Geophysical Research Abstracts, Vol. 9, 02369, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-02369

The way to noble gas paleotemperatures derived from fluid inclusions in stalagmites

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Dissolved atmospheric noble gases in groundwater are used to reconstruct paleotemperatures based on their temperature dependent solubilities. The disadvantage of the groundwater archive is its limited temporal resolution. In contrast, the speleothem archive offers precise absolute dating and high-resolution records. Noble gases dissolved in microscopic water inclusions in speleothems are expected to reflect the cave temperature and thus potentially are a new tool for paleotemperature reconstruction.

First experiments show that noble gas concentrations from fluid inclusions in stalagmites can be measured with sufficient precision. To obtain gas concentrations, the extracted water amount has to be determined, which can be achieved manometrically down to less than 0.1 microliter (corresponding to 0.1 g of stalagmite with a water content of 0.1 %wt). Stalagmite samples exhibit in general rather high noble gas signals. However, the calculation of NGTs from fluid inclusions is not yet possible, because all experiments have shown that the stalagmites contain a large amount of air filled inclusions, which contribute much more noble gases than the water. The critical issue is therefore the separation of the water-derived component from the air. This problem is analogous to the separation of excess air from the equilibrium component in groundwater samples, except that the air/water ratio in speleothems is about 100 times higher.

The way to solve this problem is the selection of adequate samples with a low air/water ratio. Small stalagmite parts can be investigated concerning the water content and the microscopic structure. If additionally some special extraction techniques can be developed in order to reduce the air/water ratio, the determination of NGTs from fluid inclusions in stalagmites appears to be possible.