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Central European lapse rate based on speleothem fluid inclusions

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While the modern stable isotope lapse rate for precipitation shows a gradient of -0.19 ‰ per 100 meters elevation for Switzerland (Schotterer, 2010), there is only scarce information about the isotope lapse rate in the past and it is usually assumed that they remained constant through time. To investigate the lapse rate in the past, we use speleothems from caves along an altitudinal transect, which contain past drip water preserved in micrometric sized fluid inclusions (0.01 to 0.1 weight %). This drip water corresponds to precipitation water falling above the cave and thus constitutes an excellent archive of past precipitation, allowing us to determine lapse rates in the past. To extract and analyze this water, we used an improved speleothem fluid inclusion water extraction line available at the Quaternary Geology group of the University of Basel. The new design allows us to measure up to ten samples a day.

For this study, we measured more than 100 fluid inclusion samples from various stalagmites in a transect from the Jura mountains to the swiss alps with elevations ranging between 373 and 2'000 meters. These measurements enable us to obtain direct information on past precipitation as well as determine absolute paleotemperatures (Affolter et al., 2019). They allow us to determine the stable isotope and temperature lapse rates for different time intervals, such as Marine isotope stage 5a, the Younger Dryas and the Holocene.

Furthermore, to better understand the water isotopes in cave environments, we have launched (in 2023) the Citizen Science project "Cave Drip Water" in collaboration with various caving clubs in Switzerland and France (https://duw.unibas.ch/de/quartaergeologie/citizen-science/). The purpose of this program is to collect drip water samples and consequently monitor stable isotopes from numerous caves distributed at different elevations across Switzerland and in neighbouring regions. From this data, we will reconstruct a modern cave drip water lapse rate for Switzerland. In addition, it will allow us to investigate the spatial distribution of water isotopes in karst systems and compare it with the most recent water isotope patterns in precipitation from Switzerland. Moreover, these observations will set a baseline for the use of water isotopes analyzed in speleothem fluid inclusion measurements.

Here we present preliminary isotope and temperature lapse rates based on speleothem fluid inclusion water for the Holocene, Younger Dryas and the MIS 5a intervals as well as the first results

from the Citizen science project “Cave Drip Water”.

REFERENCES

Schotterer U., Schürch M., Rickli R., Stichler W. (2010). “Wasserisotope in der Schweiz: Neue Ergebnisse und Erfahrungen aus dem nationalen Messnetz ISOT“ Gas, Wasser, Abwasser 2010

Affolter et al. (2019), Sci. Adv. 5 eaav3809, doi.org/10.1126/sciadv.aav3809