Lecture Abstract:

The "Fluid Inclusions of stalagmites" Lecture

By Werner Aeschbach-Hertig[1]

Fluid inclusions in speleothems offer the unique possibility to access the parent drip water of the calcite, although only in minute quantities. They upen up three new and promising approaches to paleotemperature reconstruction:

1. Analysis of the isotopic composition of the water in the inclusions offers paleoclimatic information, both from the water as archived paleoprecipitation and from a comparison of the isotope ratios of the water and the calcite [1-4].
2. Even more direct paleotemperature information can be extracted from noble gas concentrations dissolved in the water, although the application of the noble gas thermometer to speleothems remains challenging, due to noble gases from air-filled inclusions that mask the temperature signal and in some cases due to noble gas components of unknown (possibly lattice-bound) origin [5-8].
3. Palaeotemperatures can potentially be determined from the liquid-vapour homogenisation temperature of fluid inclusions in stalagmites [9-10].

[1] Dennis, P.F., Rowe, P.J., and Atkinson, T.C., 2001. The recovery and isotopic measurementof water from fluid inclusions in speleothems. Geochim. Cosmochim. Acta 65, 871–884.

[2] McGarry, S., Bar-Matthews, M., Matthews, A., Vaks, A., Schilman, B., and Ayalon, A., 2004. Constraints on hydrological and paleotemperature variations in the Eastern Mediterranean region in the last 140 ka given by the dD values of speleothem fluid inclusions. Quat. Sci. Rev. 23, 919-934.

[3] Zhang, R., Schwarcz, H. P., Ford, D. C., Schroeder, F. S., and Beddows, P. A., 2008. An absolute paleotemperature record from 10 to 6 ka inferred from fluid inclusion D/H ratios of a stalagmite from Vancouver Island, British Columbia, Canada. Geochim. Cosmochim. Acta 72, 1014-1026.

[4] Griffiths, M. L., Drysdale, R. N., Vonhof, H. B., Gagan, M. K., Zhao, J.-X., Ayliffe, L. K., Hantoro, W. S., Hellstrom, J. C., Cartwright, I., Frisia, S., and Suwargadi, B. W., 2010. Younger Dryas–Holocene temperature and rainfall history of southern Indonesia from δ18O in speleothem calcite and fluid inclusions. Earth Planet. Sci. Lett. 295, 30-36.

[1] Institut of Environmental Physics, University of Heidelberg, Germany

[5] 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 Planet. Sci. Lett. 269, 407-414.
[6] Scheidegger, Y., Brennwald, M. S., Fleitmann, D., Jeannin, P.-Y., Wieler, R., and Kipfer, R., 2011. Determination of Holocene cave temperatures from Kr and Xe concentrations in stalagmite fluid inclusions. Chem. Geol. 288, 61-66.
[7] Scheidegger, Y., Kluge, T., Kipfer, R., Aeschbach-Hertig, W., and Wieler, R., 2008. Paleotemperature reconstruction using noble gas concentrations in speleothem fluid inclusions. PAGES News 16, 10-12.
[8] 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, Chem. Geol. 272, 31-39.
ger, Y., Fleitmann, D., and Frenz, M., 2008. Paleotemperatures from fluid inclusion liquid–vapor homogenization in speleothems. PAGES News 16, 13–14.
[10] Krüger, Y., Marti, D., Hidalgo Staub, R., Fleitmann, D., and Frenz, M., 2011. Liquid–vapour homogenisation of fluid inclusions in stalagmites: Evaluation of a new thermometer for palaeoclimate research. Chem. Geol. 289, 39-47.