Neogene-Quaternary deformation in the northern part of the Venezuelan Andes from satellite imagery analysis

Guillaume Backé, Damien Dhont, Yves Hervouët

UMR 5831 : Imagerie Géophysique, Université de Pau et des Pays de l'Adour, Avenue de l'Université, BP 1155, 64013 Pau cedex, France, mail: guillaume.backe@univ-pau.fr

The NE-SW Venezulan or Mérida Andes extend from the Colombian border in the SW to Barquisimeto in the NE, and form a 100 km wide belt with peaks reaching 5000 m in its central part. This belt began to rise in the Miocene, probably as a consequence of the collision between the Panama arc against the South American plate. Uplift of the Mérida Andes accelerated during the Plio-Quaternary due to transpressional tectonics related to oblique convergence between two independent blocks belonging to the South American plate: the Maracaibo block to the north and the Guyana shield to the south. The Andean stage in this area corresponds to the building of the Mérida Andes. The northern part of the Venezuelan Andes is superimposed to the E-trending Caribbean belt, which uplifted during the late Cretaceous-Eocene as a consequence of the collision between the South American and Caribbean plates (Carribean stage). Important strike-slip faults are associated to these oblique movements. The right-lateral strike-slip Bocono fault cut the Venezuelan Andes in two parts along the axial part of the belt. 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, extruded to the NNE as a consequence of the relative convergence between the Maracaibo block and the Guyana shield. The seismicity is well expressed at block boundaries but also occurs within the blocks themselves. However, the present-day geodynamic setting is still poorly defined, partly because of the lack of kinematic data.The study area is located at the junction between the Mérida Andes and the Caribbean mountain belt. This is a key area to understand the transition between these two belts. Our aim is to implement the structural mapping in order to propose a new model of deformation at regional scale. The methodology is based on satellite images analysis. We use Landsat TM, Spot panchromatic and radar JERS-1 scenes to obtain detailed structural information in this area of high vegetation cover.

This analysis was complemented by interpretations of fault-plane solutions of earthquakes, seismic lines and structural field data permitting the analysis of these complementary data set into a GIS. We focused on three main areas where the structures are clearly exposed. In the Mene Grande area, our structural analysis allows us to precise the geometry and timing of deformations. The morphology of the Cerro la Galera anticline is that of a fault bend fold propagating to the SW. This fold developped along the Burro Negro fault during the Eocene-Oligocene and then eroded. At the local scale, the geometry of the Cerro La Luna (or Cerro Misoa) is that of a pop-up structure that developped during the Andean stage. In the Jirajara area located in the northern part of the Valera fault, we have evidenced a releasing-bend basin at left-stepping offset of the fault. To the east, this basin is surrounded by the relief of the Serrania de Jirajara composed by sediments of Eocene age forming flat-lying structural surfaces cut by curved scarps. These scarps are interpreted as normal faults bounding blocks tilted toward the lowland of the basin. In the Sierra de Barragua area, we have mapped the Rio Diquiva fault lying 25 km east of of Valera fault and parallel to it. This fault is a major structure bounding two distincts areas of sedimentation during the Eocene. Andean motion along this fault is sinitral as evidenced by drag folds in the Sierra de Barragua.

These observations show that the kinematic behaviour of the Trujillo block is not the behaviour of a rigid block simply extruded by forces applied at its boundaries by the adjacent plates. On the contrary, it shows that the Trujillo block is composed by a mosaic a crustal blocks with dimension of ~50 km in width, that move relative to each other.