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Controls on the segmentation of an active forearc setting – Chile (37˚-41˚S)

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It has been shown that many forearc-regions are characterized by seismotectonically semi-independent segments that may record recurring activity of large earthquakes in the past. It is not well known however, on which timescales these segments retain their tectono-geomorphic identity and what may govern their long-term evolution and the possible interaction between such crustal blocks. Here we investigate the forearc of the active convergent margin of south-central to southern Chile south of the coastal town Concepcíon. In this area two morphologic forearc anomalies coincide: (1) The Arauco Peninsula, a broad region of uplifted forearc-shelf and (2) the Nahuelbuta Range including the highest peak ($>$ 1500 m) of the southern Chilean forearc.

Although some models such as basal accretion and antiformal stacking have been suggested based on analogue modeling to explain this topographic anomaly, its ultimate controls and its spatial and temporal evolution are not fully understood yet. We use remote sensing, analysis of topography and drainage basins, sedimentology, as well as structural and geophysical data to reconstruct the tectonic landscape evolution of the active forearc setting in order to identify recent to active deformation patterns and the responsible driving forces.

Our analysis reveals three distinct forearc segments in this area that appear to have had a semi-independent structural and geomorphic evolution. From north to south these are: the Nahuelbuta segment, the Valdivia segment and the Bueno segment. Whereas the Valdivia segment is subjected to subsidence, the other two segments record Quaternary uplift. The latter areas are characterized by broad, N-S oriented antiformal

structures with numerous anomalies in the fluvial network, including wind gaps, flow reversals and lateral migration of drainage patterns.

Furthermore, we identify two different uplift signals distinct in time and space being cumulatively responsible for the topographic forearc anomaly: (1) a regional long-term uplift process affecting the entire Nahuelbuta and Bueno segments since Eocene time, (2) a local, short-term uplift trend limited to the Arauco region of the northern Nahuelbuta area during the Quaternary. This uplift seems to be locally focused by two major upper plate fault zones, the Bío-Bío Fault Zone in the north and the Lanalhue Fault Zone in the south. Interestingly, the locus of short-term uplift spatially coincides with the ongoing subduction of the oceanic Mocha Fracture Zone beneath the Nahuelbuta segment. Additionally, morphologic data and the distribution of drainage anomalies suggest a progressive flexure of the upper plate. The resulting deformation is regional and not bounded by upper plate structures. Seismic data indicate plate locking due to the subduction of a young, buoyant slab as a driving force.

To subsume, our data suggests that despite the important local influence of upper plate structures the regional deformation pattern of the South Chilean forearc is strongly controlled by the morphologic and physical characteristics of the subducting plate. This may explain the variability of forearc behaviour during timescales of 10^5 to 10^6 years if anomalies on the oceanic plate migrate through time.