Goldschmidt 2023 Abstract
https://doi.org/10.7185/gold2023.18351

Advancing Interlaboratory Calibration of Low-Temperature Mineral $\Delta'^{17}O$ Measurements: A Set of Sulfate, Oxide, and Silicate Reference Materials

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Triple-oxygen isotope compositions ($\Delta'^{17}O$ and $\delta^{18}O$) of low-temperature minerals such as sulfates, oxides, and phyllosilicates have been increasingly used to reconstruct the redox state and paleohydrology of the Earth's surface. While international $\Delta'^{17}O$ standards are available for high-temperature minerals, there is a lack of interlaboratory sulfate, oxide, and phyllosilicate reference materials. Currently, $\Delta'^{17}O$ results for these minerals are often reported either relative to in-house standards or to international standards of different phases (e.g., water, quartz), which likely behave differently during sample processing (e.g., fluorination). Resulting calibration discrepancies may thus cause uncertainties in the application of low-temperature mineral $\Delta'^{17}O$ values as environmental proxies. Improving interlaboratory calibration is therefore essential.

To address this problem, we synthesized large batches of sulfate, oxide, and phyllosilicate minerals that can be used as interlaboratory standards. Mineral purity and homogeneity were assessed using several petrographic (e.g., XRD, SEM) and geochemical (e.g., FTIR) methods. Importantly, each mineral was precipitated from natural waters with $\delta^{18}O$ values spanning from approximately -35 to +35‰ VSMOW. Resulting mineral $\Delta'^{17}O$ and $\delta^{18}O$ values are thus expected to cover the entire range of natural samples and can be used to build mineral-specific, multi-point calibrations.

High-precision $\Delta'^{17}O$ and $\delta^{18}O$ measurements will be made on the synthesized minerals by isotope ratio mass spectrometry at ETH Zürich, and aliquots will be made available for laboratories interested in participating in an interlaboratory comparison. This effort will ultimately lead to better accuracy and reproducibility, and it will enable the community to gain more reliable information on the biogeochemical and hydrological processes of the past and present Earth's surface.