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Flexural and gravity modelling of the Mérida Andes and Barinas–Apure Basin, Western Venezuela

Luis Chacín, María I. Jácome *, Carlos Izarra

Departamento de Ciencias de la Tierra, Edificio de Física y Electrónica II, Universidad Simón Bolívar, Valle de Sartenejas, Baruta, Caracas, Venezuela, CP 89000

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Abstract

The kinematic evolution of the Barinas–Apure Basin and the southern Mérida Andes from Lower Miocene to the Present is numerically modelled using flexural isostatic theory and geophysical and geological data. Two published regional transects are used to build up a reference section, which is then used to constrain important parameters (e.g. shortenings and sedimentary thicknesses) for the flexural modelling. To control the location of the main fault system in the flexural model earthquake information is also used. The estimated flexural elastic thickness of the South American lithosphere beneath the Barinas–Apure Basin and the Mérida Andes Range is 25 km. The value for the final total shortening is 60 km. The flexural isostatic model shows that the Andean uplift has caused the South American lithosphere subsidence and the development of the Barinas–Apure Basin.

In addition, gravity modelling was used to understand deep crustal features that could not be predicted by flexural theory. Consequently, the best-fit flexural model is used to build a gravity model across the Mérida Andes and the Barinas–Apure Basin preserving the best-controlled structural features from the flexural modelling (e.g. basin wavelength and depth) and slightly changing the main bodies density values and deep crustal structures. The final gravity model is intended to be representative of the major features affecting the gravity field in the study area. The predicted morphology in the lower crustal level of the final gravity model favours the hypothesis of a present delamination or megathrust of the Maracaibo crust over the South American Shield. This process would use the Conrad discontinuity as a main detachment surface within an incipient NW dipping continental subduction.

Keywords: Mérida Andes; Barinas–Apure Basin; Flexural isostatic modelling; Gravity modelling; A-type subduction; Subsidence

1. Introduction

The Barinas–Apure Basin (BAB) is Venezuela's third largest oil-producing basin. This depression, with an area of about 95,000 km^2 (Martínez, 1976) and a maximum depth of about 5000 m (González de Juana et al., 1980), is located in western Venezuela

* Corresponding author. Tel.: +58 212 9063514; fax: +58 212 9063503.
E-mail addresses: chacin@gmail.com (L. Chacín), mjacome@usb.ve (M.I. Jácome), cizarra@usb.ve (C. Izarra).

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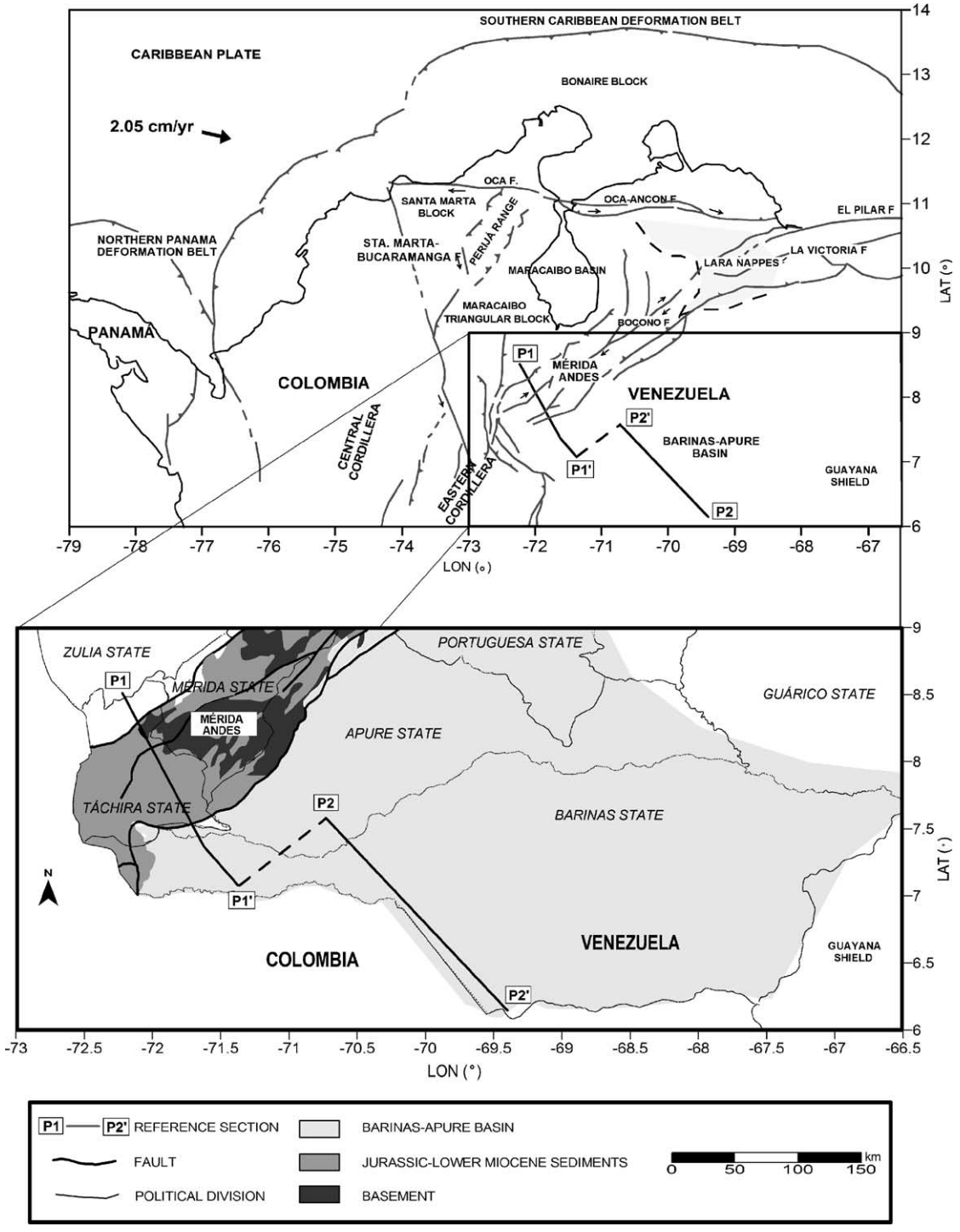

Fig. 1. Above: Present regional tectonic setting of NW South America. The location of the Mérida Andes Range, the Barinas–Apure Basin and section P1–P2 (used in the flexural modelling) is shown. Below: A simplified geological map of the study area (after Case et al., 1990) depicting a regional resemblance between surface geology and exhumed units on section P1–P2 (see Fig. 2).