



Comments

Comment on “Dynamic topography in South America” by Federico M. Dávila & Carolina Lithgow-Bertelloni



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ABSTRACT

In their article [Dávila and Lithgow-Bertelloni \(2013\)](#) propose that the Andes have been isostatically uncompensated throughout the Cenozoic and that additional forces induced by mantle flow were required to explain the observed topographies. Although this hypothesis seems plausible, they provide a regional model of “the Bermejo-Pampas foreland of Argentina” which implies that the deposition of the Los Llanos Formation (in La Rioja, NW Argentina) occurred during Miocene. However, this age is incongruent with the presence of a neosauropod nesting site at Sanagasta and a Cretaceous faunal assemblage in Tama both in Los Llanos Formation and well documented in recent publications. Therefore, the proposed model for “the Bermejo-Pampas foreland of Argentina” appears incorrect. Moreover, the Cretaceous exposures at Sanagasta and Tama foster the need of revising the alleged Cenozoic age of the Los Llanos Formation in La Rioja and neighboring provinces, and the tectonic models associated with this formation.

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In their article [Dávila and Lithgow-Bertelloni \(2013\)](#) provide new insights on the Cenozoic topographies in South America. Based on new results and previous regional models these authors propose that the Andes have been isostatically uncompensated throughout the Cenozoic and that additional forces induced by mantle flow (i.e. dynamic topography) were required to explain the observed topographies. Although this hypothesis seems plausible, it is necessary to highlight some geological inconsistencies noted in one of the regional models provided: “the Bermejo-Pampas foreland of Argentina” in the current flat slab segment (27°–34° S.L.). According to [Dávila and Lithgow-Bertelloni \(2013\)](#) dynamic subsidence contributed to a depositional space in the Sierras Pampeanas broken foreland, during the development of the Andean foreland, from Early to Middle Miocene (see figs. 8 and 9 from [Dávila and](#)

[Lithgow-Bertelloni, 2013](#), and also [Dávila et al., 2007](#)). As such, the ~100 m of sub-horizontal deposits of the so called Los Llanos Formation ([Ezpeleta et al., 2006](#)) exposed in the forebulge area (at the key locality of Tama, west margin of the Sierra de Los Llanos, La Rioja, NW Argentina), would be a clear evidence not only of dynamic subsidence, but also of a transition from subsidence to exhumation and uplift throughout the Miocene, associated with the change from normal dipping to flat subduction of the Nazca slab ([Dávila and Lithgow-Bertelloni, 2013](#)).

However, the assumption of a Miocene age for Los Llanos Formation, based on unreliable correlations with Miocene exposures of the Sierras Pampeanas ([Dávila et al., 2007](#)), is questionable and contradicts several seminal publications supporting a Cretaceous age of this formation. It would appear that the geo-paleobiological studies of a Cretaceous neosauropod nesting site with a substantial amount of eggs clutches preserved *in situ* ([Fig. 1](#)) in the Los Llanos Formation exposures at Sanagasta (see [Fig. 2](#) from [Grellet-Tinner and Fiorelli, 2010](#)), in the Sierra de Velasco ([Hünicken et al., 2001; Hünicken, 2005; Tauber, 2007; Grellet-Tinner and Fiorelli, 2010; Fiorelli et al., 2012, 2013](#)) were totally overlooked. The presence of sauropod dinosaurs is incongruent with a Miocene age, as no

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Fig. 1. One of the eighty *in situ* neosauropod egg clutches from the Sanagasta nesting site, in the Los Llanos Formation. The more than 25 eggs are exposed in the field for their exhibition at the Sanagasta Geologic Park.

record of sauropod dinosaurs has ever been substantiated from the Cenozoic. Moreover, the presence of a new and highly diverse terrestrial fauna characterized by turtles, derived notosuchian crocodyliforms, and representatives of the three major dinosaur clades (Fiorelli et al., 2011a, 2011b, 2012), a typical faunal assemblage of Cretaceous ecosystems in Argentina and Brazil, in the Tama exposures further advocate a Cretaceous rather than a Miocene age for the Los Llanos Formation. The recent discovery at the same locality of a Late Cretaceous microfossils association, represented by charophytes and freshwater ostracods [i.e. *Ilyocypris triebeli* Bertels and *Wolburgiopsis neocretacea* (Bertels)] (Carignano et al., 2013), previously known from the Mesozoic Neuquén Basin, Precordillera of San Juan and La Rioja, and the Salta Group, further and independently support a Cretaceous age for these exposures.

Although interesting and probably valid, the model cited by Dávila and Lithgow-Bertelloni (2013) does not reflect properly the geological history of the sedimentary infill at the region comprised (at least) between the Sierra de Velasco and the Sierra de Los Llanos, in the La Rioja province. In light of the paleontological evidence, it is clear that the tectonic activity and linked deposition of the Los Llanos Formation did not result from Miocene geodynamic processes. Finally, the above-mentioned paleontological record (Hünicken et al., 2001; Hünicken, 2005; Tauber, 2007; Grellet-

Tinner and Fiorelli, 2010; Fiorelli et al., 2011a, 2011b, 2012, 2013; Carignano et al., 2013) compels revising the alleged Cenozoic age of the various outcrops assigned to the Los Llanos Formation in La Rioja and neighboring provinces as well as of the tectonic models that emerged from there.

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