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An anilioid snake from the Upper Cretaceous of northern Patagonia

Raúl O. Gómez [a,*], Ana M. Báez [a], Guillermo W. Rougier [b]

[a] *Departamento de Ciencias Geológicas, Facultad de Ciencias Exactas y Naturales, Universidad de Buenos Aires, Pabellón 2, Ciudad Universitaria, C1428EHA Buenos Aires, Argentina*

[b] *Department of Anatomical Sciences and Neurobiology, University of Louisville, Louisville, Kentucky, USA*

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Abstract

We report the first record of anilioids from southern South America, a region where they do not live today. The fossils come from the Allen Formation (Late Campanian–Early Maastrichtian) at Bajo Trapalcó and Bajo de Santa Rosa localities, Río Negro province, Argentina. The remains consist of several vertebrae, most of which belong to the mid–posterior precloacal region of the column. Comparisons to other extant and extinct anilioid taxa indicate that these remains represent a new taxon, *Australophis anilioides* gen. et sp. nov. *Australophis* is morphologically closer to Palaeocene *Hoffstetterella* from Brazil and extant South American *Anilius* than to any other snake. These taxa might be closely related, in which case they would represent a lineage distinct from that including *Cylindrophis* and uropeltids. The two lineages must have diverged by the Late Cretaceous.

Keywords: Serpentes; Anilioidea; *Australophis*; Cretaceous; Patagonia

1. Introduction

Some of the most basal forms among living snakes have traditionally been considered to comprise a distinct lineage, Anilioidea (Rieppel, 1988). The extant South American *Anilius* Oken, 1816 and Asian *Anomochilus* Berg, 1901, *Cylindrophis* Wagler, 1828 and the uropeltids, as well as several extinct taxa, have been referred to this lineage (Rage, 1984). However, in recent morphology-based phylogenetic analyses of snakes, the taxa traditionally recognized as anilioids have been placed basal to all other alethinophidians, although they are not always recovered as a monophyletic taxon (Rieppel, 1988; Kluge, 1991; Cundall et al., 1993; Tchernov et al., 2000; Lee and Scanlon, 2002). Moreover, molecular evidence points to the paraphyletic or polyphyletic nature of 'anilioids' (Vidal and Hedges, 2002, 2004; Wilcox et al., 2002; Gower et al., 2005).

The earliest fossil remains referred to as anilioids are from the Albian–Cenomanian of North America (Gardner and Cifelli, 1999). In South America, the oldest records are from the lower Palaeocene of Bolivia (Muizon et al., 1983; Rage, 1991) and Peru (Rage, 1981), although the presence of anilioids from the Late Cretaceous Adamantina Formation of Brazil has been briefly reported but the material is still undescribed (Zaher et al., 2003). Herein we describe the first Late Cretaceous anilioid remains from southern South America, a location far to the south of their present range. The material consists of a few precloacal vertebrae recovered during the 2004 field season to outcrops of the Allen Formation in northern Patagonia. This expedition was carried out by one of us (GWR) in association with the Museo Municipal de Lamarque.

Institutional abbreviations. AC, Amherst College Museum of Natural History, Massachusetts, USA; DGM, Divisão de Geologia e Mineralogia, Departamento Nacional da Produção Mineral, Seção Paleontologia, Rio de Janeiro, Brazil; MML-PV, Museo Municipal de Lamarque, Río Negro, Argentina.

Anatomical abbreviations: PRW, prezygapophyseal width; CTW, cotyle width; ZW, zygosphene width; CL, centrum

* Corresponding author.
E-mail address: raulgomez@gl.fcen.uba.ar (R.O. Gómez).

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length; MVL, maximum length of vertebra; WIC, interzygapophyseal constriction width.

2. Geological setting

The remains described herein were discovered at the Bajo Trapalcó (39°47′02″S, 66°42′17″W) and Bajo de Santa Rosa (39°54′28″S, 66°34′57″W) localities (hereafter both referred to as the Trapalcó area), which are located near the ranch post "El Matuasto" in the vicinity of the town of Lamarque, Río Negro province, Patagonia, Argentina (Fig. 1).

The snake-bearing rocks belong to the Allen Formation, a unit that is part of the infilling of the Neuquén Basin, one of a series of northwest-southeast trending basins formed by the widespread extension that affected Patagonia in the Early Jurassic (Franzese et al., 2003). Renewed tectonic activity and inversion during the earliest Late Cretaceous resulted in the accumulation of the continental deposits of the Neuquén Group and the lower part of the Malargüe Group (Vergani et al., 1995). The Allen Formation is the most basal unit of the latter group, which also comprises the Jagüel, Roca, and Carrizo formations (Barrio, 1990).

The Allen Formation, formerly known as "Facies Lacustre Senoniana" (Wichmann, 1927), is extensively exposed in the Trapalcó area. This sequence has been informally divided into lower and upper members, which represent a transgressive cycle that ended with the entrance of the Maastrichtian sea documented by the Jagüel deposits (Andreis et al., 1974; Uliana and Dellapé, 1981; Barrio, 1990). The Allen Formation has been interpreted as a nearshore-to-restricted-marine palaeoenvironment (Uliana and Dellapé, 1981). Barrio (1991), however, has drawn attention to differences in the facies associations that he ascribed to diverse tidal ranges related to basin architecture. Thus, while on the eastern part of the basin the facies association may be interpreted as representing intertidal deposits, on the western part this unit exhibits features suggesting a tide-dominated estuary. At the Trapalcó area the lowermost levels, from which the fossils were collected, were deposited in a meandriform fluvial system with channel facies and floodplains (Artabe et al., 2004). These levels comprise an alternation of tabular layers of siltstones and fine-grained sandstones with intercalated conglomerates. The fossil-bearing bed consists of friable, yellowish, fine-grained clean sandstone enclosed between siltstone layers (Fig. 2).

At Bajo de Santa Rosa, one of the several fossiliferous levels of the Allen Formation has yielded abundant, taxonomically diverse vertebrate remains, in addition to the material

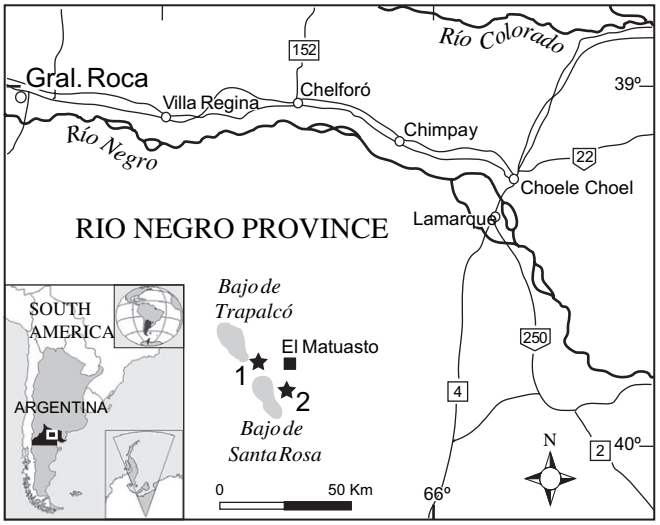

Fig. 1. Map showing the geographical location of the localities were the specimens of *Australophis anillioides* gen. et sp. nov. were discovered. 1, Bajo Trapalcó; 2, Bajo de Santa Rosa.

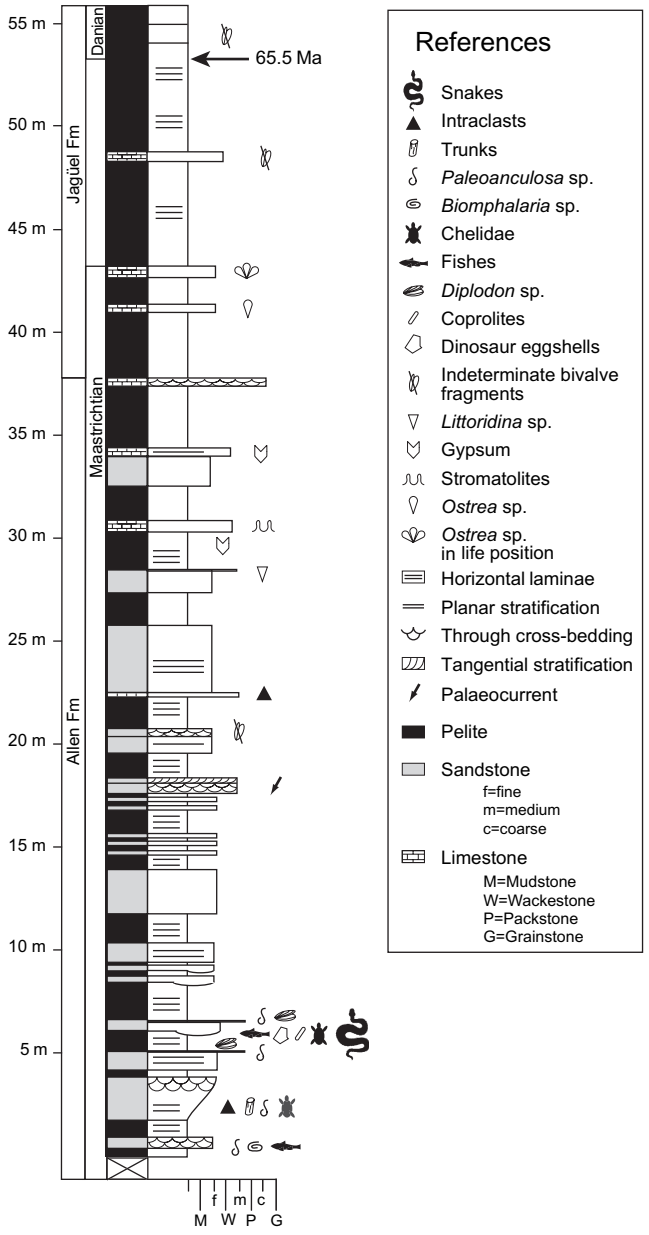

Fig. 2. Upper Cretaceous–Lower Palaeocene stratigraphy at Trapalcó area, showing the position of the snake-bearing bed (modified from Concheyro et al., 2002).