The stress mapping in the Bolivian Orocline through probabilistic moment tensor approach.

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INTRODUCTION AND MAIN RESULTS

Crustal seismicity in the Central Andes exhibits contrasting patterns, with reverse faulting dominating the sub-Andean belt and strike-slip or normal faulting in the high plateau. To improve the characterization of regional stresses in Bolivia, we determined 13 new focal mechanisms of shallow earthquakes, integrating local, regional and IMS-CTBTO seismic data with probabilistic full waveform moment tensor inversion and P-wave polarities. A cluster analysis of these mechanisms, combined with 18 previous solutions, reveals three dominant patterns: reverse faulting with NE–SW compression in the NW–SE sub-Andean belt, reverse faulting with E–W compression south of the Orocline, and strike-slip faulting in the Eastern Cordillera. These findings provide a refined stress map, linking plateau spreading and Nazca plate convergence.

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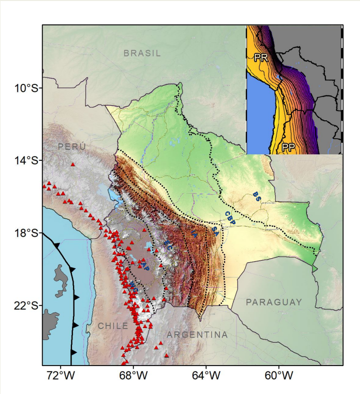
Introduction, tectonic and earthquake setting.

The central Andes (CA) orogenesis is controlled by the subduction process of the oceanic Nazca plate beneath of continental lithosphere of Western South America, a complex interaction between these plates generates different subduction angles and even flat-slab parts (Peru and Argentina). For the CA this angle is mostly 30° eastward dipping. The subduction process is the main driver for the seismic activity in the CA of Bolivia, the earthquakes can go from Shallow (depths until 35 km), intermediate (from 100 to 350 km) and deep (from 500 to 700 km) as shown in Figure 1.



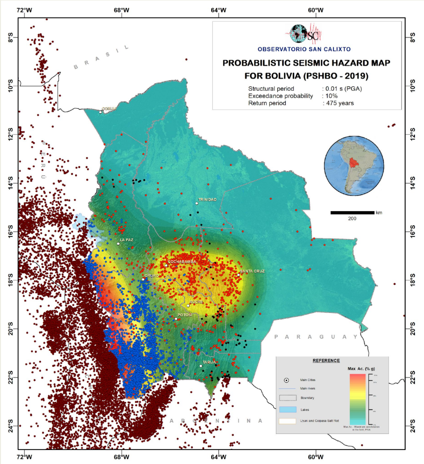


Figure 1. Left image the subduction process and the different morphotectonic provinces in the CA. Right image the seismic distribution for Bolivia, base map of probabilistic earthquake hazard map

Methodology (Grond and P-wave polarities)

Full waveform moment tensor inversion has been performed with the Grond software (Heimann et al., 2018), a probabilistic source inversion algorithm. We invert earthquake source parameters at regional distances, by fitting full waveform displacement traces and their amplitude spectra at different frequency ranges. Synthetic seismograms were generated using pre-calculated Green's functions (https://greens-mill.pyrocko.org/) built with the QSEIS code (Wang et al. 1999). To further constrain the focal mechanisms we also use P-wave polarities. Take-off angles were calculated with a 3D model (Rivadeneyra, 2021; Rivadeneyra and Bianchi, 2022) within NonLinLoc (Lomax et al., 2000), which takes into account the strong lateral variation in crustal thickness across the Central Andes.

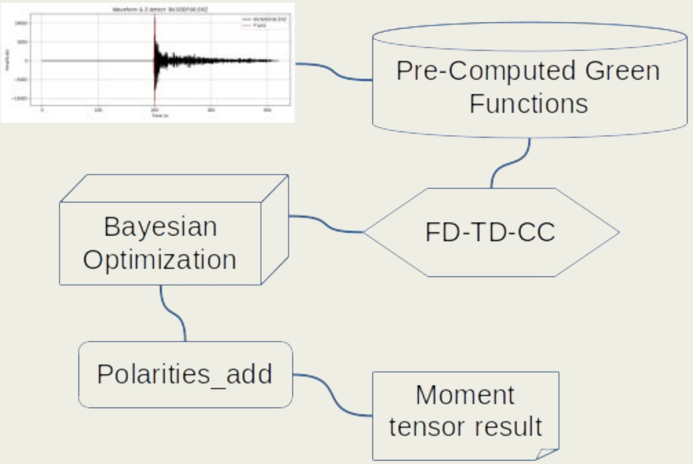
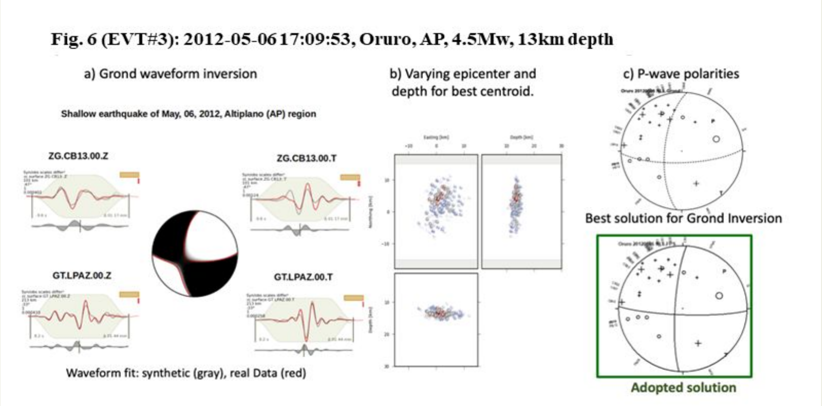
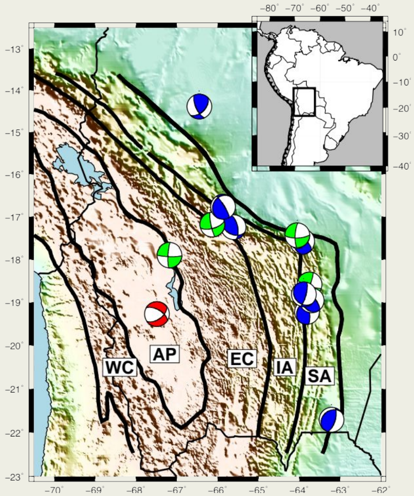
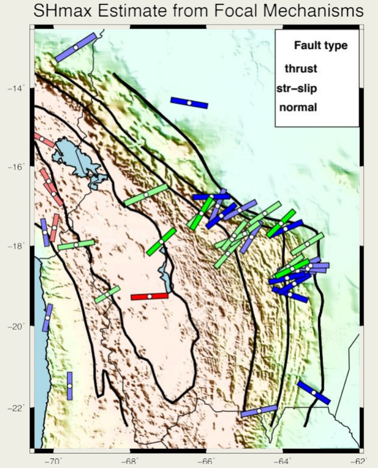


Figure 2. Probabilistic moment tensor inversion workflow (Grond). FD-TD stands for Frequency and Time Domains, CC Cross Correlation.

Results and Conclusions







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