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Subduction versus crustal tectonics: impact on southern Ecuadorian margin uplift -quantification of uplift rates and modelling of marine terraces

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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 (e.g. Pedoja et al., 2011) 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 the 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 also showed evidences of 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 marine terraces formed by the intense tectonic activity of a crustal fault near the megalopolis of Guayaquil, the CCPP fault that delimits the North Andean Sliver (NAS) to the south (Alvarado et al., 2016). Our study marks an unknown and peculiar setting of the coastal deformation along the Ecuadorian margin which could have an impact on seismic hazard assessment.

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