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Active faulting and forearc block rotation in south-central Chile from GPS-derived deformation (36-39˚S)

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This study focuses on the control of crustal faulting and block rotation on surface deformation in the forearc of the south-central Chile margin. The Arauco-Nahuelbuta block is located in the overlapping rupture zones of the Valdivia 1960 and Concepción 1835 megathrust earthquake segments. There, active crustal faults have been identified and mapped based on deformed coastal geomorphic features, seismic-reflection profiles, and microseismicity. We present new GPS data and finite-element models to gain insight into forearc kinematics and particularly to address the role of crustal faults on seismotectonic segmentation. The present-day surface deformation field in the Arauco-Nahuelbuta block mainly responds to interseismic locking of the plate interface resulting in upper-plate contraction. In addition, the southern domain of this block includes post-seismic mantle rebound following the 1960 (M_w 9.5) earthquake. GPS observations reveal active crustal faulting and block rotation overimposed to the inter- and post-seismic signals. In the northern domain, finite-element models better reproduce the GPS velocities by including the Santa María fault, which is rooted in the plate interface, and accommodates about 30 % of the plate convergence margin-parallel component. A rotating forearc block has been identified in the northern limit of the 1960 rupture zone, bounded by the Lanalhue deep-reaching fault. Maximum

rotation at the edge of this block is accommodated by diffuse deformation across the Lanalhue fault, which seems to be locked. We explain this block rotation as a result of collision between the Chiloé forearc sliver against a buttress formed by the Arauco-Nahuelbuta block. Our study demonstrates that crustal faulting in coastal regions may contribute to the surface velocity field during interseismic periods. These structures may play an important role on the seismotectonic segmentation of subduction-zone forearcs by delimiting the rupture areas of megathrust earthquakes.