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3D Lithospheric-Scale Structural, Thermal, and Rheological Modeling of the Southern Central Andes

Understanding the coupled multi-scale geodynamic processes related to the subduction of the oceanic Nazca Plate beneath the South American Plate is one pre-requisite to better assess seismic hazards in the region. It is essential to identify all relevant forces within the system, such as negative buoyancy of the subducting slab or mechanical coupling between the Andean domain and the Pampean foreland, to analyze tectonic processes like subduction or strain transfer and localization. We approach this by initially investigating the present-day physical state of the subsurface, including first-order variations in pressure caused by mean lithostatic stress, temperature, and rock composition as constrained by multi-disciplinary observations.

For this we build data-based 3D lithospheric models to characterize the system's response to these forces, with particular attention to the rheological behaviour dictated by rock composition, temperature, and pressure. By employing an integrated methodology combining seismic velocity conversions with gravity modelling (IGMAS+), we create refined 3D models of the crust and lithosphere that capture structural, thermal, and rheological properties of the subsurface, as these exert significant control on spatial variations in lithospheric strength and deformation behaviour.

Datasets such as surface heat flow, earthquake catalogues, as well as geodetic observations can then be used to validate the models and shed light onto the underlying geophysical processes active in the region.

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