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Miocene to recent precipitation history of the central Atacama Desert as reconstructed from a clay pan record in the Coastal Cordillera, northern Chile.

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Hyperaridity is the major limiting factor of Earth-surface processes and biological activity in the Atacama Desert of northern Chile, one of the oldest and driest deserts on Earth. On geological timescales, however, the general aridity, which is thought to have onset during the Oligocene to Miocene, has been punctuated by distinct pluvial periods. Also nowadays sporadic but severe rainfall events, like during the flood in 2015, occur within the hyperarid core of the Atacama Desert. During the Miocene and Pliocene, such wetter conditions caused lake formation in parts of the Central Depression and Coastal Cordillera, but also amplified surface processes as well as changes in vegetation dynamics. Unfortunately, due to the limited number and heterogeneity of suitable paleoclimate archives, the long-term precipitation history of the central Atacama Desert and its drivers are still a matter of controversy.

Here we present a first quasi-continuous (on time periods of 10-100 kyr) record of the Mid-Miocene to present paleoclimatic and environmental history of the central Atacama Desert obtained from an endorheic clay pan. Due to its location in the Coastal Cordillera, the investigated clay pan is assumed to have been decoupled from Andean ground and surface-water inflow, and thus to have recorded only local and regional precipitation variations on different timescales.

The investigated 52 m-long sediment sequence exhibits significant changes in the sedimentological, geochemical paleontological, and mineralogical properties. Preliminary data from the recovered Mid-Miocene sediments imply permanent lacustrine conditions with

alternating evaporation cycles that point to significantly different hydrological and/or climatic conditions in Coastal Cordillera than today. A major lithological shift, accompanied by a well-preserved paleosol, documents a significant local groundwater lowering, probably due to fault activation during the mid-Miocene. Subsequent high sedimentation of coarse-grained alluvial deposits indicates alternating periods of wetter than present precipitation, though still arid, conditions with episodic shallow lake phases during the Miocene. A distinct drop in the sedimentation rate and a synchronous transition to fine-grained distal alluvial deposits highlights a significant change in the moisture availability in the Coastal Cordillera during the Pliocene and Pleistocene, probably marking the final onset of hyperarid conditions in the central Atacama Desert.