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The Late Miocene paleogeography of the Amazon Basin and the evolution of the Amazon River system

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ABSTRACT

On the basis of paleontological content (vertebrates and palynology) and facies analysis from river banks, road cuts, and three wells, we have assigned the uppermost levels of the Solimões Formation in western Amazonia, Brazil, to the Late Miocene. The vertebrate fossil record from outcropping sediments is assigned to the Huayquerian–Mesopotamian mammalian biozones, spanning 9–6.5 Ma. Additionally, we present results that demonstrate that deposits in Peruvian Amazonia attributed to Miocene tidal environments are actually fluvial sediments that have been misinterpreted (both environmentally and chronologically) by several authors.

The entire Late Miocene sequence was deposited in a continental environment within a subsiding basin. The facies analysis, fossil fauna content, and palynological record indicate that the environment of deposition was dominated by avulsive rivers associated with megafan systems, and avulsive rivers in flood basins (swamps, lakes, internal deltas, and splays). Soils developed on the flatter, drier areas, which were dominated by grasslands and gallery forest in a tropical to subtropical climate.

These Late Miocene sediments were deposited from westward of the Purus arch up to the border of Brazil with Peru (Divisor Ranges) and Bolivia (Pando block). Eastward of the Iquitos structural high, however, more detailed studies, including vertebrate paleontology, need to be performed to calibrate with more precision the ages of the uppermost levels of the Solimões Formation.

The evolution of the basin during the late Miocene is mainly related to the tectonic behavior of the Central Andes (~3°–15°S). At approximately 5 Ma, a segment of low angle of subduction was well developed in the Nazca Plate, and the deformation in the Subandean foreland produced the inland reactivation of the Divisor/Contamana Ranges and tectonic arrangements in the Eastern Andes. During the Pliocene southwestern Brazilian Amazonia ceased to be an effective sedimentary basin, and became instead an erosional area that contributed sediments to the Amazon fluvial system. At that time, the lowland fluvial systems of southwestern Amazonia (the Purus, Jurua and Javarí basins) become isolated from the Andes by the newly formed north-flowing Ucayali system and south-east flowing Madre de Dios System. It was during the early Pliocene that the Amazon fluvial system integrated regionally and acquired its present appearance, and also when it started to drain water and sediments on a large scale to the Atlantic Ocean.

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1. Introduction

Neogene and Quaternary paleogeographic reconstruction of Amazonia has produced many hypotheses and models (eg. Hoorn 1994b; Campbell et al., 2006. Frailey et al., 1988) with large discrepancies. The only late Tertiary lithostratigraphic unit defined and outcropping in western Brazilian Amazonia is the Solimões Formation, which extends for thousands of square kilometers to the west of Manaus (Fig. 1).

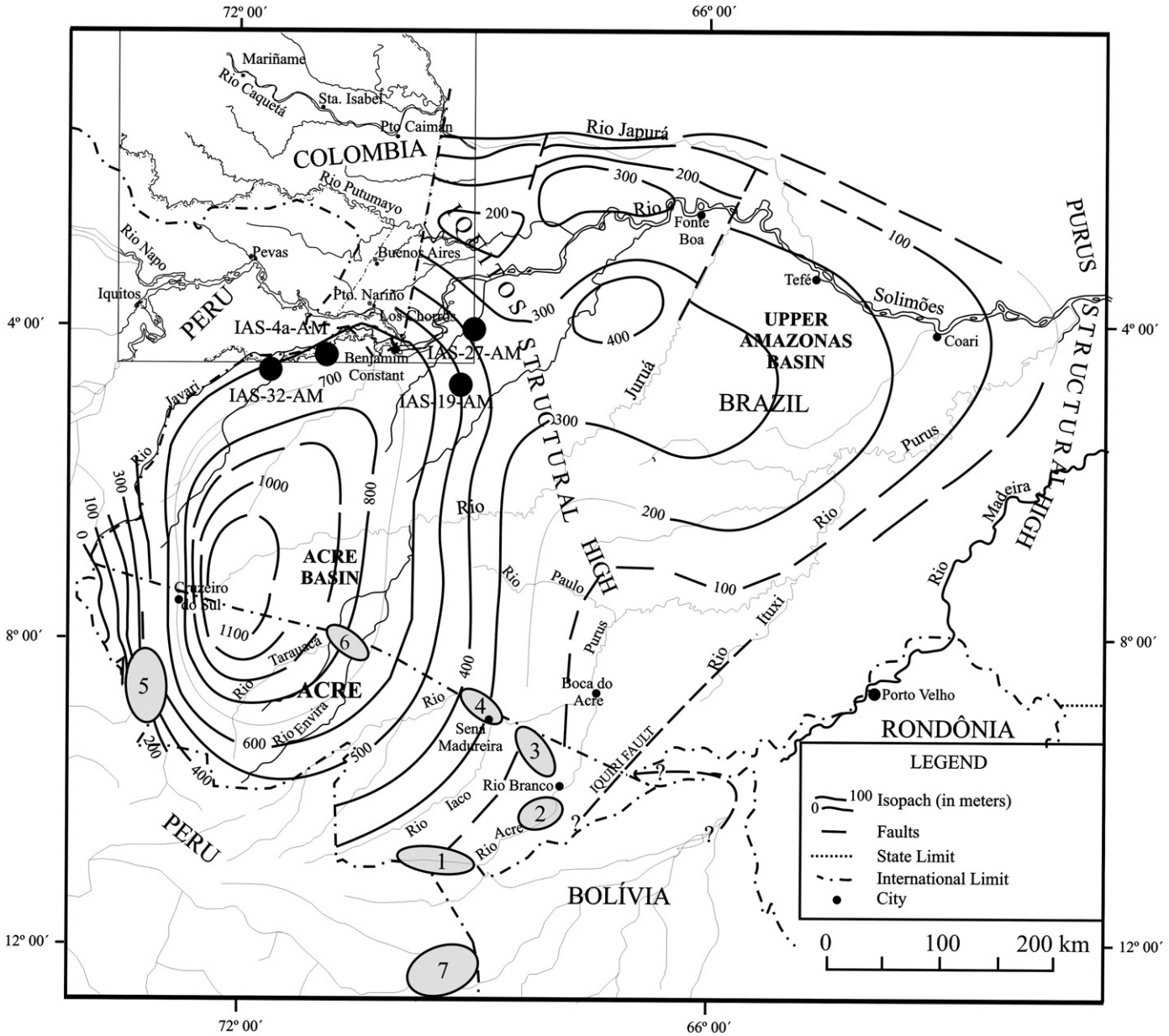

Fig. 1. Isopach map of the Solimões Formation (from Maia et al., 1977) showing the main depocenters and structural highs within the basin. Numbered circular areas indicate main areas with fossiliferous, palynological and /or geological data. 1 = Upper Acre river; 2 = Acre river upstream of Rio Branco; 3 = BR 364 from Rio Branco to Sena Madureira; 4 = BR 364 from Sena Madureira to Manuel Urbano and outcrops along the Iaco and Purus rivers; 5 = Upper Jurua River; 6 = Feijó-Tarauacá area; 7 = Madre de Dios basin. See Table 1 for details. Wells are indicated as 1AS-32-AM, 1AS-27-AM 1AS-19-AM and IAS-4a-AM.