



Causes for Neogene to Recent horizontal extension in the Southern Central Andes

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Unraveling the tectono-morphological evolution of the central Andean high plateau, the Puna Plateau, and its eastern foreland is paramount for understanding orogenic processes in non-collisional orogens and continental interiors. Previous studies using fault-slip inversion techniques interpreted kinematic axes in the Central Andes in terms of changes in absolute plate motion, plate convergence direction and vertical-axis rotation associated with the Central Andean orocline. However, none of these hypotheses accounts for the cause of Neogene horizontal extension and vertical shortening documented from the Southern Central Andes. Based on the analysis of first-order structures, acquisition of 1750 brittle shear faults from 148 stations complemented by kinematic axes from 318 stations (4756 fault data) compiled from published sources, we reassess the kinematics of Neogene to Recent upper-crustal deformation in the Southern Central Andes. In particular, we explore to what extent horizontal extension pertains to local versus regional geodynamic causes.

Inversion of fault-slip data applying the Numerical Dynamic Analysis indicates chiefly WNW-ESE and NE-SW directed, horizontal shortening and subvertical extension in the Puna Plateau, the adjacent Eastern Cordillera and the topographically lower Pampean Ranges. Horizontal shortening in the Puna Plateau and Eastern Cordillera is also associated with orogen-parallel extension. In addition, these regions are also characterized by fault populations indicating vertical shortening and horizontal extension in various directions.

Some of the fault populations indicating vertical shortening and horizontal extension formed by longitudinal outer arc stretching of ramp-anticlines in the hanging walls and synclines in the footwalls of prominent reverse faults. Other causes for local vertical shortening include areas that underwent volcano-tectonic collapse. However, most sites characterized by vertical shortening and horizontal extension do not seem to be associated with local deformation kinematics and, thus, require an explanation in terms of regional deformation that affected the upper crust in the Southern Central Andes. We propose that much of the upper crust in topographically elevated regions in the southern Central Andes underwent gravitational spreading mostly parallel to the orogen axis. This geodynamic scenario is in agreement with Neogene to Recent left-lateral transtension in prominent NW- striking volcano-tectonic belts and horizontal shortening transverse to the orogen axis throughout the southern Central Andes.