VENEZUELAN ANDEAN TECTONICS REVEALED BY SAR JERS IMAGERY

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KEYWORDS : radar imagery, neotectonics, fault mechanism, pull-apart, extrusion, gravity collapse, Andes

Observations on satellite imagery with 3D (Dimensional) GIS (Geographic Information System) permit to implement the mapping of the large neotectonic structures of the Venezuelan Andes. Radar images are particularly useful for the detection of fault scarps, which can be related either to active faults or to lithologic contrasts because they express sensitive changes in the morphology (Chorowicz et al., 1995; Dhont et al., 2002). A mosaic of Synthetic Aperture Radar (SAR) scenes of the Japanese Earth Resources Satellite-1 (JERS-1) was used for geomorphic analysis at regional scale.

The NE-SW Venezuelan or Mérida Andes (Figure 1) extend from the Colombian border in the SW to Barquisimeto in the NE, and constitute a 100 km wide belt with peaks reaching up to 5000 m. This chain began to uplift in the Miocene, probably as a consequence of the collision of the Panama arc against the South American plate (Audemard, 1993). Uplift of the Mérida Andes accelerated during the Plio-Quaternary due to transpression related to oblique convergence between two independent blocks belonging to the South America plate, the Maracaibo block to the north and the Guyana shield to the south.

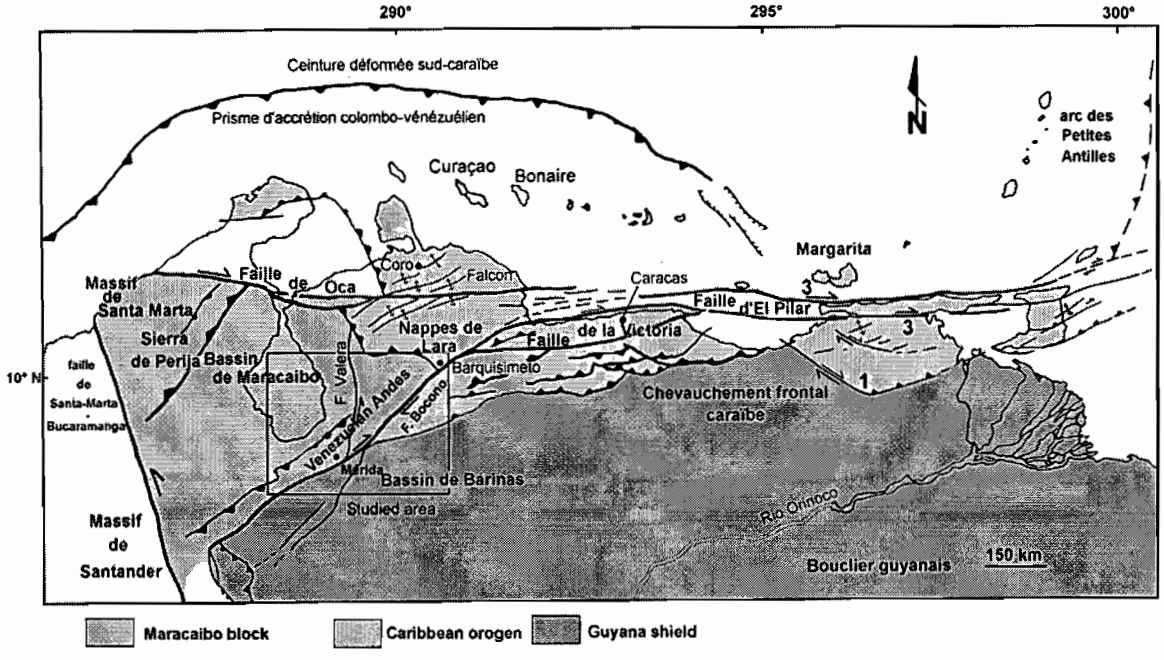

Figure 1. Structural map of the northwestern part of South America and location of the studied area.

Important strike-slip faults are associated to these oblique movements. The right-lateral strike-slip Bocono fault divides the Venezuelan Andean belt in two parts along its NE-trending direction. The N-S left-lateral strike-slip Valera fault is another main accident, which branches to the Bocono fault in a triple-junction geometry. These two faults individualise the Trujillo triangular block (Hervouët et al., 2001), extruded to the NNE as a consequence of the relative convergence between the Maracaibo block and the Guyana shield.

From fault plane solutions of large earthquakes affecting the area (Figure 2), we have plotted the horizontal projections of the slip vectors in these earthquakes, in which the direction of motion is shown of the south side relative to the north (Figure 3). On the southern and northern flank of the Mérida Andes, slip vectors are perpendicular to the belt. Focal mechanisms indicate that gravity collapse occurs within the belt. Slip vectors along the Bocono and Valera faults clearly indicate that they are respectively purely dextral and sinistral. The N-trending El Empedrado fault does not seem active. Within the Trujillo block, slip vectors are directed north to northeast, consistent with NNE lateral escape of the block.

Figure 2. Lower hemisphere fault plane solutions of earthquakes (Harvard cmt, Choy et al., 2000, Audemard and Audemard, 2002) plotted on a Digital elevation Model (pixel size = 5000 m) of the northernmost part of the Andes.

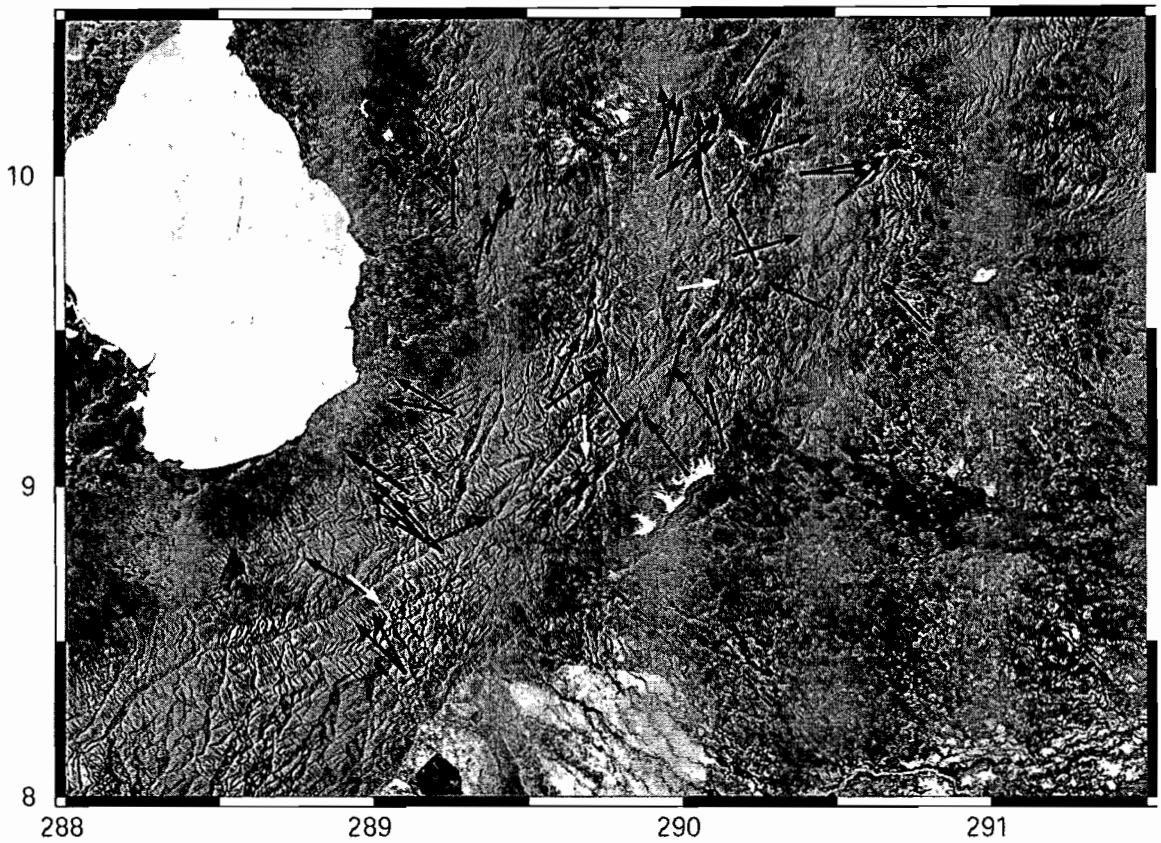

Figure 3. Mosaic of SAR JERS-1 image (negative print, looking west) of the sudied area, and horizontal projections of slip vectors from the earthquakes of Figure 2. White arrows indicate gravity collapse of blocks.

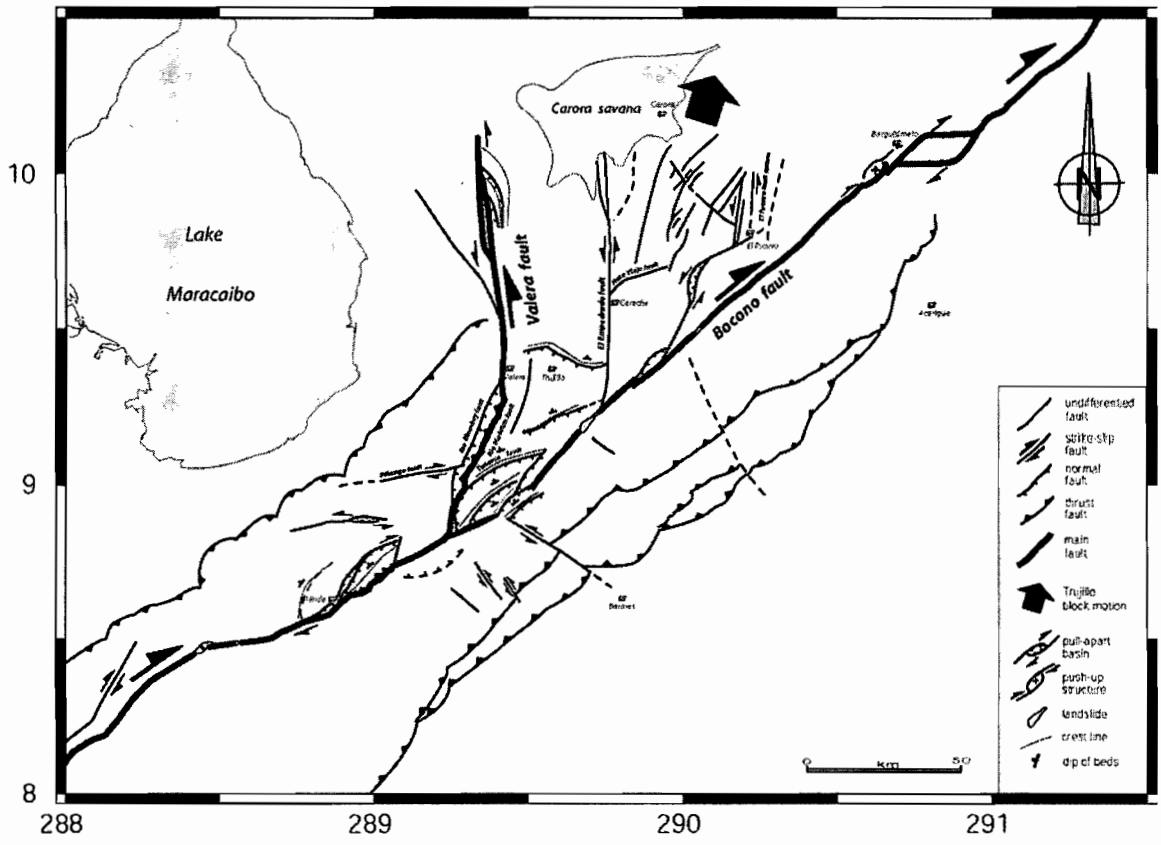

Figure 4. Structural interpretation of the mosaic of radar images of Figure 3.

Radar imagery permit to map precisely the Bocono and Valera faults (Figure 4). The Bocono fault is a continuous but broken line bordered by pull-apart and push-up structures. Pull-apart basins constitute troughs where gravity collapse can occur. We have been able to map collapse structures with dimensions reaching several tens of kilometres along the Bocono and Valera faults. These structures initiate by means of listric faults having a curved trace in plan view. The Tuñame and Rio Momboy faults are interpreted as normal faults bounding such collapse structures. Others can be observed north of Mérida along the Rio Mucujun and at the northern end of the Valera fault. Radar imagery shows that Trujillo block is intensively deformed within the Barbacoas area, consistent with active seismicity of this area.

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AKNOWLEDGEMENTS

This study has been made possible by means of the agreement ULA-UPPA, ULA-PDVSA, the ECOSNORD project (V00U02) and the SPOT ISIS program