Goldschmidt 2023 Abstract
https://doi.org/10.7185/gold2023.15922

Triple oxygen isotopes provide insights into hydrological and climatological controls of ephemeral lakes in southern Spain

CLAUDIA VOIGT[1], FERNANDO GÁZQUEZ[1], LUCÍA MARTEGANI[1] AND MIGUEL RODRÍGUEZ-RODRÍGUEZ[2]

[1]University of Almería

[2]University Pablo de Olavide

Presenting Author: cvoigt@ual.es

Stable isotopes of water (δ^2H, $\delta^{18}O$) have been widely used for hydrological balancing of lakes. However, deviations from isotope steady-state due to variations in climate and recharge conditions can lead to uncontrollable biases of the lake water balance estimates. Recent studies demonstrated that the ^{17}O-excess parameter derived from the measurement of $\delta^{17}O$ in addition to $\delta^{18}O$, allows to distinguish recharge and non-recharge conditions and identify periodic admixture of unevaporated waters, occurring, e.g., during precipitation events [1-2]. Moreover, the triple oxygen isotope composition of lake sediments, such as gypsum and carbonates, has been suggested as a powerful tool for paleoclimate reconstruction [3-4].

Here, we present results of an ongoing monitoring study of triple oxygen and hydrogen isotopes in permanent and ephemeral lakes in southern Spain. The region is characterized by a relatively homogeneous Mediterranean-type climate. The dataset comprises three hydroperiods extending from winter to early summer between January 2020 and September 2022. We combine simple isotope and hydrological mass balance models to assess the mechanisms that control isotope and lake level variations throughout the hydroperiods.

While the isotope composition of permanent lakes varies little throughout the year, ephemeral lakes vary strongly from -6 to 21‰ for $\delta^{18}O$, -153 to 40 per meg for ^{17}O−excess and -89 to 11‰ for d−excess. In general, ^{17}O−excess and d−excess decrease with increasing $\delta^{18}O$. The highest $\delta^{18}O$ and lowest ^{17}O−excess and d−excess values occur in early summer before complete desiccation of the lakes. Comparing model results and observations, we demonstrate that the ^{17}O-excess allows to identify the lake's hydrological connectivity to groundwater aquifers. Further, we show how seasonal variations in climate and rainfall control the isotope composition of lake water. These results have significant implications for the quantitative assessment of water balances of ephemeral lakes and the interpretation of isotope data of paleo-lake water obtained from lake sediment archives.

This study is funded by the Marie Skłodowska-Curie grant programme (101063961).

[1] *Surma et al.* (2018) Sci Rep **8**, 1–10. [2] *Voigt et al.* (2021) HESS **25**, 1211–1228. [3] *Passey and Levin* (2021) RMG **86**, 429–462. [4] Gázquez *et al.* (2018) EPSL **481**, 177-188.