

## Isolated theropod teeth from the Cretaceous strata of Khouribga, Morocco

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Predatory dinosaur (Theropoda) teeth are described from Khouribga near Casablanca (Ad-Dar al-Bajda) in northern Morocco. A morphological study of specimens shows that two teeth represent the family Spinosauridae. A third tooth shows features characteristic of the genus *Carcharodontosaurus*. These are the first finds of dinosaurs from Khouribga.

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Key words: Morocco, Cretaceous, Theropoda (Dinosauria), Carcharodontosauridae, Spinosauridae.

### INTRODUCTION

Cretaceous dinosaur remains are recorded from several localities in Morocco (Lavocat, 1954; Lapparent, 1960; Monbaron, 1978; Dutuit and Ouazzou, 1980; Taquet, 1984; Buffetaut, 1989a, b; Sereno *et al.*, 1996; Russell, 1996; Jacobs *et al.*, 1996; Kellner and Mader, 1997). Many specimens have been collected, but most are still undescribed.

The Geological Museum of the Polish Geological Institute has a small collection of dinosaur fossils from Cretaceous deposits of northern Morocco. This collection includes two “crocodilian-like” teeth (spinosaurid teeth) and one *Carcharodontosaurus saharicus* tooth. Because of the scarcity of spinosaurid remains from Africa and *Carcharodontosaurus* remains from Morocco, a short description of the material is presented here.

All of the specimens are from Cretaceous deposits in Khouribga 150 km SE of Casablanca (Ad-Dar al-Bajda), northern Morocco (Fig. 1) and were collected from the same locality (Jastrzbski, pers. comm., 1997). Unfortunately, specific location and detailed stratigraphic data are not available. Matrix adhering to the specimens shows that they were preserved in coarse

dark red sandstone. The stratigraphic level of these specimens is Albian or Cenomanian. This is the general age of strata outcropping in this area, the age of the Tegana Formation in the region of Ksar es Souk, where isolated teeth of Spinosauridae have been found, and the biostratigraphic level *Carcharodontosaurus*.

### SYSTEMATIC PALEONTOLOGY

Superorder **Dinosauria** Owen, 1842  
Order **Saurischia** Seeley, 1888  
Suborder **Theropoda** Marsh, 1881  
Family **Spinosauridae** Stromer, 1915  
Genus *Spinosaurus* Stromer, 1915  
*Spinosaurus* sp.

(Figs. 2, 3 and 5A, B)

The two spinosaurid teeth (MUZ PIG 1647.II.1 and MUZ PIG 1674.II.2) are only slightly laterally compressed and have an oval transverse section. They are slightly curved lingually (Fig. 2). MUZ PIG 1647.II.1 (Fig. 2A) is the larger of the two teeth (126 mm long, the base of the tooth measures 34 mm by



Fig. 1. Location of the Khouribga site in Morocco

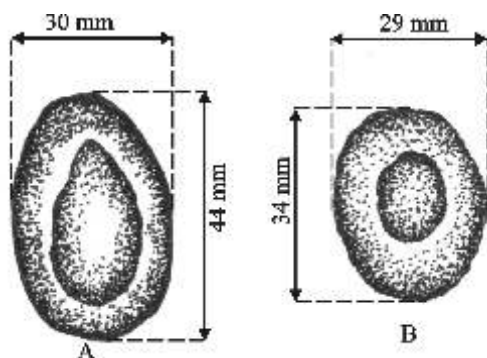


Fig. 3. Transverse section in specimen: A — MUZ PIG 1647.II.2, B — MUZ PIG 1647.II.1

29 mm) and retains part of the root. Specimen MUZ PIG 1647.II.2 (Fig. 2B) is smaller (114 mm long, transverse section at the base 44 mm by 30 mm), has a broken tip, and retains a substantial part of the root. The medial and lateral crown surfaces on the both teeth are ornamented with a series of low, longitudinal ridges (Fig. 2C).

The teeth are different from those of typical tetanurans, which are compressed laterally, recurved, unornamented in most cases, and have serrated edges (Currie *et al.*, 1990; Kellner, 1995, 1996; Abler, 1997; Sander, 1997). They are similar to the teeth of the holotype of *Spinosaurus aegyptiacus* described by Stromer (1915) and teeth described by Kellner and Mader (1997), but are bigger (Fig. 4C). Teeth similar to those of *Spinosaurus aegyptiacus* are found in *Baryonyx walkeri* (Charig and Milner, 1986, 1990) and *Suchiomimus tenerensis* (Sereno *et al.*, 1998). However, *Baryonyx* and *Suchiomimus* teeth are serrated (Fig. 4A, B). This feature is not observed in the specimens MUZ PIG 1647.II.1 and MUZ PIG 1647.II.2.

Spinosaurid teeth are also similar to some crocodylian teeth, particularly those of *Sarcosuchus* or related taxa. The specimens MUZ PIG 1647.II.1 and MUZ PIG 1647.II.2 differ from typical crocodylian teeth in being comparatively longer and narrower.

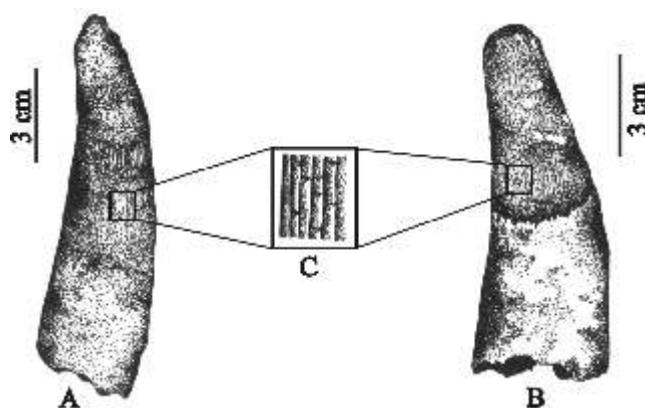


Fig. 2. Isolated spinosaurid (*Spinosaurus* sp.) teeth

The lateral view: A — MUZ PIG 1647.II.1, B — MUZ PIG 1647.II.2; C — magnified view of lateral and medial surfaces shows longitudinal ridges

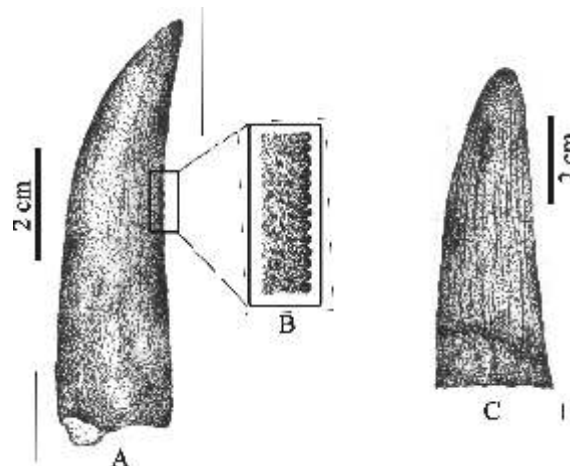


Fig. 4. BMNH R9951 (holotype) *Baryonyx walkeri* (Charig and Milner, 1990): A — isolated tooth in lingual view, B — magnified view of lateral surface margin; specimen LINHM 001, spinosaurid tooth from the Ksar es Souk Province, Morocco (Kellner and Mader, 1997), C — lingual view

Family **Carcharodontosauridae** Stromer, 1931  
Genus *Carcharodontosaurus* Stromer, 1931  
*Carcharodontosaurus saharicus* Depéret  
and Savornin, 1927

(Figs. 5C and 6)

The *Carcharodontosaurus* tooth (MUZ PIG 1647.II.3) is 104 mm long. The posterior margin of the crown is only slightly recurved and becomes convex toward the crown tip. The tooth has enamel ornamentation including transverse bands and arcuate wrinkles near the crown margins (Fig. 6). These tooth features are found in maxillary teeth from the *Carcharodontosaurus saharicus* skull described by Sereno *et al.* (1996) and isolated *Carcharodontosaurus* teeth described



Fig. 5. Teeth from Cretaceous strata of Khouribga, Morocco, housed in the Geological Museum of the Polish Geological Institute, Warsaw

A — MUZ PIG 1647.II.1, spinosaurid (*Spinosaurus* sp.); B — MUZ PIG 1647.II.2, spinosaurid (*Spinosaurus* sp.); C — MUZ PIG 1647.III.3, *Carcharodontosaurus saharicus* (Depéret and Savornin, 1927)

from western Algeria (Depéret and Savornin, 1927), Niger (Lapparent, 1960), Tunisia (Bouaziz *et al.*, 1988) and Sudan (Werner, 1994).

Theropod teeth described herein are the first finds of dinosaur remains at Khouribga and expand the record of dinosaurs from Cretaceous deposits of Morocco.

## DISCUSSION

The first remains of *Spinosaurus aegyptiacus* were collected and described from the Baharija Oasis in central Egypt (Stromer, 1915, 1934). The Egyptian spinosaurid material, including the holotype was destroyed during World War II (Buffetaut, 1989b). New spinosaurid material has been reported recently from Niger and Algeria (Taquet, 1984; Sereno *et al.*, 1998), Tunisia (Bouaziz *et al.*, 1988), and Morocco (Taquet, 1984; Buffetaut, 1989a, b; Russell, 1996; Kellner and Mader, 1997).

Taquet (1984) reported the presence of a possible spinosaurid in the Kem Kem region of Morocco but did not describe the material. The spinosaurid material described by Buffetaut (1989a, b) included an incomplete maxilla from continental red beds near the town of Taouz at the base of the Hamada du Guir plateau.

Russell (1996) described new species of *Spinosaurus maroccanus* from Tafilalt in southern Morocco. Spinosaurid material from Tafilalt included a median cervical vertebrae, dentary fragments and dorsal neural arch. Spinosaurid material described by Kellner and Mader (1997) included two teeth from the Ksar es Souk Province.

The remains of *Carcharodontosaurus* in Morocco were collected from Ksar es Souk Province (Monbaron, 1978), Hammada du Guir (Buffetaut, 1989a, b), Kem Kem (Lavocat, 1954; Sereno *et al.*, 1996).

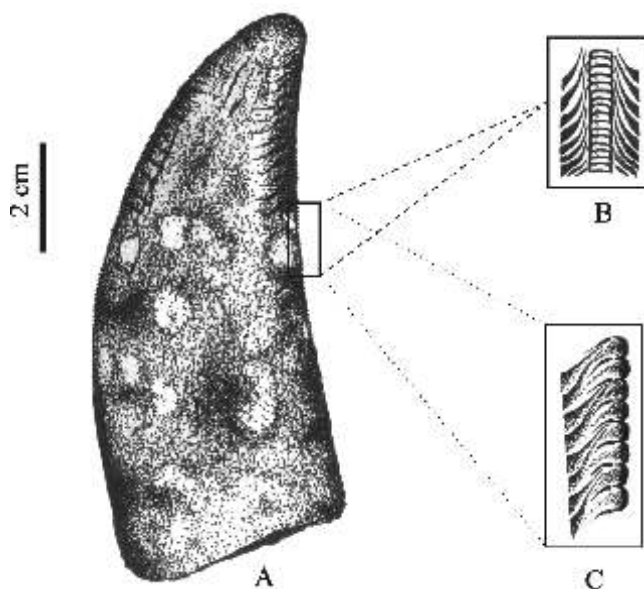


Fig. 6. MUZ PIG 1647.II.3 *Carcharodontosaurus saharicus* (Depéret and Savornin, 1927). A — tooth in lateral view, B — magnified view of the posterior margin, C — magnified view of the margin lateral surfaces

The Khouribga locality needs future research. It may provide more interesting Cretaceous dinosaur remains, including the rare spinosaurid fossils.

**Abbreviations of cited repositories:** MUZ PIG — Geological Museum of the Polish Geological Institute, Warsaw, Poland; LIMHM — Long Island Natural History Museum, New York, USA; BMNH — British Museum of Natural History, London, UK.

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