

EVIDENCE OF ABELISAUROIDAE (CARNOSAURIA: SAURISCHIA) FROM THE LATE CRETACEOUS OF THE PARANÁ BASIN*

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ABSTRACT

Remains of Abelisauridae (fragment of right premaxilla and tooth) were recovered from sandstones of the Adamantina Formation, in a locality in the southwest of São Paulo state. The high energy of the depositional environment is responsible for the fragmented condition of this and other vertebrate remains collected from this locality. There are mentions of other evidence of this family in the Cretaceous of South America, India, Madagascar, and Europe. There could be another indication of Abelisauridae in Brazil, from a locality in Mato Grosso state, including teeth, fragmented ribs, caudal vertebrae, a broken scapula, pubis, tibia, metatarsal, ungual phalanx, and other diverse fragments, apparently from the same individual, deposited in the DNPM Section of Paleontology in Rio de Janeiro. Abelisaurids are considered to be an endemic group of Carnosauria in South America.

The materials motivating this contribution come from locality no. 5 (Santo Anastácio II) of Bertini (1993). It is an abandoned quarry on the outskirts of the city of Santo Anastácio, in southwestern São Paulo state, previously cited in Campos & Castro (1978), Mezzalana (1989), Bertini (1993), and Bertini et al. (1993). This locality consists of medium to thick sandstones and conglomerate beds, reddish to purplish and slightly pink, with silty-clayey matrix and associated pebbles of reddish clay, attributable to the Adamantina Formation (Bertini 1993).

Until now other materials of micro- and macrovertebrates have been recovered from this place, including Lepisosteidae (scales, vertebrae, cranial and maxillary fragments, isolated teeth); Osteoglossiformes (scales); Siluriformes (pectoral and dorsal spines and cranial fragments); *Neoceratodus* sp. (tooth plates); Anura (isolated vertebrae); Testudines (shell fragments); Ophidia (isolated vertebrae); Crocodylomorpha (isolated teeth, including specimens of *Peirosaurus torminni* and *Sphagesaurus huenei*); Theropodomorpha (isolated teeth of Carnosauria and/or Deinonychosauria, fragments of diverse appendicular bones); Sauropoda (isolated teeth); Mammalia (fragment of right mandibular ramus), obtained by means of prospecting and/or **screenwashing** (Bertini 1993, Bertini et al 1993).

Taking into account some of its cranial characters, in accordance with Bonaparte & Novas (1985) and Bonaparte (1985, 1991), Abelisauridae is defined by a tall, elongated, well-fenestrated skull (antorbital fenestra larger than in other Carnosauria, reaching a comparatively more anterior position, a small accessory opening may or may not occur anterior to the fenestra, near the anterior border of the antorbital fossa), four teeth in the premaxilla, some rugosities on the premaxilla and nasals, interorbital region wider than in other carnosaurs, external lateral contact between the lacrimals and postorbitals (forming a supraorbital “roof”), very tall orbital cavity, squamosal with the quadratojugal process directed ventrally and not anteriorly as in Tyrannosauridae, quadrate longer than in tyrannosaurids and fused to the

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quadratojugal, lower temporal fenestra larger than in tyrannosaurs.

To look for phylogenetic links between Abelisauridae and Cretaceous carnosaurids from the Northern Hemisphere (Allosauridae, Tyrannosauridae) would hardly be reasonable, in light of the isolation of our continent during part of the Mesozoic Era (Bonaparte, 1986), reflecting itself in endemism and justifying the anatomical differences. As Bonaparte suggested (1985), there exist affinities between *Abelisaurus* and *Piatnitzkysaurus floresi* from the Jurassic of South America, this last exhibiting plesiomorphic characteristics, from which *Allosaurus* could have been derived in one direction, and Ceratosauridae-Abelisauridae in another. According to current knowledge, the paleogeographic distribution of abelisaurids includes Africa, South America, India, and southern Europe, probably as a result of migratory events from Africa (Bonaparte 1991). The temporal frequency is included between the Albian and Maastrichtian.

The material, recovered from the Upper Cretaceous of São Paulo state and motivating this note, comprises a

fragment of right premaxilla (Fig. 1) and one isolated, possibly associated tooth (Fig. 2), deposited in the Museu de Paleontologia e Estratigrafia da UNESP-Rio Claro, under the numbers URC R-44 and URC R-45, respectively.

The fragment of right premaxilla (Fig. 1) includes a section of the nasal opening and bears four alveoli, observed in palatal view, with the remains of three tooth roots. The internal face of the premaxilla has sediment adhered to it. The area proximal to the teeth and/or alveoli is considerably damaged.

The surface of the premaxilla is irregular and shows a collection of small tubercles, going from the region anterior to the nasal opening inferiorly toward the first preserved alveolus, as can also be observed in the type material of *Abelisaurus comahuensis* (Bonaparte & Novas 1985, Bonaparte 1991). It has a small orifice positioned a little in front of the anterior border of the nasal opening. In the region adjacent to the first and second alveoli is a relatively large tubercle, inclined posterosuperiorly anteroinferior to the nasal opening.

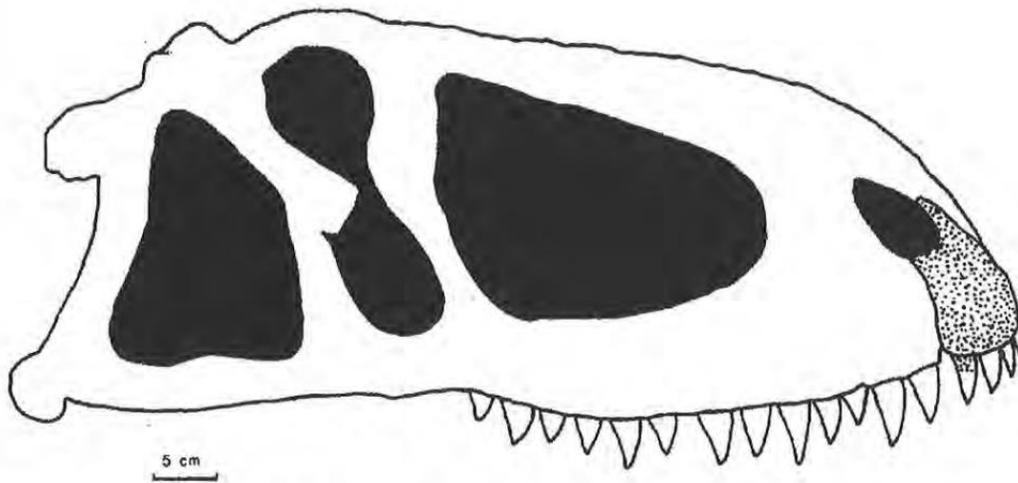


Figure 1 – Approximate position of URC R-44, fragment of right premaxilla of Abelisauridae, in a skull (in right lateral view) of the genus *Abelisaurus* (Bonaparte & Novas, 1985).

The preserved area of the alveoli seems to include the regions of the roots, therefore in the best-preserved alveolus, where the longest tooth fragment is found, we observe bony material involving the entire portion of the remaining tooth. The first of the four preserved alveoli, the previous one, shows only a small fragment of root, the second is lacking any remnant, and the last two show fairly large and significant sections of the roots.

Dimensions: height of the premaxillary fragment (from the inferiormost portion preserved, with the remains of most posterior tooth root that it contains, up to the most superior region preserved, above the nasal opening) = 151 mm;

: length of the premaxillary fragment (from the most anterior portion preserved, anterior to the nasal opening, up to the most posterior region preserved, at the continuation of this opening, above the teeth) = 122.5 mm;

: greatest height (preserved) of the nasal opening (at the most posterior preserved borders) = 76 mm;

The isolated tooth (Fig. 2) seems to represent part of the crown region and was collected a few centimeters distant from the premaxillary fragment, permitting the supposition that it pertained to the same individual. Its dimensions would match that of a portion of the tooth crown if any had been found associated with the abelisaur premaxilla mentioned above.

One of the faces of the isolated tooth (Fig. 2) was found fairly damaged, lacking part of the dentine and enamel, perhaps resulting from transport prior to burial. The anteroposterior length between the serrated edges is practically constant in the proximal two-thirds, and decreases only in the distal one-third.

Dimensions: height (from the most proximal preserved region up to the distal apex) = 58 mm;

: length (between the serrated borders in the anteroposterior direction) = 13 mm.

The worn character of this cranial fragment says much about the manner in which the remains of this carnosaur were transported and deposited. The conglomeratic to thick sandstones, with eventual clay pebbles, shows evidence of intensely energetic water and possible reworking of already consolidated sediments. Corroborating this, only isolated remains of teeth and bony fragments, all highly fragmented, are



Figure 2 – Lateral view of tooth (URC R-45) found near cranial fragment URC R-44, possibly associated, attributed to *Abelisauridae*.

collected in the locality, and up to this moment no sample contains articulated elements.

The characteristic that draws more attention in the skull of *Abelisauridae*, and perhaps no other group of *Carnosauria* exhibits such a conspicuous form, is the intense cranial fenestration, with a very well-developed antorbital fenestra. With specific regard to the premaxillae, these are tall but flat with regard to the four dental alveoli and show profuse rugosities, apparently very typical of the group (Bonaparte & Novas 1985, Bonaparte 1991). Despite the fragmentary aspect of URC R-44, it is a sufficiently flat bony element at the level of the four alveoli or roots of the teeth, and the rugosities are clearly presented.

There are three South American *Abelisauridae*: *Carnotaurus sastrei* Bonaparte, 1985 (upper Albian, Gorro Frigio Formation, Chubut province), represented by a skull and mandibles; *Abelisaurus comahuensis* Bonaparte & Novas, 1985 (lower Maastrichtian, Allen Formation, Río Negro province),

whose type material consists of an incomplete skull; and *Xenotarsosaurus bonapartei* Martinez et al., 1986 (Campanian, Bajo Barreal Formation, Chubut province), based on incomplete hind limbs and vertebrae.

Outside South America: from the Lameta Group, Upper Cretaceous of central India (Madhya Pradesh, Jabalpur localities), *Indosuchus raptorius* Huene & Matley, 1933 was interpreted as Abelisauridae by Bonaparte & Novas (1985) and Bonaparte (1986, 1991), endorsed by Buffetaut et al. (1988) and Molnar (1990); from the same provenance, *Indosaurus matleyi* Huene & Matley, 1933 could be an abelisaur, according to Bonaparte & Novas (1985), Molnar (1990) and Bonaparte (1991). Buffetaut et al. (1988) cite this family for material collected in Provence, southern France. *Majungasaurus crenatissimus* (Déperet, 1896) Lavocat, 1955, from the Upper Cretaceous of Madagascar, was considered as an abelisaur by Molnar (1990) and Bonaparte (1991).

Carnotaurus would be a primitive form, where the antorbital fenestra still does not reach the development observed in *Abelisaurus* or *Xenotarsosaurus*, and other characteristics (such as the morphology of the squamosal and the elongated quadrate) clearly suggest phylogenetic relationships between the three genera (Bonaparte 1991).

In agreement with Bonaparte (1991) there would be two types of cranial morphologies in the family: high and short skull, as observed in *Carnotaurus*; low and elongated skull, exhibited by *Abelisaurus*. The specimen from the Adamantina Formation seems to be closer to this last model, including the presence of four teeth in the premaxilla.

Comparing the dimensions of the cranial fragment in question (URC R-44) with *Abelisaurus comahuensis*, we can speculate that the total size of the skull of this form from the Adamantina Formation would be around 120 cm or a little more.

There remains a brief commentary on the relatively larger proportions, especially the height and significant lateral flattening, of the tooth (Fig. 2) found near the premaxilla, when compared to others produced by the same locality and tentatively assigned to Theropoda.

Other evidence of the family Abelisauridae could exist in the Brazilian Cretaceous. There is the set of bony elements from the Confusão farm, on the left bank of

the river of the same name, approximately 1 km from the bar with the Rio das Garças, Mato Grosso state, collected by geologist Carlos Oiti Berbert in 1971 and deposited in the Paleontology Section of the DNPM under catalogue number DGM 859-R. These materials comprise teeth, rib fragments, caudal vertebrae, the distal portion of a scapula, pubis, tibia, lateral metatarsal, a large ungual phalanx, and other diverse fragments, apparently representing a single individual. The tibia associated with these remains exhibits a prominent cnemial crest, concave laterally and convex internally in the anteroposterior direction, a character typical of Abelisauridae, according to Bonaparte (1991).

The presence of abelisaurids in the Adamantina Formation of São Paulo state, and in terrains associated with the Bauru depositional system of Mato Grosso, reinforces Bonaparte & Novas (1985) and Bonaparte (1985, 1986, 1991), who considered this family as a Gondwanan lineage. The group would have had a long, local, and endemic evolutionary history, thanks to the isolation of South America resulting from the fragmentation of Gondwana. The progressive separation of tectonic plates would conclude by leading to a situation where, from common ancestors, Tyrannosauridae formed a North American and east Asian group, Spinosauridae (and eventually Carcharodontosauridae) dominated in Africa, and Abelisauridae were the predators/scavengers of the South American Cretaceous *par excellence*. Up to the present no other group of carnosaurs from the upper Mesozoic has been registered on our continent.

BIBLIOGRAPHIC REFERENCES

- BERTINI, R. J. 1993. *Paleobiologia do Grupo Bauru, Cretáceo superior continental da bacia do Paraná, com ênfase em sua fauna de amniotas*. Rio de Janeiro. 393 p. (Doctoral Thesis, Universidade Federal do Rio de Janeiro).
- BERTINI, R. J.; MARSHALL, L. G.; GAYET, M.; BRITO, P. M. 1993. The vertebrate fauna of the Adamantina and Marília Formations, Upper Cretaceous of the Paraná Basin, southeast Brazil. *Neues Jahrbuch für Mineralogie, Geologie und Paläontologie*, **188** (1): 71–101.

- BONAPARTE, J. F. 1985. A horned Cretaceous carnosaur from Patagonia. *National Geographic Research* **2**: 63–95.*
- BONAPARTE, J. F. & NOVAS, F. E. 1985. *Abelisaurus comahuensis*, n. g., n. sp., Carnosauria del Crétacico tardío de Patagonia. *Ameghiniana* **21** (2-4): 259–265.
- BONAPARTE, J. F. 1986. History of terrestrial Cretaceous vertebrates of Gondwana. In: IV CONGRESO ARGENTINO DE PALEONTOLOGÍA Y BIOESTRATIGRAFÍA, 4. Mendoza, 1986. *Actas...*, Mendoza, v. 2, p. 63–95.
- BONAPARTE, J. F. 1991. The Gondwanian theropod families Abelisauridae and Noosauridae. *Historical Biology* **5**(1): 1–25.
- BUFFETAUT, E.; MECHIN, P.; MECHIN-SALESSY, A. 1988. Un dinosaure théropode d'affinités gondwaniennes dans le Crétacé supérieur de Provence. *Comptes Rendus de l'Académie des Sciences Paris* **306**, s. 2: 153–158.
- CAMPOS, D. A. & CASTRO, H. E. F. 1978. Localidades fossilíferas da folha Goiânia (SE-22). In: BRASIL. DNPM. *Carta geológica do Brasil ao milionésimo. Folha Goiânia (SE-22)*. Brasília, Departamento Nacional da Produção Mineral, p. 63–72.
- DEPERET, C. 1896. Note sur les dinosauriens sauropodes & théropodes du Crétacé supérieur de Madagascar. *Bulletin de la Société Géologique de France* **24**, s. 3: 176–194.
- HUENE, F. & MATLEY, C. A. 1933. The Cretaceous Saurischia and Ornithischia of the Central Provinces of India. *Palaeontologica Indica* **21**(1): 1–72.
- LAVOCAT, R. 1955. Sur une portion de mandibule de théropode provenant du Crétacé supérieur de Madagascar. *Bulletin du Muséum de l'histoire Naturelle, Paris* **27**, s. 2: 256–259.
- MARTÍNEZ, R.; GIMÉNEZ, O; RODRÍGUEZ, J.; BOCHATEY, G. 1986. *Xenotarsosaurus bonapartei* nov. gen. et sp. (Carnosauria, Abelisauridae), un nuevo Theropoda de la Formación Bajo Barreal, Chubut, Argentina. In: IV CONGRESO ARGENTINO DE PALEONTOLOGÍA Y BIOESTRATIGRAFÍA, 4. Mendoza, 1986. *Actas...*, Mendoza, v. 2, p. 23–32.
- MEZZALIRA, S. 1989. *Os fosseis do estado de São Paulo*. São Paulo, Instituto Geológico, 142 p.
- MOLNAR, R. E. 1990. Problematic Theropoda: “carnosaurs”. In: WEISHAMPEL, D. B. et al., eds., *The Dinosauria*. Los Angeles*. University of California. p. 306–317.

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