Active tectonic escape of the northwestern Venezuelan Andes

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Introduction

The Venezuelan -or Mérida- Andes strike N50°E from the colombian border in the SW to the Caribbean sea in the NE. The belt is 100 km wide and its highest summits reach 5000 m in its central part. Uplift of the belt is a consequence of the relative convergence between the triangular-shaped Maracaibo crustal block and the Guyana shield craton belongings to South America.

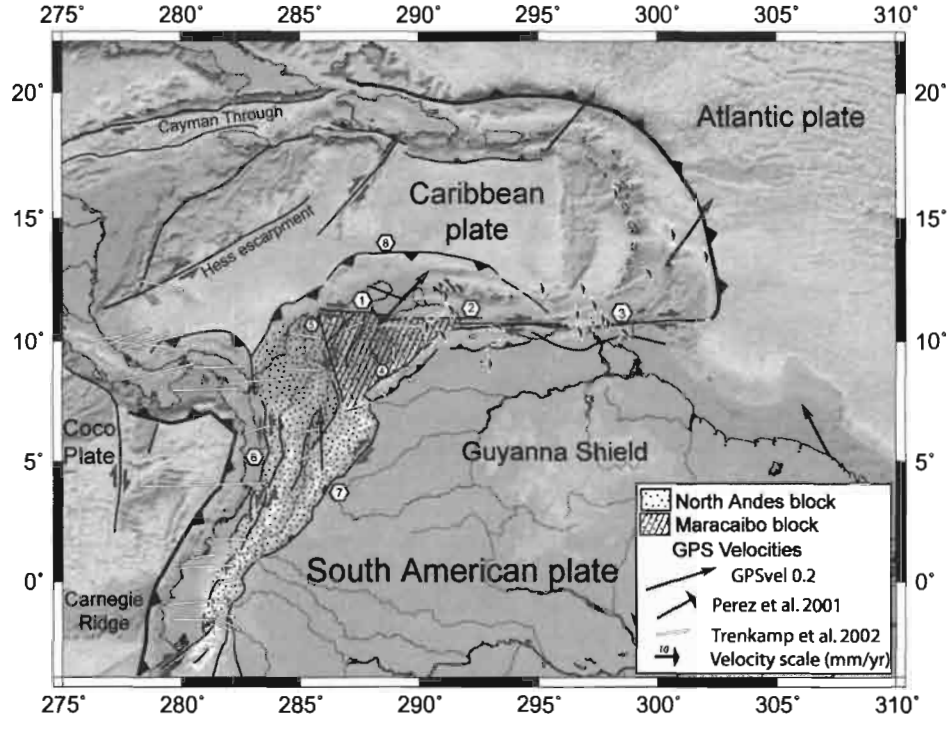

Figure 1: Main structural feature and GPS vector of the northern South America. 1:Oca fault; 2:Ancon fault; 3: El Pilar fault; 4: Bocono fault; 5: Santa Marta-Bucaramanga fault; 6 Romeral fault system; 7: Eastern frontal fault system; 8: South Caribbean subduction zone. See Corredor et al. (2002) for a complete GPS data review.

Recent GPS data acquired in the northern part of South America, show that motion of the Northern Andes block (including the Maracaibo block, the Eastern Cordillera in Colombia and the Andes of Ecuador) is directed NE, obliquely to the E-W relative convergence between the South American and the Nazca plates (Freymuller et al., 1993, Gutscher et al., 1999; Perez et al., 2001; Trenkamp et al., 2002). The Northern Andes block has then been interpreted as an escaping continental block squeezed in an area of intracontinental convergence. The Maracaibo block can be subdivided in a series of smaller triangular crustal wedges bounded by strike-slip faults. The main one corresponds to the Trujillo block, which is bounded by the N-trending left-lateral strike-slip Valera Fault and the N30°E-trending right-lateral strike-slip Bocono Fault (Fig. 1). Structural analysis (Hervouët et al., 2001,

2005; Audemard and Audemard, 2002; Dhont et al., 2005) and GPS data (Perez et al., 2001; Trenkamp et al., 2002; Corredor, 2003) are consistent with motion of the Trujillo block towards the NE to NNE.Our aim is to implement the structural mapping of the central part of the Venezuelan Andes in order to better constrain the kinematics of the area using remote sensing, field structural and available focal mechanism data.

Structural analysis

We have mainly based our study on the analysis of Synthetic Aperture Radar (SAR) scenes of the Japanese Earth Resources Satellite-1 (JERS-1) satellite and Digital Elevation Model shaded images from the Shuttle Radar Topographic Mission launched in 2000.

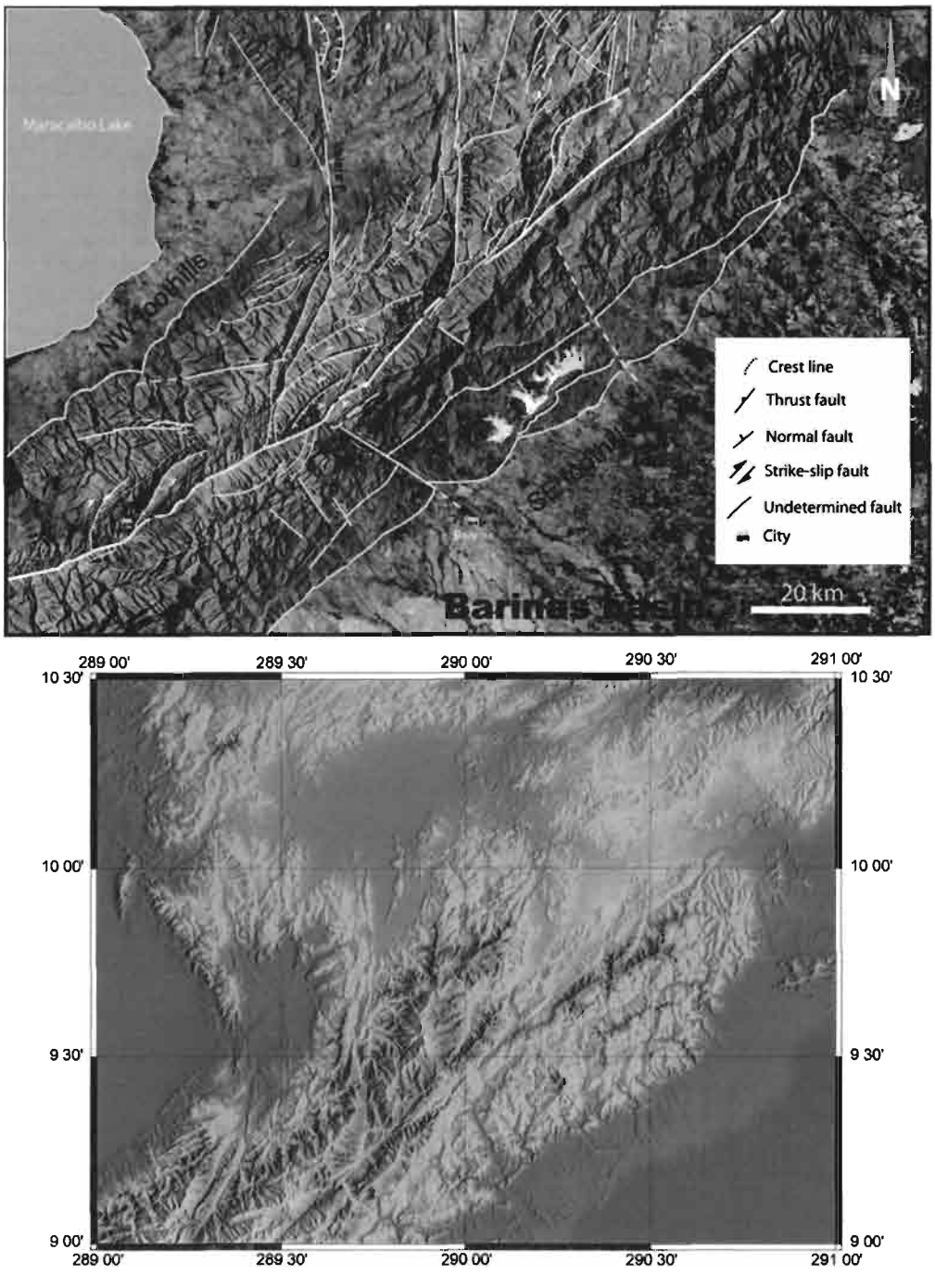

Figure 2: a). JERS-1 radar mosaic of images of the Northern Venezuelan Andes (negative view) and structural interpretation

from analysis of this image and –b) DEM imagery.

These data display the overall width of the belt, whoseboth flanks are overthrusting the northwestern and southeastern foothills. A complex network of faults develops in the Mérida Andes. The most obvious structures are the Bocono, Valera, Burbusay, El Tocuyo, Tuñame and Mucujun faults. In complement to this morphostructural analysis, field work enabled us to discretise three main tectonic stages from the Miocene onwards. The oldest one corresponds to a NW-SE compression, which corresponds to the middle-late Miocene Andean compressional stage. It has been followed by strike-slip tectonics responsible for the formation of mostly N-S to N40° faults (e.g. Valera, Burbusay and Bocono faults). The latest stage corresponds to a global NE-SW extension responsible for the growth of a fault swarm comprising the Tuñame, Jajo, Los Asaderos, El Zamuro, Trujillo, Santa Ana-La Urbina, Loma Pancha and Rio Negro structures. Several drainage anomalies, displacement of Quaternary terraces and geomorphic features attest for a Quaternary extension in the latest stage.

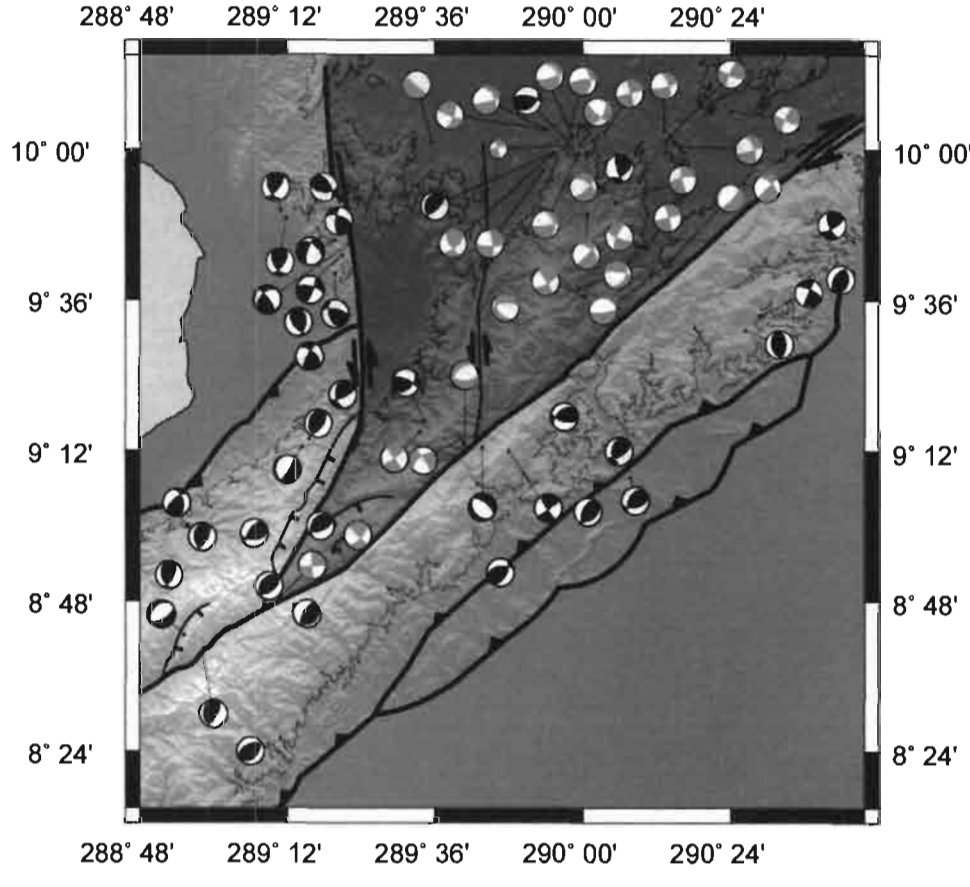

Figure 3: Map of focal mechanism solution for the Northern Venezuelan Andes (see Audemard et al., 2005, for a complete review).

Conclusions

Our structural analysis, along with analysis of the distribution of the seismicity in the central part of the Venezuelan Andes, clearly demonstrate the lateral mass movement of the Trujillo block towards the NE. The Trujillo triangular block is divided in three smaller wedges, moving NE relative to South America taken as a reference. This crustal movement is made possible regarding the lateral escape of the Northern Andes block towards the Caribbean oceanic plate, which probably constitutes a free border.

Acknowledgement

This work has been performed by means of the agreement ULA-UPPA, ULA-PDVSA, and ECOS-Nord project (V00U02). The authors are grateful to J.T. Castrillo, J. Choy and S. Klarica for their help during fieldwork and stimulating discussions on the neotectonics of the Venezuelan Andes.

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