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Calcite precipitation on glass substrates and active stalagmites in Katerloch Cave (Austria): Constraints from environmental monitoring

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Located near Graz at the SE-rim of the Alps Katerloch is well-known for its impressive dripstone decoration, e.g. several metres tall and relatively fast growing (0.2-0.7 mm/yr on average) candle-stick-type stalagmites. In the course of an ongoing multi-annual and partially high-resolution cave monitoring program we study modern (active) sites of carbonate deposition focusing on the site-specific growth dynamics and connection of modern regional and cave environmental conditions with petrographic, chemical and stable isotopic information captured in the speleothems.

Fresh calcite precipitates on artificial (glass) substrates underneath active drip sites were collected continuously from 2006 to 2014 (eight years!). The samples (up to 7 mm thick) represent cave sections of different temperature and drip sites of partially different characteristics (e.g. drip rate). We also recovered short drill cores (up to 3 cm length, 1 cm diameter) from the top of active stalagmites probably representing the last decades to centuries of calcite crystallization. Moreover, an actively growing stalagmite (K10) comprising both modern and past calcite deposition was collected. ^{238}U-^{234}U-^{230}Th dating using MC-ICP-MS of K10 (71 cm long) revealed several distinct growth intervals (separated by growth interruptions) starting at 129.1 $\pm$1.2 kyr BP (Last Interglacial) up to now, mostly reflecting warm and humid climate intervals.

High-resolution (100 μm) isotope profiles micromilled from the multi-annual modern calcite precipitates on artificial substrates revealed low δ^{13}C values of -12.8 to -8.3 ‰ (VPDB) and relatively high δ^{18}O of -6.9 to -4.9 ‰The δ^{18}O curves from all collection sites (different growth rate) record a pronounced decrease during their most recent growth period most likely corresponding to a significant decrease towards lower oxygen isotope values observed in drip waters collected in the year 2014 compared with samples from 2005 to 2007. Drip water δ^{2}H /δ^{18}O values plot between the Western Mediterranean Meteoric Water Line and Global MWL indicating a significant contribution of Mediterranean moisture to regional precipitation. The prominent shifts could also be explained by changes in seasonality of precipitation and water infiltration. Geochemical and petrographic results from the modern stalagmite calcite are therefore compared to new and published (Boch et al., 2011) hydrochemical and cave air data, as well as regional meteorological data. The modern datasets are further compared to data from Katerloch stalagmites of older time intervals.

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