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# New abelisaurid remains from the Anacleto Formation (Upper Cretaceous), Patagonia, Argentina

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ABSTRACT

New theropod remains with abelisaurid affinities from the Upper Cretaceous (Anacleto Formation, lower Campanian), NW Patagonia, Argentina, are here described. The specimen (MPCN-PV 69) consists of a partial premaxilla, fragmentary vertebrae, proximal portion of both humeri, distal portion of the pubis, and an incomplete pedal ungual. Characters linking with Abelisauridae are a premaxilla with a subquadrangular body, externally ornamented, and paradental plates with a striated surface; and humerus with bulbous proximal head, conical internal tuberosity, and reduced greater tubercle. The humerus is similar to those of *Carnotaurus* and *Aucasaurus*, due to the presence of a bulbous head and a discontinuity between the head and the internal tuberosity, but also differs from both taxa in the more distal location of the greater tubercle with respect to the internal tuberosity. *Aucasaurus* also comes from Anacleto Formation, but differences in the humeri suggest that MPCN-PV 69 is a different taxon. The phylogenetic analysis performed supports the affiliation to Abelisauridae, but fails to determinate a more precise relationship with others abelisaurids. However, a majority rule consensus of the analysis shows a position within Brachyrostra. Despite being fragmentary, MPCN-PV 69 probably represents a new abelisaurid from the Anacleto Formation, thus increasing the knowledge and diversity of Late Cretaceous South American abelisaurids.



## 1. Introduction

The deposits of the Anacleto Formation (Campanian), in Patagonia, are renowned for their rich content of fossil continental tetrapods, standing out the record of an abundant dinosaur fauna. Sauropods are the most diverse dinosaurs in this unit, which are represented by *Antarctosaurus wichmannianus* (von Huene, 1929), *Neuquensaurus australis* (Lydekker, 1893; Powell, 1986; Salgado et al., 2005), *Barrosasaurus casamiquelai* (Salgado and Coria, 2009), *Rinconsaurus caudamirus* (Calvo and González Riga, 2003), *Overosaurus paradasorum* (Coria et al., 2013), among others. In sedimentary rocks of this formation were also found the extensive nesting sites of sauropods from Auca Mahuevo, together with many eggs with embryonic remains, some of them with casts of the skin (Chiappe et al., 1998, 2000, 2001, 2004; Garrido et al., 2001; Chiappe and Coria, 2004). Ornithischians are represented so far by the ornithopod *Gasparinisaura cincosaltensis* (Coria and Salgado, 1996). On the other hand, unlike many sauropods found in this formation, the record of theropods is scarcer, and only includes the neovenatorid megaraptoran *Aerosteon riocoloradensis* (Sereno et al., 2008) and the abelisaurid *Aucasaurus garridoi* (Coria et al., 2002). Despite the well-known *Abelisaurus comahuensis* (Bonaparte and Novas, 1985) has been considered as belonging to the Anacleto Formation after the inclusion of all dinosaur bearing deposits of the Lago Pellegrini to that unit, it is locally known that the specimen actually comes from the Allen Formation at the Sr. Fernández field, close to Salitral Moreno, Río Negro Province (F. Fernández, pers.

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comm.). Since no witnesses are alive and no field notes were taken, more information is necessary to assess the stratigraphic provenance of this taxon.

In the present contribution we describe the partial skeleton of an abelisaurid theropod that comes from the Anacleto Formation, at the Verdecchia's family field, close to Fisque Menuco (General Roca), Río Negro Province, Argentina. Despite these remains are fragmentary, they probably represent a new taxon, thus increasing the record of abelisaurid theropods from this geological unit.

Abelisauroids are between the most peculiar predatory dinosaurs that lived during the Late Cretaceous in southern continents. They are represented by two morphologically distinct groups (Bonaparte, 1991a). One of them is the still poorly known medium to small-sized noasaurids (Bonaparte and Powell, 1980). These are represented by *Noasaurus leali* (Bonaparte and Powell, 1980), *Masiakasaurus knopfleri* (Sampson et al., 2001), *Laevisuchus indicus* (Huene and Matley, 1933), and *Ligabueino andesi* (Bonaparte, 1996), among other taxa. The second group includes the medium to large-sized abelisaurids, including *Abelisaurus comahuensis* (Bonaparte and Novas, 1985), *Carnotaurus sastrei* (Bonaparte, 1985), *Aucasaurus garridoi* (Coria et al., 2002), *Ekrixinatosaurus novasi* (Calvo et al., 2004a), *Ilokelesia aguadagrandensis* (Coria and Salgado, 1998), *Skorpiovenator bustingorryi* (Canale et al., 2009), *Pycnonemosaurus nevesi* (Kellner and Campos, 2000), *Rugops primus* (Sereno et al., 2004), *Majungasaurus crenatissimus* (Depéret, 1896), *Indosaurus matleyi* (Huene and Matley, 1933), *Rajasaurus narmadensis* (Wilson et al., 2003), *Rahiolisaurus gujaratensis* (Novas et al., 2010), and *Arcovenator escotae* (Tortosa et al., 2013), among others. Some of them are represented by nearly complete skeletons that document extensively the anatomy of the group.

Abelisauroids have been recorded from South America, Africa, Australia, Europe, Asia, Madagascar and India (Carrano and Sampson, 2008) and, despite being recorded from the Middle Jurassic to the Late Cretaceous, they are especially abundant in the Upper Cretaceous strata of southern continents. The deposits of the Anacleto Formation illustrate the last endemic stage of a South American fauna with an exclusive Gondwanan signature (Apesteguía, 2002; Leanza et al., 2004) and thus a high diversity of abelisaurids is expected.

The survey in the study site was performed in a joint effort between the PANGEA Network of Italian Museums, the Agencia Cultura of Río Negro Province, the Museo Argentino de Ciencias Naturales 'Bernardino Rivadavia', and the 'Félix de Azara' Foundation. Later, when founded, the Museo Patagónico de Ciencias Naturales, where materials are now deposited, replaced the last two institutions in the fieldworks.

*Institutional abbreviations.* AMNH, American Museum of Natural History, New York, USA; FMNH PR, Field Museum of Natural History, Chicago, USA; GSI, Geological Survey of India, Calcutta, India; MACN, Museo Argentino de Ciencias Naturales "Bernardino Rivadavia", Buenos Aires, Argentina; MCF-PVPH, Museo Carmen Funes, Plaza Huincul, Neuquén, Argentina; MNN, Musée National du Niger, Niamey, Niger; MPCA, Museo Provincial 'Carlos Ameghino', Cipolleti, Río Negro, Argentina; MPCM, Museo Paleontologico Cittadino di Monfalcone, Gorizia, Italy; MPCN-PV, Museo Patagónico de Ciencias Naturales, General Roca, Río Negro, Argentina; UA, Université d'Antananarivo, Antananarivo, Madagascar; UCPC, University of Chicago Paleontological Collection, Chicago, USA; UNPSJB-PV, Universidad Nacional de la Patagonia "San Juan Bosco", Comodoro Rivadavia, Argentina.

## 2. Systematic paleontology

Theropoda Marsh, 1881
Neotheropoda Bakker, 1986
Ceratosauria Marsh, 1884
Abelisauroidea Bonaparte, 1991
Abelisauridae Bonaparte and Novas, 1985
*Genus et sp.* indet.

## 3. Material

The specimen MPCN-PV 69 (Fig. 1) consists on a small to mid-sized theropod skeleton composed by a partial premaxilla, three probable dorsal vertebrae, fused sacral vertebrae, the proximal half of both left and right humeri, the distal portion of the pubis, and an incomplete pedal ungual phalanx, plus some indeterminate fragments. Due to the grade of fusion of the neural arches to the centra, the specimen corresponds probably to an adult or at least to a subadult. The total length of the skeleton is difficult to specify because it is highly fragmented, but is estimated to be between 3 and 5 m long.

Most of the material was found on surface in a single 4 $m^2$ area at the bottom of a creek along three different years in which the specimen bones were subsequently added by weathering of the origin site. The premaxilla, however, comes from several meters toward the top of the hill, but we consider it as belonging to the same specimen since it was found in the same erosive line and further the preservation is identical to the other bones. No systematic excavation was made in the place and the site of origin was not discovered. Whereas only this area provided theropod remains, the whole fossiliferous area provided the remains of numerous adult and juvenile specimens of titanosaurid sauropods that were not studied yet (Apesteguía et al., 2012).

## 4. Locality and horizon

Verdecchia family field is located 20 km SW from Fisque Menuco (General Roca), Río Negro Province, Argentina (Fig. 1A). The outcrop, found and described by Héctor Leanza in the Geologic Chart General Roca (Hugo and Leanza, 1999), represents a limited exposure with amphitheater structure where outcrops the Anacleto Formation (Río Colorado Subgroup) considered as lower Campanian, Upper Cretaceous (Dingus et al., 2000; Leanza et al., 2004; Garrido, 2010).

The Anacleto Formation is composed by a sequence of continental deposits, mainly sandstones, claystones and concretional limestones (for more detailed geological data see Supplementary Information). The exposed level within this geological unit is not well determined, but was suggested as corresponding to its basal levels (H. Leanza, pers. comm.). The presence of fossil vertebrates in the area was noticed by C. Hugo and H. Leanza during the geological prospection.

The site presents a rich bonebed belonging probably to cf. *Laplatasaurus araukanicus* (Huene, 1929) or *Bonitasaura salgadoi* (Apesteguía, 2004). Turtle shells and a dipnoan tooth plate were also found in the area. The theropod material here studied was found by Mr. Raúl Ortíz in the context of a fieldtrip lead by one of the authors (S. A.) in coordination with the Group Pangea. All the material is housed in the MPCN, at General Roca, Río Negro.

## 5. Results

### 5.1. Description

#### 5.1.1. Premaxilla

The only cranial material recovered belongs to a fragmentary premaxilla, with four teeth preserved still inserted in the corresponding alveoli (Fig. 2). The preserved portion is approximately