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THE YOUNGEST CROCODYLIFORM RECORD FROM PATAGONIA (CHICHINALES FORMATION, EARLY MIOCENE)

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KEY WORDS:
Crocodyliformes, Patagonia, Miocene, Chichinales Formation.

ABSTRACT:
After K-P extinction, Patagonian crocodyliforms became less diverse, and scarcer in Paleogene layers. The specimen here described comes from “Puerta del Diablo” ranch at the Natural Protected Area of Paso Córdoba, southwestern of General Roca city (Río Negro province, Argentina) and was found in strata from the Chichinales Formation, Early Miocene (Colhuehuapian SALMA). MPCN-PV-174 is represented by an isolated fragment of the posterior region of the skull roof. This fragmentary material is assigned to an indeterminate Crocodyliformes. Previous contributions identified the most recent record of a crocodyliform from Patagonia as coming from the Early Oligocene. The specimen here described indicates that crocodyliforms were still present in the Early Miocene of Patagonia. This suggests that suitable habitats and climate for the existence of crocodilians were still available in northeastern Patagonia, at least.

EL REGISTRO MÁS RECIENTE DE CROCODYLIFORMES EN PATAGONIA

PALABRAS CLAVE:
Crocodyliformes, Patagonia, Mioceno, Formación Chichinales.

RESUMEN:
Después de la extinción del Cretácico-Paleógeno, los crocodiliformes patagónicos son registrados en las capas terciarias de forma menos diversa y escasa. El especimen aquí descrito proviene de la localidad Puerta del Diablo, Área Natural Protegida de Paso Cordoba, sudoeste de la ciudad de General Roca (provincia de Río Negro, Argentina) y fue hallado en capas de la Formación Chichinales, Mioceno Temprano (SALMA Colhuehuapense). MPCN-PV 174 se encuentra representado por un fragmento aislado de la parte posterior del techo craneano. Este fragmentario material es asignado a un Crocodyliformes indeterminado. Las contribuciones previas han identificado el registro más reciente de un crocodiliforme en tiempos del Oligoceno temprano. El especimen aquí descrito indica que los crocodiliformes estuvieron presentes en el Mioceno temprano de Patagonia. Esto sugiere un clima y hábitat adecuado para la existencia de cocodrilos para estos tiempos al menos en el norte de Patagonia.

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O MAIS NOVO REGISTRO DE CROCODILIFORMES NA PATAGÔNIA

PALAVRAS CHAVE:
Crocodyliformes, Patagônia, Mioceno, Formação Chichinales.

RESUMO:
Após a extinção do Cretáceo-Paleogene, os crocodiliformes patagônicos são registrados nas camadas terciárias de maneira menos diversa e escassa. O espécime descrito aqui vem da localidade Puerta del Diablo, Área Natural Protegida de Paso Cordoba, a sudoeste da cidade de General Roca (província de Río Negro, Argentina) e foi encontrado em camadas da Formação Chichinales, Mioceno Precoce (SALMA Colhuehuapense). MPCN-PV 174 é representado por um fragmento isolado da parte traseira do teto craniano. Este material fragmentário é atribuído a um Crocodyliformes indeterminado. Contribuições anteriores identificaram o registro mais recente de um crocodiliforme nos primeiros tempos do Oligoceno. O espécime descrito aqui indica que os crocodiliformes estavam presentes no início do mioceno da Patagônia. Isso sugere um clima e habitat adequados para a existência de crocodilos para esses tempos, pelo menos no norte da Patagônia.

INTRODUCTION

The fossil record in South America indicates that a large diversity of forms, size and behavior of crocodyliforms was present in Gondwanan landmasses, especially during the Mesozoic Era (see CANDEIRO; MARTINELLI, 2006; POL; GASPARINI, 2007; KELLNER; PIHEIRO; CAMPOS, 2014). After the K-P extinction, Patagonian crocodyliforms became less diverse (GASPARINI, 1996), and are represented exclusively by some scarce records of “Sebecosuchia” and Neosuchia (GASPARINI, 1996; DE LA FUENTE et al., 2007). In this regard, Patagonian neosuchians are restricted to Paleocene period, whereas sebecosuchians survive until the Oligocene (GASPARINI, 1996). Later dissapeared from the area and were probably displaced to lower latitudes during Early to Mid-Tertiary probably following tropical climates (GASPARINI, 1984).

The aim of the present paper is to describe an isolated and fragmentary skull bone belonging to a crocodilyform specimen from Early Miocene layers at northern Patagonia. This indicates that these animals were still present in southern landmasses in more recent times than was previously thought and improves our knowledge of the clade in Patagonia.

GEOLOGICAL AND GEOGRAPHICAL SETTING

The specimen here described comes from “Puerta del Diablo” ranch at the Natural Protected Area of Paso Córdoba, southwestern of General Roca city, Río Negro province, Argentina (Fig. 1). This new specimen was found in strata from the Chichinales Formation, Early Miocene (KRAMARZ et al., 2004). This unit is 73 meters in thickness and is composed of whitish to greyish tufts and clays, which overlay in erosive discordance on the Cretaceous Neuquén Group (WINDHAUSEN, 1922; GROEBER, 1929). Fossil remains come from the lower 2.10 m of the lithostratigraphic

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unit (BARRIO; CARLINI; GOIN, 1989). A detailed analysis of the geological context and stratigraphy of the locality was made by Barrio; Carlini; Goin (1989). Its mammalian fauna includes taxa that allow to refer this unit to the Colhuehuapian "South American Land Mammalian Age" (WINDHAUSEN, 1922; GROEBER, 1929; PASCUAL, 1984; BARRIO et al., 1989; VUCETICH; VERZI, 1991; KRAMARZ et al., 2004; PAZ; KRAMARZ; BOND, 2011).

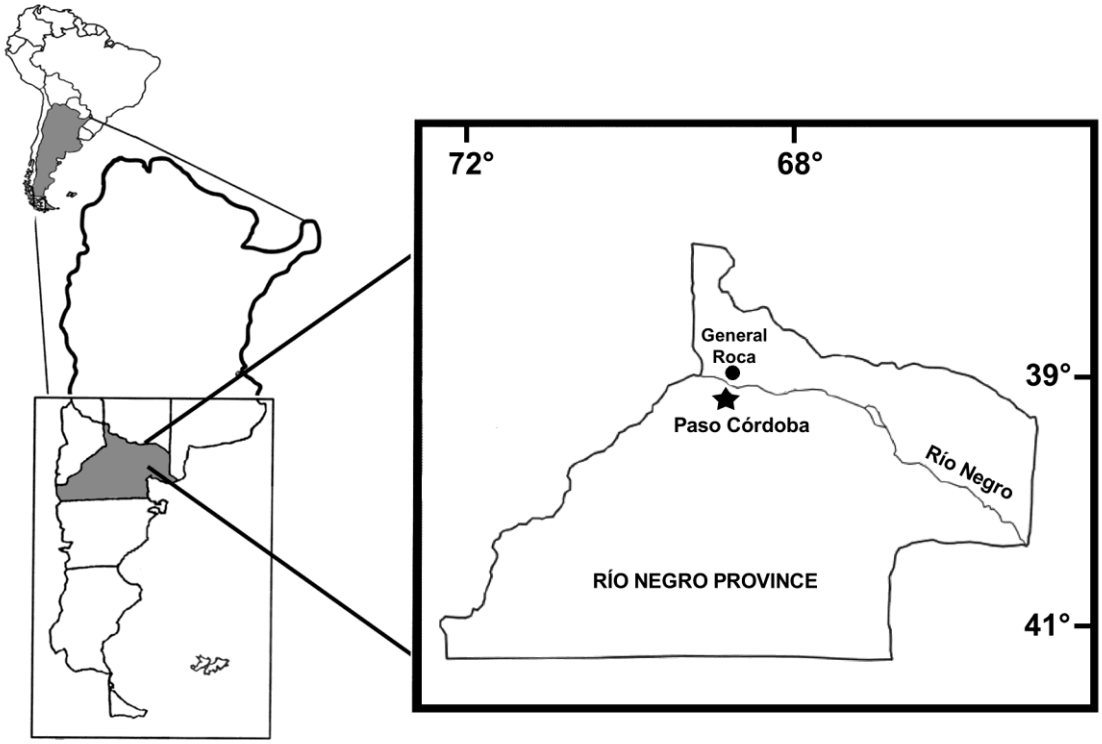

Figure 1. Map showing the fossiliferous locality, the star marks the precedence of the fossils.

SYSTEMATIC PALEONTOLOGY

ARCHOSAURIA Cope, 1869
CROCODYLIFORMES Hay, 1930 (sensu Clark, 1986)
Indeterminate genus and species

Referred material. The specimen here described (MPCN-PV-174)[1] is represented by an isolated fragment of the posterior region of the skull roof.

Description. MPCN-PV-174 consists on a highly incomplete skull roof fragment, which based on its dorsoventral thickness and ornamentation may belong to the squamosal area. The external ornamentation is composed by deep subcircular pits (Fig. 2). The pits are regularly distributed and subequal in size and shape. The pits are

[1] Institutional abbreviations. MPCN-PV: Colección Paleontología de Vertebrados, Museo Patagónico de Ciencias Naturales "Juan Carlos Salgado", General Roca City, Río Negro province, Argentina.

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separated by thick ridges of bone and the bone surface lacks any sign of grooves or crests (Fig. 2). The internal surface of the bone is totally smooth. In lateral view the dorsal suface is gently convex.

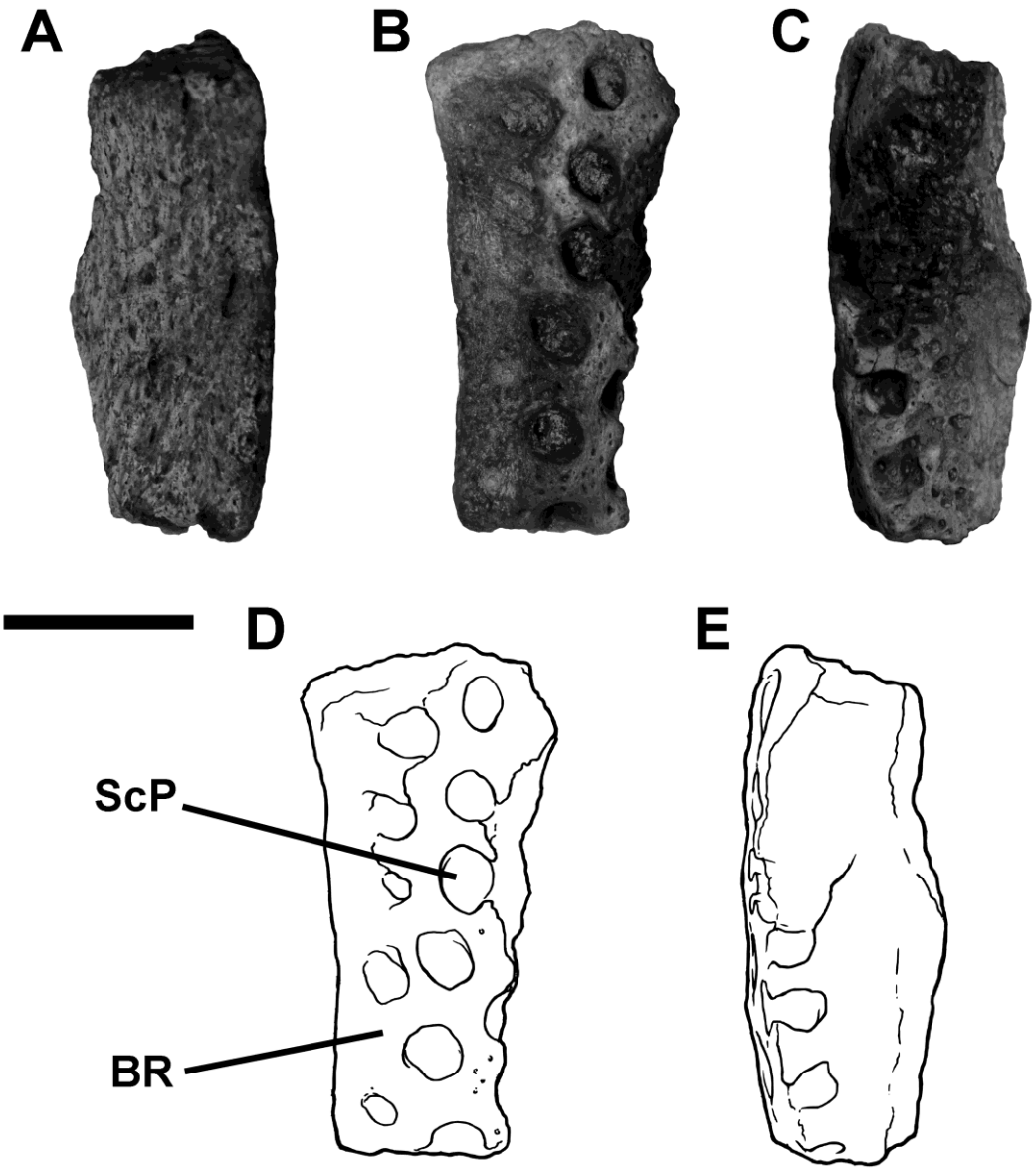

Figure 2. MPCN-PV-174 in **A**, lateral view; **B**, dorsal view; **C**, medial view; **D**, lineal drawing of dorsal view; and **E**, lineal drawing of medial view. **Abbreviations:** ScP, sub-circular pits; BR, bone ridge. Scale bar: 1 cm.

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DISCUSSION AND CONCLUSIONS

The fragmentary specimen here described shows a typical crocodyliform ornamentation composed by pits separated by ridges (ORTEGA et al., 2000; ANDRADE et al., 2011). The specimen may be distinguished from sebecosuchians and most notosuchians with the exception of Araripesuchus and some peirosaurids (ORTEGA et al., 2000; MARINHO; RIBEIRO; CARVALHO, 2006) by lacking a vermiculate ornamentation composed by small fossae and shallow grooves (GASPARINI, 1981, 1984). Regrettably, the incomplete nature of MPCN-PV-174 may be identified as Crocodyliformes indet.

The fossil record of crocodyliforms in Patagonia is relatively abundant. The Cretaceous remains are relatively frequent and well represented by several terrestrial taxa, including Peirosaurids, Baurusuchids, "Sebecosuchians", Notosuchians, and Neosuchians (CANDEIRO; MARTINELLI, 2006; POL; GASPARINI, 2007). The post-Mesozoic record indicates that, after the K-P extinction event, Patagonian crocodyliforms became less diverse (GASPARINI, 1996). In fact, the Tertiary record is relatively scarce, and is restricted to "Sebecosuchia" and Neosuchia (GASPARINI, 1996; DE LA FUENTE et al., 2007). In this context, Gasparini (1984, 1996) identified an isolated frontal bone coming from the Deseadan layers (Late Oligocene) of the Sarmiento Formation of Chubut Province, as the most recent record of a crocodyliform from Patagonia. This author described the specimen as belonging to the Sebecosuchia. Gasparini (1984) considered that the extinction of sebecosuchian crocodyliforms may be the result of a progressive retreat of tropical climates to lower latitudes during the early and mid-Tertiary as have been documented by Pascual; Ortiz Jaureguizar; Prado, (1996), Pascual; Ortíz Jaureguizar (2007), and Baez; Gasparini (1977). Habitat change due to entrance of cold water and different diastrophic events in Patagonia probably caused the regional extinction of crocodyliforms from those areas, whereas they persisted until the Miocene in Perú, Colombia, and probably Venezuela (GASPARINI, 1996). In contrast, the specimen here described indicates that crocodyliforms survived up to Early Miocene times in Patagonia. This suggests that suitable habitats and climate for crocodilians were still available in northeastern Patagonia by Neogene times, at least. This is in agreement with recent evidence, indicating important tropical climatic influence in this portion of the continent by the Miocene, as demonstrated by fossil squamates, birds, and mammals (CENIZO; AGNOLIN, 2010; DEGRANGE; NORIEGA; ARETA, 2012; FERNICOLA; ALBINO, 2012; KAY et al 2012).

Present finding constitutes an important addition to the knowledge of fossil crocodyliforms in Patagonia, and expands the biochron for the entire clade in the area. Further, it suggests that relatively humid and wet oasis existed in Patagonia during early Miocene times, at least.

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