

Interactive comment on “Early Pliocene vegetation and hydrology changes in western equatorial South America” by Friederike Grimmer et al.

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Paper: Early Pliocene vegetation and hydrology changes in western equatorial South America by Grimmer et al.

Reviewer Carina Hoorn

Summary The purpose of the paper is to establish the direction of shift of the ITCZ following the closure of the Central American Seaway (CAS) and uplift of the northern Andes. The paper comprises a palynological study of sediments from the interval between 4.7 and 4.2 Ma of the appropriately situated ODP core 1239A. The specific aims are to reconstruct vegetation, climate and topography in this region throughout this time interval. The conclusion is that an (already) high Andean landscape existed

C1

at the time, and that both vegetation and landscape during this interval match with a scenario corresponding to a southward shift of the ITCZ. Fluctuations of the ENSO are also considered. The results are in accordance with other paleoceanographic data in the region.

Main comments:

There is a shortage of continuous records from the Pliocene in the eastern Pacific that reflect hydrological and climatic change in the region. This paper aims to fill this gap. However, the dataset makes it hard to see the big changes that one would expect from the text. If possible the dataset should be extended with additional data to which are referred in the text.

• The interaction of Andean uplift, closure of the CAS, shifting ITCZ and ENSO altogether make it quite a daunting task to interpret the palynological diagram and assign changes to specific causes. The case is clearly made and looked at from all angles. Question: Is there a chance that some of the subtle changes in the diagram can be related to the Pliocene uplift pulses in the Andes and related atmospheric changes? Such pulses are postulated in tectonic reconstructions (e.g. Anderson et al., 2015, Geosphere) and are mentioned by authors in the paragraph starting at line 464.

• The new dataset further confirm that a high topography (Anderson et al., 2015) and paramo (Bermudez et al., 2015 in Basin Research; Hoorn et al., 2017 in Global & Planetary Change) was in place at least since the early Pliocene. It might be worthwhile highlighting the regional character of this condition?

Note that modern type precipitation patterns are likely to have been in place already from middle Miocene onwards (see Kaandorp et al., 2006; Hoorn et al., 2010; Barnes et al., 2012) and this would have required a significant orographic barrier. A high Andes might go as far back as the mid-Miocene, however, first evidence for a paramo is now set as latest Miocene to early Pliocene. Lines 406-407 could be reconsidered in this context.

C2

â€” The elemental concentrations analysis needs to be better introduced and is currently rather hidden and makes a surprise first appearance in the methods section. In methods also explain why this is a useful additional technique. Part of the text in section 4.3 (line 360 onwards) could be moved to the introduction to explain approach.

â€” The discussion of the Holocene samples in relation to the Pliocene seems a bit ambivalent and does not form a very good guideline to better understand the new results.

â€” Lines from 313: A rather crucial line comes up here and reads as follows: “unpublished data from the earliest Pliocene show that the percentage of lowland rainforest before 4.7 Ma was very low”. The evidence that is presented seems rather subtle and perhaps not iconic for an important vegetation & climate change. The authors allude to data of the earliest Pliocene, which they say strengthen their case. However, they are not visible. If these data belong to the authors it might be timely to include them here (or a selection of them) and make a more compelling case.

â€” A map with the scenarios for the changing ITCZ would be welcome. Instead this could also be added to figure 1.

Minor comments:

â€” In line 465 Hoorn et al. 2010 are listed as backing up a rapid rise of the region since 4– 6 Ma, However we suggest in the mid-Miocene the Andes must have already been high with further uplift at a later stage.

â€” The writing style at places can be somewhat convolute and could do with rephrasing. A suggestion for the opening sentence would be: “The progressive closure of the Central American Seaway (CAS) and the uplift of the northern Andes profoundly re-organized early Pliocene ocean and atmospheric circulation in the Eastern Equatorial Pacific (EEP).”

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