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Active tectonics of the Atacama Basin area, northern Chile: Implications for distribution of convergence across the central Andes

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The central Andes in South America is formed as the Nazca plate subducts northeastward beneath the South American plate along the Peru-Chile trench, parallel to the coastline. It has been shown that the convergence rate between the two plates is ∼70-80 mm/yr, and about 10-15 mm/yr of the convergence is absorbed in the sub-Andean belt, east of the active volcanic arc. However, the convergence in the forearc region is still not well constrained.
In order to understand how much convergence is absorbed in the forearc region, we analyzed the active tectonic characteristics of the Atacama Basin, just west of the active volcanic arc. With the help of various remote sensing datasets such as 30-m and 90-m resolution digital elevation models (DEM) produced from SRTM data, thermal infrared radiometer (TIR) ASTER images, Landsat, and Google Earth images, we identified many N-S trending compressional structures around the Atacama Basin. The active structures are found mainly in the northern and southern part of the basin.
The structures in the north deformed many volcanic rocks at the surface, such as ignimbrites and several lava flows. Structures may extend southward to San Pedro de Atacama, the largest town in the Atacama Basin, and produced tectonic scarps inside the town. River terraces also formed in the hanging-wall block of the structures, north of San Pedro. From field surveys, we measured the offset amount of the structures and collected volcanic rocks in order to constrain the age of the deformation. These results enabled us to calculate the long-term deformation rate of the structures. Our results indicate that the long-term slip rate of the structures in the southern part of the basin is quite low, in the order of 10-1 mm/yr.
Furthermore, we obtained detailed topographic profiles across the structures. In the south, the profiles were surveyed by using real-time kinematic (RTK) GPS. Together with the attitudes of bedding planes, we constructed the subsurface geometry of the structures based on the shear fault-bend fold model. Our results indicate that the shortening rate in this area is about 0.2 mm/yr, significantly lower than the shortening rates in the backarc region of the central Andes. Thus the forearc region of the central Andes may act as rigid block, and most of the plate convergence west of the volcanic arc is absorbed along the subduction interface.