

## Isotopic re-equilibration of fluid inclusions in natural speleothem by artificial heating

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Isotopic compositions of inclusion water in speleothems are promising new climatic proxies. Oxygen isotope ratio of water ( $\delta^{18}\text{O}$ ) may provide direct estimate for past temperature changes. Several studies, however, used hydrogen isotope ratio of water ( $\delta\text{D}$ ) because the  $\delta^{18}\text{O}$  may be affected by re-equilibration between water and host calcite. Thus, precise knowledge about magnitude and reaction rate of the re-equilibration is needed to evaluate paleoclimate records in speleothems.

To estimate the re-equilibration effect, we measured isotope composition of fluid inclusions in natural stalagmites, which had been heated in laboratory before isotope measurement. Several (3-5) subsamples were cut from the same depth of stalagmites. Then, each sub-sample was heated at different interval (0 -80 hours) under continuous evacuation using a turbomolecular pump. The experiments were conducted under different temperatures of 25 and 105°C. The  $\delta^{18}\text{O}$  and  $\delta\text{D}$  values of fluid inclusions in a sub-sample were measured using a semi-automated system, which was modified based on cavity ring-down spectroscopy technique (Uemura et al., 2016).

Under the 105°C heating, the inclusion  $\delta^{18}\text{O}$  values of a layer show a small increase from the initial value to ca.30 hours heating, and then after that it appears to stay flat. In contrast, the  $\delta^{18}\text{O}$  value shows no trend under the room temperature. The  $\delta\text{D}$  value shows no trend at any experimental conditions, suggesting that loss of inclusion water during long-time evacuation does not cause the  $\delta^{18}\text{O}$  enrichment. Preliminary data suggest ca. 5% of fluid inclusion water may re-equilibrated with surrounding host calcite at the 105°C heating experiment. The results prove the existence of re-equilibration effect, but its magnitude is not significant for estimating glacial-interglacial temperature changes.

Keywords: speleothem, fluid inclusion, stable isotope, glacial interglacial cycle