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Neotectonic deformation versus climate control in the Central Andes of Argentina, insights from 10Be Surface Exposure Dating

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Mountainous regions and their forelands commonly supports a suite of landforms sensitive to climate change and tectonics, providing -if addressed with appropriate geomorphological and geochronological approaches- record for landscape, climate, and tectonic evolution. In particular, alluvial fans are valuable archives of Quaternary climate and tectonics. The southern Central Andes and their forelands provide a perfect setting to study such forcings, since first, the extreme aridity favors the geomorphological preservation of the fan surfaces, so that 10Be surface exposure dating can be applied to establish robust and precise chronologies. And second, the neotectonic activity in this region results in widespread deformation of Quaternary deposits and recent devastating earthquakes. However, rates of uplift and shortening on the reverse faults remain largely unknown and very little is known yet about the Pleistocene climate history in the southern Central Andes, which limits a robust evaluation of the role of climate for the alluvial fan formation and landscape evolution.

We combined structural and geomorphic investigations with 10Be surface exposure dating in the western Precordillera of the Southern Central Andes of Argentina (31°30′-31°53′ SL/69°20′ WL) in order to establish a numeric chronology for four deformed alluvial fan surfaces, to estimate uplift rates and to evaluate the potential climate role in controlling the fan construction and evolution. Surface exposure ages were determined for a few large boulders, amalgamated pebbles, and via depth profiles on sand samples. Boulder ages range from 145 to 212 ka for the oldest well-preserved fan remnants (Q1a, n=3), from 63 to 108 ka (Q2, n=3) and 21-28 ka (Q3, n=2), amalgamated pebbles yield ages range from 106 to 127 ka for the oldest fan surface (Q1b, n=79), all calculations assuming no erosion and using the scaling scheme for spallation based on Lal 1991, Stone 2000. Boulders from current channels have 10Be concentration equivalent to 12-31 ka of exposure. The depth profiles yield minimum ages (assuming negligible erosion) of 120 ka (Q1a as well as Q1b) and 79 ka (Q2) and are thus mostly in good agreement with boulder ages.

Uplift rates of 0.32 mm/yr and 0.83 mm/yr can be estimated for western front of the Precordillera using minimum ages from the depth profiles. Additionally, the exposure ages may tentatively be interpreted to document fan formation at times of globally low temperatures and glacial maxima (Marine Isotope stages 2, 4 and 6, respectively).