Subduction versus crustal tectonics impact on southern ecuadorian margin: quantification and modelling of marine terraces uplift rates. Towards long term interseismic coupling pattern.

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Abstract

A purely elastic model predicts a null deformation budget over one seismic cycle and then does not contribute to relief building (Savage, 1983; Okada, 1992). The along-strike long-range pattern of permanent coastal uplift we observe in numerous convergent margins contradicts this model, suggesting more complex rheological earth structure models. Several studies suggest a link between the upper plate deformation and frictional properties on the plate interface. In order to better understand this relationship, we have studied 4 sites along the southern Ecuadorian margin (from 0◦55' to 3◦55'). For these areas, we quantified the permanent deformation by the morpho-tectonic (study of marine terraces) and drainage basins analyses of the coastal deformation. In addition, we tested the modeling of the development of marine terraces by three independent methods to reproduce the actual coastal morphology and quantify uplift rates. Our results are robust and strongly supported by several approaches, from field observations, morpho-tectonic analysis to modeling. We deliver a new and accurate morpho-tectonic map of coastal uplift and active faults, and a pattern of coastal uplift rates along the southern Ecuadorian margin. In contrast to previous studies, we propose that the southern Ecuadorian margin (from 0◦55' to 2◦42') is uplifting with a quite homogeneous rate (_˜0,4 mm/a). Variations in the uplift rate are local and suggest the influence of local tectonic activity and/or deep processes related to the subduction zone (e.g., subduction of seamounts, splay faults, local changes in the interplate characteristics, etc). We calculated an equivalent interseismic coupling model from the inversion of uplift rates data for the southern Ecuadorian margin. It shows that 18% of the seismic cycle deformation is converted into permanent deformation. The equivalent interseismic coupling model and the interseismic coupling model calculated from the inversion of GPS data match quite well. The good correlation between the two interseismic coupling models suggests that

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coastal morphology, and marine terraces in particular, could be used for assessing frictional properties along the plate interface at long-term scales (~ 250 ka). Finally, we evidenced recent and very high uplift rates (~1.4 mm/yr) on Puná Island in the Gulf of Guayaquil uplift rates are anomalously higher compared with the other areas. This island represents an example of levels of marine terraces formed not by the subduction influence but the action of intense tectonic activity. Our analysis shows that the deformation of the island is strongly influenced by an intense tectonic activity along a crustal fault, near the megalopolis of Guayaquil. Our study marks an unprecedent attempt to model the coastal deformation along the Ecuadorian margin and could have an impact on seismic hazard assessment.