

RESEARCH ARTICLE

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A Pliocene–Pleistocene continental biota from Venezuela

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Abstract

The Pliocene–Pleistocene transition in the Neotropics is poorly understood despite the major climatic changes that occurred at the onset of the Quaternary. The San Gregorio Formation, the younger unit of the Urumaco Sequence, preserves a fauna that documents this critical transition. We report stingrays, freshwater bony fishes, amphibians, crocodiles, lizards, snakes, aquatic and terrestrial turtles, and mammals. A total of 49 taxa are reported from the Vergel Member (late Pliocene) and nine taxa from the Cocuiza Member (Early Pleistocene), with 28 and 18 taxa reported for the first time in the Urumaco sequence and Venezuela, respectively. Our findings include the first fossil record of the freshwater fishes *Megaleporinus*, *Schizodon*, *Amblydoras*, *Scorpiodoras*, and the pipesnake *Anilius scytale*, all from Pliocene strata. The late Pliocene and Early Pleistocene ages proposed here for the Vergel and Cocuiza members, respectively, are supported by their stratigraphic position, palynology, nannoplankton, and ⁸⁶Sr/⁸⁸Sr dating. Mammals from the Vergel Member are associated with the first major pulse of the Great American Biotic Interchange. In contrast to the dry conditions prevailing today, the San Gregorio Formation documents mixed open grassland/forest areas surrounding permanent freshwater systems, following the isolation of the northern South American basin from western Amazonia. These findings support the hypothesis that range contraction of many taxa to their current distribution in northern South America occurred rapidly during at least the last 1.5 million years.

Keywords: Neogene, Neotropics, Northern South America, Urumaco sequence, Paleodiversity, *Megaleporinus*, *Amblydoras*, *Anilius*, Camelidae, *Chapalmalania*

Introduction

During the Miocene, the coastal marine areas of northern South America arid regions of northern Colombia and northwestern Venezuela today were influenced by a complex hydrographic system that flowed mostly from western Amazonia into the Proto-Caribbean Sea (Díaz de Gamero 1996; Hoorn et al. 2010; Aguilera et al. 2013).

Some of the best-known terrestrial and aquatic vertebrate faunas that document the changing biodiversity during that time are preserved in the middle–late Miocene Socorro and Urumaco formations, in northwestern Venezuela (e.g., Sánchez-Villagra et al. 2010). Diverse assemblages of aquatic and terrestrial vertebrates, such as fishes, amphibians, turtles, crocodylians, snakes, and mammals, have been reported from these sedimentary units that accumulated in a coastal plain-delta system (Lundberg and Aguilera 2003; Aguilera 2004; Linares 2004; Aguilera et al. 2006; Hsiou and Albino 2010; Lundberg et al. 2010; Quiroz and Jaramillo 2010; Sánchez-Villagra et al. 2010; Aguilera et al. 2013; Scheyer et al. 2013,

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