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Challenges on the way to noble gas temperatures on speleothems

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In the last years, speleothems gained importance as a paleoclimate archive. Nonetheless, so far no proxy in speleothems has really gained acceptance as a commonly used paleotemperature indicator. Application of the noble gas thermometer to speleothem fluid inclusions promises in principle the determination of absolute paleotemperatures. Kluge et al. (2008) and Scheidegger et al. (2010) showed that the precise measurement of noble gas concentrations on fluid inclusions is possible in general. Unfortunately, the extraction and measurement technique presented by Kluge et al. (2008) allowed the determination of reasonable noble gas temperatures (NGTs) only for some samples. Some of the problems which occurred as well as some (possible) solutions will be presented.

A general problem for the application of the noble gas thermometer on speleothems is the presence of air-filled inclusions in the speleothem. Noble gases released from them mask the temperature signal of the noble gases dissolved in the water-filled inclusions. In order to reduce the air/water volume ratio, a stepwise extraction technique has been developed successfully. However, often the different extraction steps on one sample lead to temperatures that do not agree well with each other.

Samples of the stalagmite H12 from Hoti Cave in Oman showed an excess in neon. A similar neon excess was found by Scheidegger et al. (2010) but for a larger number of samples. They suggest that helium and neon can be situated in voids between the atoms forming the carbonate lattice. However, a sample of stalagmite H12 showed neon excess in the very first extraction step, which is not expected for a matrix related component.

The NGTs reported by Kluge et al. (2008) seemed to be 2 to 3 °C too low compared to independent temperature reconstructions. In order to investigate this offset and the overall accuracy of the extraction and measurement technique, tiny amounts of air-equilibrated water (AEW) were measured as test samples. In a first test with these so-called μAEWs the heavier noble gases (Ar, Kr, Xe) seemed to be underestimated, while a second measurement run did not show this offset. Overall, these tests demonstrated the good reproducibility of better than 5% for the noble gas concentrations.

References

Kluge, T., T. Marx, D. Scholz, S. Niggemann, A. Mangini, W. Aeschbach-Hertig, 2008, A new tool for palaeoclimate reconstruction: Noble gas temperatures from fluid inclusions in speleothems, Earth and Planetary Science Letters 269, 407-414

Scheidegger, Y., H. Baur, M. S. Brennwald, D. Fleitmann, R. Wieler, R. Kipfer, 2010, Accurate analysis of noble gas concentrations in small water samples and its application to fluid inclusions in stalagmites, Chemical Geology 272, 31-39