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Active surface deformation in the south-central Andes revealed by multiple-sensor InSAR and field observations

Bodo Bookhagen (1), Manfred Strecker (1), and Ricardo Alonzo (2)

(1) Universität Potsdam, Institut für Erd- und Umweltwissenschaften, Potsdam-Golm, Germany (bodo.bookhagen@uni-potsdam.de), (2) Universidad Nacional de Salta, Facultad de Ciencias Naturales (FCN), Salta, Argentina

With average elevations of about 3.7 km the semi-arid to arid Andean Plateau (Altiplano-Puna) of the central Andes constitutes the world's second largest orogenic plateau. The internally drained sedimentary basins are evaporitic salt pans at present-day, but during the Quaternary the basins have repeatedly experienced high lake levels during pluvial periods. Due to protracted sedimentary infilling and sustained internal drainage conditions the basins have thick sedimentary sequences and are partly coalesced. The basins are bordered by reverse-fault bounded ranges, reaching 5 to 6 km elevation. Here, we use cosmogenic nuclides and InSAR techniques to describe (1) long-term and decadal tectonic deformation and (2) seasonal surface deformation associated with groundwater movement of lithium brines. The vegetation-free salt-pan surface provides ideal conditions to observe deformation from multiple sensors, including TerraSAR-X, Sentinel-1, ALOS, and ENVISAT. Furthermore, we rely on 12m TanDEM-X topographic data to characterize 10^3-10^6 yr surface deformation using cosmogenic nuclide exposure dating and digital elevation model analysis.

The Puna, the Argentine sector of the Andean plateau, has been previously characterized as a region of low-tectonic activity, with strike-slip and extensional faulting associated with mafic volcanism. Especially the eastern plateau margins record this type of kinematic regime, while the adjacent foreland is characterized by a higher level of seismicity and ongoing contraction. Here, we present evidence of contraction and tectonic shortening in the central Puna Plateau during the past two decades and beyond. For example, the E-dipping Miocene sedimentary strata west of the Salar de Pocitos basin are folded and faulted and are involved in the growth of an anticline that has been going on since at least 11 Ma. Field observations of tilted shorelines associated with former lake-highstands indicate that shortening in this region has continued into the late Pleistocene and Holocene. The usage of InSAR timeseries allows to identify previously unknown tectonic activity and to improve understanding of orogenic processes and crustal dynamics in the central Andes