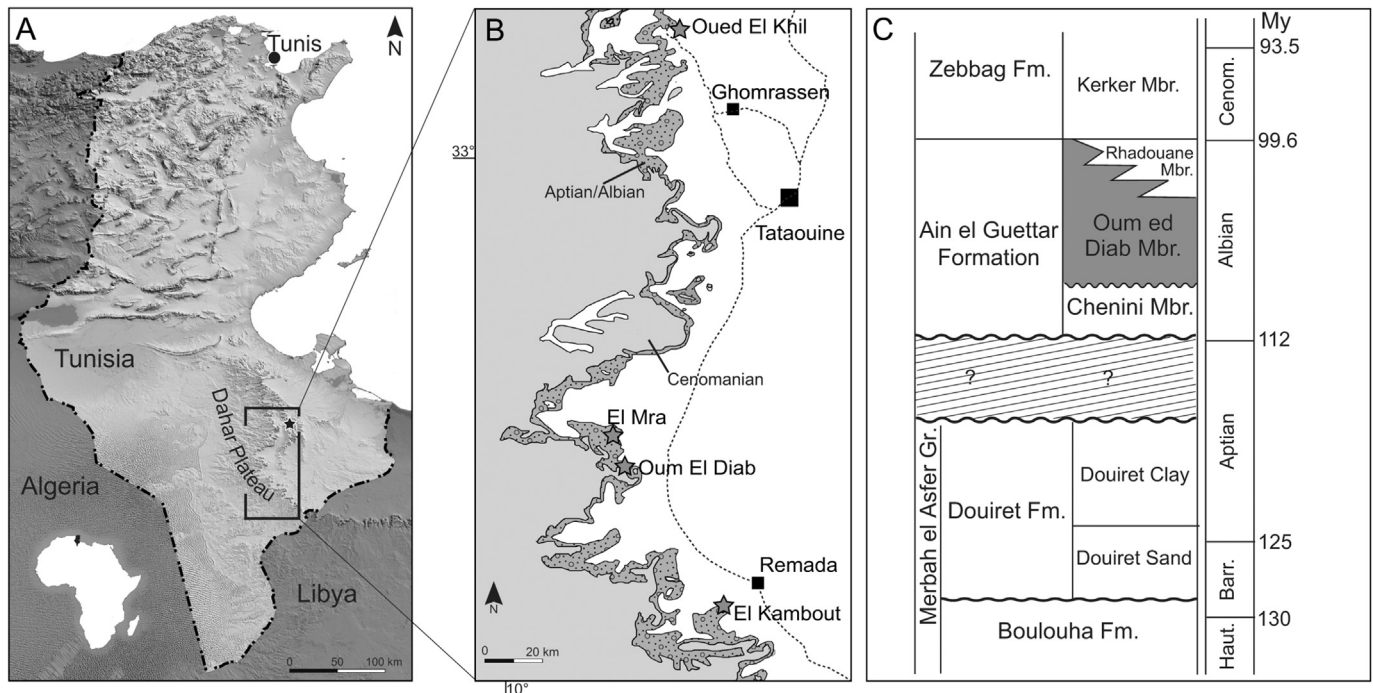


Fig. 1. A, present day reference map of Tunisia showing the location of the Tataouine Basin. B, locality map showing the mid-Cretaceous outcrops located along the prominent Jeffara Escarpment. Stars indicate localities discussed in the text. C, stratigraphic nomenclature and chrono-stratigraphic subdivision for the Cretaceous beds in the study area. Specimens described here were collected from the Albian Oum ed Diab Member.

specimens of *Elhrazosaurus nigeriensis* and *Lurdusaurus* are devoid of complete skull and teeth (Taquet and Russell, 1999; Galton, 2009), and those of *Ouranosaurus* lack detailed information on teeth and variability along the dental series (Taquet, 1976). For this study, we compared the Tunisian material to 14 isolated teeth as well as several lower jaw fragments with *in situ* teeth hosted at the National History Museum in Paris and four isolated teeth housed in the Natural History Museum in Venice collected at the Gadaofaoua locality.

In 1960, De Lapparent reported on an isolated tooth from the Jebel Kambout locality near the town of Remada in the Tataouine Governorate of southern Tunisia (named *Gara Kanboute* in the manuscript) and referred it to *Iguanodon*. The Jebel Kambout locality, located approximately 75 km to the south of Tataouine, has been lately the subject of detailed stratigraphic and paleontological studies (Fanti et al., 2012) allowing the referral of the specimen described by De Lapparent to a specific stratigraphic unit. In fact, De Lapparent (1960, p. 13) states that the tooth was collected ‘at the top of the continental series, only several meters under the marine Cenomanian [English translation from the original French manuscript]’: based on measured field sections at the Jebel Kambout locality, we refer the tooth to the upper deposits of the Albian Oum ed Diab Member (Fanti et al., 2012, 2015a, in press). Unfortunately, the author provided only a brief description supported by a single photograph of the specimen in lingual view (De Lapparent, 1960, Plate V, fig. 23). The tooth, currently housed in the National History Museum in Paris (MNHN.F.HGN167) has a preserved crown approximately 40 mm long apicobasally and 20 mm wide mesio-distally.

Institutional abbreviations: **GAD**, Gadaofaoua locality (Niger) as in the collections of the National History Museum in Paris; **MGGC**, Museo Geologico Giovanni Capellini, Bologna, Italy; **ONM**, Office National des Mines, Tunis, Tunisia.

3. The Oum Ed Diab member

Specimens described in this study are representative of five different localities covering latitudinally more than 100 km in the Tataouine Basin of southern Tunisia (Fig. 1). In the Tataouine Basin, the Albian Ain el Guettar Formation displays variation in terms of facies and overall thickness from north to south (Fanti et al., 2012). Major stratigraphic gaps are represented at the base of both the Chenini and the Oum ed Diab members: the former represents a regional, angular, erosive unconformity, whereas the latter has been interpreted as a transgressive surface responsible for a mixed faunal assemblage representative of both units. The deposition of the Oum ed Diab estuarine/coastal deposits on top of the coarse, wadi-like, alluvial plain beds of the Chenini Member marks a major variation in the paleoecologic – and consequently taphonomic – conditions in the Aptian of Tunisia. With the exception of one tooth possibly representative of the Chenini Member (*sensu* Fanti et al., 2012), they pertain to the sandy deposits of the Oum ed Diab Member of the Ain el Guettar Formation. Stratigraphic and biostratigraphic data from the study area allowed referral of the Oum ed Diab Member and coeval lateral units to the Albian. The deposition of this unit is interpreted as the result of high-rate accumulation of siliciclastic deposits in a vast estuarine to embayment environment dominated by arid to xeric climatic conditions (Fanti et al., 2014a,b, 2015a, in press). This unit is remarkably rich in well-preserved vertebrate remains and it is bounded at the base by a transgressive lag deposit that yielded a diverse fauna that includes elasmobranchs, bony fish taxa, crocodyliforms, and dinosaurs, including carcharodontosaurids, spinosaurids, abelisaurids, and titanosauriforms (Bouaziz et al., 1988; Benton et al., 2000; Cuny et al., 2004, 2010; Sfarfi, 2006; Bodin et al., 2010; Fanti et al., 2014a,b). The overlying finer facies are dominated by crocodylian remains, spinosaurid theropods, and rebbachisaurids (i.e., *Tataouinea hannibal*, Fanti et al., 2013,

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