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Paleo-environment in the upper amazon basin during early to middle Miocene times

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The Amazon River has the largest catchment in the world and is responsible for the largest water discharge from land to the ocean. The river system that flows from the Andes to the Atlantic Equatorial Margin exists since the late Miocene, and results from Andean uplift which strongly affected erosion/deposition and major flow patterns in northern South-America.
Two outcrop sites from the Solimões basin, Mariñame (17.7-16.1 Ma) and Los Chorros (14.2-12.7 Ma), may shed light on the inland paleo-environmental conditions during a period of active Andean uplift in the early to middle Miocene. Earlier works revealed the Mariñame outcrops to represent a river born in Amazonia. Instead the Los Chorros outcrops are relics of the Amazon River system, characterized by extensive wetlands consisting of swamps, shallow lakes, crevasse splays channels and crevasse-delta lakes (e.g. Hoorn et al., 2010). The freshwater ecosystems alternate with some intervals that are rich in marine palynomorphs (such as dinocysts), mangrove pollen, brackish tolerant molluscs and ostracods, which indicate brackish conditions and a marine influence. It is thought that these marine incursion are related to phases of global sea-level rise and rapid subsidence in the Andean foreland (Marshall & Lundberg, 1996).
Still, much remains unknown about the Miocene river systems, like the extent and diversity of the wetland system and the nature of the marine incursions. To get a better understanding of the sources of the (in)organic material, geochemical methods were used. Strontium (Sr) and Neodymium (Nd) isotopes were analyzed on bulk sediments, and used for a paleo-provenance study. The Sr and Nd isotopic signature in the older section (Mariñame) is in general more radiogenic compared to the Los Chorros section. The most radiogenic values are comparable to those found nowadays in the the Precambrian Guyana shield. A Guyana sediment source would suggest a distinctly different flow direction of the major rivers during early-middle Miocene. The younger Los Chorros sediments show Sr and Nd values comparable to those nowadays found in the Solimões region, indicating an Andean source existed already during early-middle Miocene times.
Lipid biomarkers were identified and quantified and carbon isotopic compositions of organic matter for whole samples were determined to identify the sources of organic matter. Ratio's between typically terrestrial and aquatic GDGTs indicate shifts between more terrestrial settings and more aquatic settings. Intervals which suggest a more aquatic setting often contain marine palynomorphs and thus could result from a marine incursion at the time. Changes in the overall composition of biomarker lipids at each site reflects the diversity and dynamic features of the wetland. Differences in both provenance and biomarker composition between the two sites demonstrate the diversity within the basin. This diversity could either be geographical diversity since the two sites are located about 380 km from each other. Or, considering the differences in age between the two sites of 2-5 Myrs, it could also reflect the fast changing environmental conditions as a result of Andean uplift.

Hoorn, C. et al (2010). The Development of the Amazonian Mega-Wetland (Miocene; Brazil, Colombia, Peru, Bolivia). In: C. Hoorn and F. Wesselingh (eds) Amazonia: Landscape and Species Evolution: A look into the past. Wiley-Blackwell Publishing Ltd., pp. 123- 142.
Marshall, L.G., Lundberg, J.G. (1996) Miocene deposits in the Amazonian Foreland Basin. Science 273, 123–124.