8th International Symposium
on Andean Geodynamics
(ISAG)

Quantifying relative rock uplift along the ecuadorian coastal margin: an example on the use of high-resolution topographic data

M. Valarezo[1], P. Reyes[1], O. Dauteuil[2], F. Michaud[3, 4], A. Cisneros[3]

[1]Departamento de Geología, Escuela Politécnica Nacional, Quito, Ecuador

[2]UMR-CNRS 6118 Géosciences Rennes, Université de Rennes 1, UEB, 35042 Rennes Cedex, France

[3]Institut de Recherche pour le Développement (IRD). Whymper 442 and Coruña, Quito, Ecuador

[4]Université Pierre et Marie Curie (UPMC, Géoazur), Villefranche sur Mer, France

Ecuadorian Coastal Region represents an inner-shelf assemblage underlain by an allochthonous oceanic terrane accreted to the NW South American margin during the Upper Cretaceous. Basement rocks consist of an incomplete ophiolitic sequence composed of gabbro and basalt. Cenozoic infilling is arranged into local sedimentary basins (e.g. Progreso, Manabí and Borbón Basins) as thick marine sequences alternating with pulses of tectonic deformation and uplifting that lead to the present-day surficial morphology. Although numerous studies have taken into account the litostratigraphy of this region, little emphasis has been placed on quantitative geomorphologic studies along the Ecuadorian margin.

Quantitative geomorphology provides useful tools to determine tectonically perturbed areas. River profile analysis by digital elevation model (DEM) treatment allows to track changes in tectonic movements, lithological variations and climatic influence in erosion patterns. We propose a new surface plotting method to determine relative incision anomalies (RI) along the entire coastal margin using incision data obtained from stream channel elevation and valley width measures. Numerical data were fitted to each lithology group to evaluate the mean incision deepening throughout the study area. The present methodology uses different source of data such as DEMs, geological maps, aerial photographs and field observations.

In this work, we have established zones with differential vertical motion. High RI values are reported to the central and northern part of the Ecuadorian region. For instance, localities such as La-Delicia, Jama, Viche, and Cristobal-Colón show greater RI values than the mean lithology constraint between +197 and +214. However, southern areas such as El-Progreso and Guayaquil show rather lower RI values of about -224, -238, respectively. These results suggest significant crustal shortening to the northern Ecuadorian coastal region, while lateral fluvial erosion processes are predominant to the south (Chongón-Colonche Massif and Progreso Basin).

By comparing our results with those reported by Nocquet et al. (2014) and Bejar-Pizarro et al.(2018), who use extended GPS and InSAR data along the entire coastal continental margin, it is shown that the method developed herein is a very sensitive tool to the detection of the relative vertical surficial movement.

Nocquet, J.M., Villegas-Lanza, J.C., Chlieh, M., Mothes, P.A., Rolandone, F., Jarrin, P., Cisneros, D., Alvarado, A., Audin, L., Bondoux, F. and Martin, X., (2014). Motion of continental slivers and creeping subduction in the northern Andes. Nature Geoscience, 7(4), p. 287.

Béjar-Pizarro, M., Álvarez Gómez, J., Staller, A., Luna, M., Pérez-López, R., Monserrat, O., Chunga, K., Lima, A., Galve, J., Martínez Díaz, J. and Mateos, R., (2018). InSAR-based mapping to support decision-making after an earthquake. Remote Sensing, 10(6), p. 899.