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Impact of upper crustal faults on interseismic surface deformation, Arauco-Concepción forearc block, Chile

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The surface velocity field along subduction margins has been successfully modeled using simple, elastic back-slip models. In many of these margins active upper crustal faults have been mapped in the forearc; but it remains unclear whether these faults are active during the coseismic or interseismic phase of the seismic cycle, or during both. In order to explore this open question, we have developed a 3D kinematic finite element model (FEM) to study the spatial variations of the interseismic deformation along the Chile subduction margin. We simulate the interseismic surface deformation using a backslip rate applying constraint equations for the nodes of the fault plane. This model includes the best available geometries of the slab and Moho, as well as topography. The downdip limit of the seismogenic coupling zone has been limited to the continental Moho/slab boundary. Downward of this limit we imposed a 10-km-deep transition zone. We have observed and processed a local GPS network in the Arauco-Concepción area, consisting of 20 new campaigns sites measured since 2003. The horizontal residuals between the GPS and FEM model show a good fit along the entire Chile margin. However, in the area of the 1960 Valdivia earthquake (39°-42°S), where postseismic deformation is ongoing, and in the Arauco-Concepción block residuals are higher. In order to improve the model, we have introduced two crustal-scale faults that bound the Arauco-Concepción block, which have been well mapped from field, seismic-reflection, and seismicity data. In the northern sector, the NE-striking Santa Maria fault (37°S) has an effect on the east-west velocity field whereas in the south the NW-striking Lanalhue fault (38°S) has a clear effect on the higher north-south anomalous velocities of the Arauco-Concepción block. Our study demonstrates

that crustal faulting in the coastal region contributes to the interseismic surface deformation in the entire forearc of the south Chile convergent margin.