Forum

Late Miocene onset of the Amazon River and the Amazon deep-sea fan: Evidence from the Foz do Amazonas Basin: COMMENT

COMMENT: doi: 10.1130/G30633C.1

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Figueiredo et al. (2009) analyzed sediments from two cores taken northeast of the mouth of the Amazon River and concluded that the Amazon River formed through a three-stage sequence beginning at 11.8–11.3 Ma. This hypothesis conflicts, in part or wholly, with virtually every other recent proposal regarding the evolutionary history of the Amazon Basin (Campbell et al., 2006). Given the importance of an accurate date for this event, a careful scrutiny of the hypothesis is required.

Figueiredo et al. stated that sediments of Andean origin reached the Foz do Amazonas Basin for the first time between 11.8–11.3 Ma, based on nannoplankton marker species referred to biozone NN9. However, Lourens et al. (2004) date NN9 in the western equatorial Atlantic to ca. 10.55–9.69 Ma. Further, the late Miocene Quechua II phase of Andean uplift began at ca. 10.0 Ma for the Central Andes (Garzione et al., 2008) and the Ecuadorian Andes (Hungerbühler et al., 2002). With no significant rise of the Andes prior to ca. 10.0 Ma, there is no basis for the claim that Andean tectonism initiated formation of the Amazon River at 11.8–11.3 Ma.

Figueiredo et al. state that breaching of the Purus Arch of central Amazonia during their "onset phase" (11.8–11.3 Ma) allowed the first flow of western Amazonian water to the Atlantic. Any hypothesis requiring a role for the Purus Arch in Neogene events of Amazonia must be rejected because it is well known that the Purus Arch is a Paleozoic structure buried beneath hundreds of meters of Cretaceous and Cenozoic sediments (Pedreira da Silva et al., 2003; Barata and Caputo, 2007). The Içá Formation, for which a Pliocene-Pleistocene age is often suggested (Pedreira da Silva et al., 2003), caps the Cenozoic sequence overlying the arch.

Figueiredo et al. describe their onset phase as being prompted, in part, by global sea-level fall. However, a rising sea level had reached nearly modern levels by the beginning of NN9 (Lourens et al., 2004). Global sea level is important because a sea level of ~40–50 m below mean sea level (bmsl) is the threshold value required before sediment can reach the Amazon Fan, as opposed to being distributed northwestward along the coast by the North Brazilian Coastal Current (Maslin et al., 2000). After the beginning of the late Miocene, sea level did not approach ~40 m bmsl again until ca. 3.0 Ma (Hardenbol et al., 1998). Thus, significant deposition of Amazon-sourced terrigenous material on the Amazon Fan could not have occurred between ca. 11.3 and ca. 3.0 Ma.

Figueiredo et al. correlate deposition on the Amazon Fan with terrigenous mass accumulation rates (TMAR) on the Ceará Rise. However, TMAR on the Ceará Rise do not correlate with any of the dates in the sequence proposed by them, as is readily seen in the records of late Miocene TMAR of the Ceará Rise (King et al., 1997). In fact, from the end of the middle Miocene until ca. 8.0 Ma, there is a small, but distinct, overall trend toward a reduction in TMAR on the Ceará Rise (King et al., 1997), the opposite of what would be expected with a growing Amazon River.

Figueiredo et al. used isotopic data to attempt to trace the provenance of the Amazon Fan sediments, defining Andean-sourced sediments as <1.6 Ga in age. However, there is little overlap in Sm or Nd content of their samples (Figueiredo et al., 2009, their appendices 4 and 5) and those interpreted as Andean-sourced by Basu et al. (1990) or McDaniel et al. (1997). Basu et al. (1990) report a mean age of 1.46 Ga for Andean-sourced fluvial sands originally derived from the Brazilian Shield, in contrast to a mean age of 1.59 Ga for late Miocene (Figueiredo et al.) samples, and 1.69 Ga for Pleistocene Amazon Fan muds (McDaniel et al., 1997).

In summary, the hypothesis of a late Miocene (11.88–11.3 Ma) origin of the Amazon River is not supported by the timing of Andean uplift, the structural geology or stratigraphy of central Amazonia, correlation with global sea-level changes, or the composition or age of the sediments analyzed. There remain no data that support a late Miocene origin for the Amazon River. The only available age indicator for the onset of the Amazon River is the Ceara Rise TMAR data set, which suggests that this event occurred at the end of the Pliocene, not in the late Miocene (Campbell et al., 2006).

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