CRUSTAL EXTENSION IN THE ANDES AND TIBETAN PLATEAU: INSIGHT FROM GPS, SEISMIC, AND 3D NUMERICAL STUDIES

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We have investigated the crustal extension in the high Andes and the Tibetan plateau using GPS, seismic, and geological data and 3D numerical modeling. The GPS data reflect the instantaneous velocity fields, the seismic data indicate stress states evolving over a time scale of 100-1000 years, and the geological data record deformation over millions of years. Our data show significant differences between the long-term and short-term behavior of crustal deformation in these two orogens. To simulate both long-term and short-term crustal extension, we developed a 3D viscoelastic finite element model. The model uses digital topography of these orogens with realistic model geometry, boundary conditions, plate convergence rates and thermal structures. We explore the evolution of stress state as a function of topographic loading, tectonic compression, and basal shearing. Our results suggest that topographic loading is the major drive for synorogenic extension in both orogens. The model predicts concurrent extension in high plateaus and thrusting faults near the foothills, consistent with observations in these orogens. The present E-W extension in the Tibetan plateau is facilitated by the relatively unrestricted eastern boundary of the plateau, and the more complicated extension patterns in the high Andes can be explained by the variable topography and geometry of the Andean orogen.