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Current stress directions in the uppermost crust of South America between 30° and 55° S

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The knowledge of active principal stress directions (stress tensors) provides hints to the current structural deformation style of a region. It supports modelling of fault development and offers possibilities to specify potential movements along pre-existing faults. Generally it permits statements on the origin of the stresses and allows their dynamic allocation to tectonic and / or gravitational forces.

With in-situ measuring of electromagnetic emissions from rocks we determined the maximum horizontal stress orientation in the uppermost crust using a new geophysical tool. From the onshore active margin along the Chilean Pacific coast across the Andes into the Argentinean foreland and in Patagonia as far as to the passive Atlantic margin (from 30˚ S to 55˚ S) we identified various stress domains which can be attributed to plate motion and plate boundary forces. With about six hundred individual measurements in central – southern Chile and southern Argentina we compiled a model of horizontal stress directions for the southern South America Plate.

Horizontal tectonic stresses affecting the earth crust are acting with the same magnitude from the surface into depth. Thus in the uppermost crust at plate margins and in intraplate settings the maximum prevailing stress direction is primarily horizontal and exceeds the gravitational stresses. Long before failure and faulting of the rock the initial and prevailing structures are microcracks reflecting micro longitudinal splitting causing electromagnetic waves with an maximum emission in the maximum active stress direction.

The identified regional stress regimes were correlated with effects of plate tectonic processes resulting from colliding and transform resistance and extension due to sub-

duction, transform faulting and passive margin processes. In addition to the regional data, some local anomalies in the active stress field were detected. They reflect for example local extension parallel to the Pacific coast e.g. on the promontories Arauco and Talinay attributed to local uplift governed by underplating in the compressive trench-arc system. Furthermore gravitational stresses exceeding tectonic stresses induced by a high topography were distinguished.

Our investigations on the orientation of the current stress regimes provide conclusions about the causative forces of either tectonic or gravitational origin in this part of the South-America Plate.