

Effects of climate, lake productivity and volcanic influences unraveled for last 13000 years in the Central Chilean Altiplano: a high-resolution geochemical study

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Available records from the Central Andes and the Altiplano evidence a pronounced heterogeneity in the regional moisture availability during the Holocene. The multi-proxy study (seismic survey, high-resolution geochemical profiles carried out by a XRF Core Scanner, mineralogical composition, TIC, TOC, biogenic silica and diatoms) of the Lago Chungará sedimentary infill (18° 15' S, 69° 10' W, 4520 m a.s.l. Chilean Altiplano) has provided new insights which could contribute to solve some of the regional paleoclimate controversies, such as the Mid-Holocene aridity crisis or the onset of ENSO conditions. A seismic survey and fifteen Kullenberg cores (up to 8 m long) allowed a detailed 3-D reconstruction of the sedimentary architecture. The chronological framework of the cores was established using 13 radiocarbon and 4 ²³⁸U/²³⁰Th dates, allowing to reconstruct the lacustrine evolution for the last 13,000 cal years BP. Three main sediment sources were distinguished along the record: volcanic supply from the nearby volcanoes (represented by Fe, Ti, K and % of plagioclase), endogenic carbonate production (highlighted by the Ca/Ti, Sr/Ti, % calcite and TIC variations) and bioclastic remains, mainly diatoms (Si/Ti, biogenic opal, S/Ti, %TOC). Three main units were identified over the pre-collapse substrate: 1.- The basal unit (13 - 7.2 cal. kyrs BP) is a finely laminated diatomite. Preliminary analyses suggest a dominant interannual frequency that could be related to the ENSO activity. Furthermore, our records indicate an increase in productivity during the Early

Holocene, coherent with the raise of paleotemperatures in the nearby Sajama ice core.

2.- The middle unit (7.2 - 4.5 cal. kyrs BP) is banded and it comprises diatomites and some carbonate-rich layers. Increased volcanic activity after 6 cal kyrs BP and climate-driven hydrological changes seemed to be the main promoters of the carbonate precipitation that occurred during this period. An arid Mid-Holocene is recorded in the Lago Chungará sediments supporting the regional low moisture availability of this period.

3.- The upper unit (after 4.5 cal. kyrs BP) is banded to massive and it contains abundant volcanic layers (lapilli, ash layers). A high correlation between the volcanic input in Lago Chungará and the total particles coarser than $63 \mu\text{m}$ recorded in the Sajama ice core is evident for the last 6000 years. The high-resolution attained in this study allowed us to identify several sharp and abrupt episodes of climate change during the Holocene, such as those observed during the Mid-Holocene (among 7.5 and 5.5 kyrs) and the 8.2 kyrs event. Timing of these events and their potential climatic forcings are discussed in comparison with adjacent records, such as those from Lake Titicaca.