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Palaeoclimate reconstructions from lacustrine terraces and lake-balance modeling in the southern central Andes: New insights from Salar de Pocitos (Salta Province, Argentina)

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The arid Puna Plateau in the southern central Andes of NW-Argentina constitutes the southern part of Earth's second largest orogenic plateau. Numerous internally drained basins are restricted by ranges that peak 5-6 km above sea level, creating a compressional basin and range morphology. The conspiring effects of this structurally controlled topography and the high degree of aridity have resulted in low stream power of the fluvial network and internally drained basins. A steep rainfall gradient exists across this area ranging from a humid Andean foreland (>1m/yr annual rainfall) to progressively drier areas westwards. At the present-day, the interior of the plateau is widely characterized by < 0.1m/yr annual rainfall and high evaporation rates. Thus continuous lacustrine archives are limited and sediments are dominated by evaporites.

Several closed basins contain vestiges of moister conditions from past pluvial periods. For example, the staircase morphology of lacustrine shorelines and abrasion platforms in the distal sectors of alluvial fans and pediments at Salar de Pocitos (24.5°S, 67°W, 3650 m asl) records repeated former lake highstands. This intermontane basin has existed since the late Tertiary, constituting a 435 km^2 salt flat in the region of Salta, NW Argentina. Comparison with palaeoclimate records from the neighboring Salar de Atacama suggests that the terrace systems at Salar de Pocitos were formed during the Late Pleistocene and early Holocene. Here we report on our preliminary results of the extent of several terrace generations in this region. We mapped terraces in the field and on satellite images and determined their elevations during a high-resolution DGPS field survey. Our analysis reveals 3-4 distinct terrace levels associated with individual lake-level highstands. However, basin-wide correlation is difficult due to ongoing tectonism and differential tilting of the basin. The highest lake terrace, ca. 25 m above modern base level, locally comprises a calcrete horizon, which provided a 14C age of 40.180 (+1420/-1200) yr BP, which may coincide with a protracted highstand in other basins in the Puna and the Bolivian Altiplano. If the extent of this pronounced terrace is used for volumetric calculations, the corresponding former water body involved 8 km^3. To reconstruct palaeoenvironmental conditions and the range of individual palaeoclimatic parameters under which the lake existed, we applied a lake balance model. Our model results indicate that changes in precipitation, temperature, and cloud cover have played a major role with respect to water evaporation and lake formation. In line with recent climate-modeling studies these findings support the notion that multiple glaciations in these arid highlands and the Eastern Cordillera may have been associated with recurring episodes of greater, easterly-sourced moisture availability.