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Active and passive seismic imaging of the Precordilleran crust, fore-arc of the North-Chilean subduction zone (Central Andes)

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In the fore-arc of the Chilean subduction zone the prominent trench-parallel fault systems can be traced for several thousand kilometers in the north-south direction. These fault systems possibly crosscut parts or the entire crust and are expected to have a close relationship to transient processes of the subduction earthquake cycle. With the motivation to image and characterize the structural inventory and the processes that occur in the vicinity of these large-scale fault zones, we are currently performing a combined analysis of active and passive seismic data sets. The active-seismic data analysis is intended to provide images of the faults at depth and allow linking surface information to subsurface structures. The correlation of the active seismic data with the observed seismicity around these fault systems complements the image and potentially reveals the origin and the nature of the seismicity (including tremors) bound to these fault systems.

In 1996, an approximately 350 km long, west-east running reflection seismic profile was acquired to image the entire crust of the Central Andean fore-arc system (North Chile; ANCORP96 seismic line). Several features such as the downgoing plate (Nazca reflector) and the Quebrada Blanca Bright Spot at mid-crustal level were clearly imaged using both standard CMP processing and Kirchhoff prestack depth migration. The latter proved to be more successful in coping with the low data coverage and varying data quality. However, the original images did not provide conclusive information on the upper crust (< 10 km depth) due to the sparse acquisition geometry and the insufficient removal of source-generated noise. The major goal of our current re-processing of the ANCORP96 reflection seismic data set is to provide improved images of the upper and middle crust, Thereby, resolving the shallow and perhaps steeply dipping segments of the major fault systems, which were not detected by the original processing. This is done by using adapted noise-suppression schemes and a novel prestack depth migration technique (Coherency Migration).

The re-processed and migrated depth sections reveal improved images of the upper and middle crust (< 20 km depth) containing significantly more details compared to the previous results. Some interesting structures were resolved but no distinct reflections from steeply dipping fault segments have been clearly identified yet. The combined interpretation of the active-seismic reflection images and the distribution of the seismicity allows us to deepen our understanding of the tectonic structures and related processes of the North-Chilean fore-arc.