



GR Focus Review

A 60-million-year Cenozoic history of western Amazonian ecosystems in Contamana, eastern Peru



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ABSTRACT

We provide a synopsis of ~60 million years of life history in Neotropical lowlands, based on a comprehensive survey of the Cenozoic deposits along the Quebrada Cachiyacu near Contamana in Peruvian Amazonia. The 34 fossil-bearing localities identified have yielded a diversity of fossil remains, including vertebrates, mollusks, arthropods, plant fossils, and microorganisms, ranging from the early Paleocene to the late Miocene–Pliocene (>20 successive levels). This Cenozoic series includes the base of the Huchpayacu Formation (Fm.; early Paleocene; lacustrine/fluvial environments; charophyte-dominated assemblage), the Pozo Fm. (middle + ?late Eocene; marine then freshwater environments; most diversified biomes), and complete sections for the Chambira Fm. (late Oligocene–late early Miocene; freshwater environments; vertebrate-dominated faunas), the Pebas Fm. (late early to early late Miocene; freshwater environments with an increasing marine influence; excellent fossil record), and Ipururo Fm. (late Miocene–Pliocene; fully fluvial environments; virtually no fossils preserved). At least 485 fossil species are recognized in the Contamana area (~250 ‘plants’, ~212 animals, and 23 foraminifera). Based on taxonomic lists from each stratigraphic interval, high-level taxonomic diversity remained fairly constant throughout the middle Eocene–Miocene interval (8–12 classes), ordinal diversity fluctuated to a greater degree, and family/species diversity generally declined, with a drastic drop in the early Miocene. The Paleocene–Pliocene fossil assemblages from Contamana attest at least to four biogeographic histories inherited from (i) Mesozoic Gondwanan times, (ii) the Panamerican realm prior to (iii) the time of South America's

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Cenozoic “splendid isolation”, and (iv) Neotropical ecosystems in the Americas. No direct evidence of any North American terrestrial immigrant has yet been recognized in the Miocene record at Contamana.

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The heavy vegetation in the jungles of eastern Peru conceals rock exposures; travel is possible only along trails; the best and only place to study the geology is along stream beds.

[Kummel (1948: 1221)]

1. Introduction

1.1. Context

The Cenozoic fossil record of northern (tropical-equatorial) South America, particularly the Paleogene interval, consists almost exclusively of small numbers of specimens from scattered outcrops with generally poor age constraints (for a review, see [Hoorn and Wesselingh, 2010](#); [Hoorn et al., 2010a](#)). In contrast to the Patagonian steppe or Andean highlands (see [Flynn et al., 2012](#)), intense vegetation cover, severe surface weathering, and seasonal flooding in Amazonia widely hamper access to extensive exploitable outcrops throughout most of this region.

The first fossils reported from Amazonia were Miocene mollusks from Pebas in Eastern Peru ([Gabb, 1869](#); [Woodward, 1871](#)), a small village east of Iquitos, Loreto Department ([Fig. 1A](#)) which subsequently gave its name to both a Miocene formation and the gigantic corresponding megawetlands system (see [Hoorn et al., 2010b](#) for a review). Subsequently, blue clays and lignite seams from this Miocene formation were

extensively investigated for pollen (e.g., [Hoorn, 1993, 1994](#)), fish ([Monsch, 1998](#)), and mollusks (e.g., [Wesselingh et al., 2002, 2006](#); [Wesselingh and Ramos, 2010](#)). The first fossil insects and mites from western Amazonia were uncovered in amber fragments originating from a late middle Miocene lignite level of the Iquitos area ([Antoine et al., 2006](#); [Petrulevičius et al., 2011](#); [Perrichot et al., 2014](#)). More recently, a species-rich crocodylomorph assemblage (seven species, including three new taxa of shell-crushing caimans) was described from the same seam ([Salas-Gismondi et al., 2014, 2015](#)).

Very few descriptions of fossil vertebrates from other areas of Amazonian lowlands in Peru were published before the 1980s ([Anthony, 1924](#); [Patterson, 1942](#); [Spillmann, 1949](#); [Willard, 1966](#); [Buffetaut and Hoffstetter, 1977](#)). By contrast, many field campaigns were organized in the 1980s and 1990s to search for Neogene and Pleistocene vertebrates, especially mammals, along the Madre de Dios/Acre River ([Fig. 1A](#); [Frailey, 1986](#)). Perhaps the most notable discovery of these campaigns was *Amahuacatherium peruvium*, a gomphotheriid proboscidean of disputed affinities and age, which was unearthed from an outcrop of the Madre de Dios River, near its confluence with the Los Amigos River (= Cerro Colorado section; [Campbell et al., 2000, 2001](#); [Alberdi Alonso et al., 2004](#); [Ferretti, 2008](#); [Campbell et al., 2010](#); [Mothé and Avilla, 2015](#)). Located in a high cliff with extensive landslides, the concerned section ranges from the late Miocene to the late Pleistocene, as constrained by magnetostratigraphy ([Campbell et al.,](#)

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