Geophysical Research Abstracts
Vol. 15, EGU2013-12315-1, 2013
EGU General Assembly 2013

Estimates of the state of stress, isostacy and Gravitational Potential Energy of the Central Andes from 3D gravity modelling

Benjamin D. Gutknecht, Rezene Mahatsente, and Hans-Jürgen Götze
Kiel University, Institut of Geosciences, Department of Geophysics, Kiel, Germany (benjamin@geophysik.uni-kiel.de)

Gravitational stress fields generated by lateral variations in lithospheric structure and thickness could be as significant as those associated with far field forces and could influence the state of stress within a plate.

To gain insight on the state of stress along the plate interface of the Andean convergent margin and plateau, we derived vertical stress (σ_v), normal stress component (σ_n) and Gravitational Potential Energy (GPE) anomalies from two existing 3D gravity models of the region. The stress anomalies are caused by spatial variations of density in the overlaying crustal/lithospheric rock column, including topographic masses, and hence, can be detected in the local gravity field. The 3D density models are constrained using results of seismic experiments, geological and petrological prior information.

The lithostatic stress anomalies onshore have been computed at the plate interface between the subducting slab and the overriding South American plate relative to a layered standard density model. To study the isostatic state of the region, vertical stress anomaly maps have been computed at various constant depths and the Moho. The GPE estimates have been made for the entire region using a constant depth of 125 km (base of the mantle lithosphere). To assess the tectonic state of the region, GPE anomalies have been computed using the mean potential energy of the lithosphere (2.379 $\cdot 10^{14}\, N\, m^{-1}$ for a body of constant density of 3200 $kg\, m^{-3}$).

Results from both models show that the fore-arc region exhibits isolated positive trench-parallel normal stress anomalies of the order of 20-100 MPa compared to the adjacent regions. The peaks of the high stress anomalies of both models correlate well with seismicity of magnitude 5 and greater east of the trench. This confirms the possibility that a physical correlation between seismicity and high-density structures above the plate interface exists. Estimates of GPE based on vertical stress show that the high topography of the Andean mountains and the ridges in the Nazca plate exhibit high GPE values of the order of $+10^{13}\, N\, m^{-1}$ relative to mean. The resulting stress from GPE could influence the state of stress in the Nazca plate and adjacent regions.