Using triple oxygen isotopes to determine evaporation and recharge at the Salar del Huasco, Chile

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Recent studies demonstrated that combined analysis of $\delta^{18}O$, $\delta^{17}O$ and δD may provide a powerful tool to reconstruct (paleo)humidity in evaporitic lake settings [1,2].

To test this approach, we investigate pond waters along three transects in the S, N and NW of the Salar del Huasco, an endorheic salt lake located in the Altiplano, Chile. The samples span a wide range of conductivity from 0.6mS·cm^{-1} to 249.0mS·cm^{-1}, showing variable degrees of evaporation. Natural waters are complemented by samples from on-site pan evaporation experiments. All waters were analyzed for their triple oxygen isotope composition by dual-inlet IRMS with long-term external reproducibility of 0.12‰, 0.25‰ and 8 per meg for $\delta^{17}O$, $\delta^{18}O$ and ^{17}O-excess, respectively. Results are compared with theoretical evaporation trajectories.

$\delta^{18}O$ values of pond waters cover a range from -13.284‰ to 12.426‰. More saline ponds are generally more enriched in ^{18}O, indicating evaporation. However, there is no clear correlation between conductivity and $\delta^{18}O$ implying that the salinity of some ponds may also be increased by subsurface dissolution of salts in groundwater.

The samples show decreasing ^{17}O-excess with increasing $\delta^{18}O$ values as expected during evaporation. Most samples fall on a recharge evaporation trajectory modelled using local parameters for mean annual humidity and temperature, and estimating the isotopic composition of atmospheric vapor from precipitation modelling. Some data points off the trend may be the result of different source waters or mixing of two or more sources (groundwater, summer/winter precipitation) with distinct isotopic compositions. Some ponds may no longer receive recharge and thus fall on another trajectory governed by simple pan evaporation.

This sample set from a complex evaporative environment highlights the general applicability of this isotope system for paleohumidity reconstruction, but suggests that for salt lakes discontinuous recharge must be taken into account.

[1] Gázquez *et al.* (2018) EPSL **481**, 177-188. [2] Surma *et al.* (2018) Sci. Rep. **8**, 4972.