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Stalagmite geochemistry and the timing of the last interglacial-glacial transition in Central Europe (NE Hungary)

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Speleothems can provide accurate chronologies for reconstructions of climate change by combination of U/Th dating and climate-related geochemical compositions. Geochemical studies of speleothems from Central Europe are mostly based on stable C and O isotope analyses, thus, complex geochemical studies combining isotope and trace element measurements are needed for more reliable climate models for this transitional area between oceanic and continental regions.

We present stable H-C-O isotope and trace element records obtained on speleothems covering the Last Interglacial (MIS 5e) and the transition to MIS 5d. A stalagmite from Baradla Cave grew from 127.5 to 110 ka. Accelerated growth rates have been detected by U/Th age data in the 127 to 126 ka and 119 to 117 ka parts.

Trace element compositions and 230Th/232Th ratios suggest changes in the hydrological regime, whereby early calcite precipitates formed in fissures during the dry and cold glacial period were dissolved by the starting flux of infiltrating meteoric water (producing elevated dissolved ion concentration but low detrital Th component), then the increasing amount of dripwater during the interglacial period resulted in trace element dilution.

Temperature and precipitation amount variations are also reflected by the stable isotope compositions. Oxygen isotope composition shows a continuous increase from 127.5 ka until about 118 ka most probably related to temperature rise, whereas C isotope values are shifted in negative direction suggesting increasing humidity in accordance with trace element contents. The presumably warmest period at ca. 118 ka is associated with rather arid climate as indicated by peak d18O values coinciding with the highest dD values of fluid inclusion water. This is followed by a pronounced negative shift in both O and H isotope values, similarly to recent Alpine studies (Meyer et al., 2008), most probably related to cooling. Hydrogen isotope compositions of fluid inclusion water evaluated together with calculated oxygen isotope compositions of water indicate warming and increasing significance of summer precipitation at the latest period of the last interglacial, then increasing importance of winter precipitation and/or changes in oceanic source composition during the cooling phase.

The good agreement with other (Alpine and marine) records indicate a synchronous climate change. However, after a negative shift in the wet/warm phase (increasing soil activity), C isotope values start to increase already at about 119 ky BP, warning to the use of the two isotope systems as event correlation tools. In conclusion, our combined isotope and trace element study indicate a complex pattern of temperature and humidity variations during and right after the Last Interglacial.

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[Meyer, M.; Spötl, C.; Mangini, A. (2008): The demise of the Last Interglacial recorded in isotopically dated speleothems from the Alps. Quaternary Science Reviews, 27, 476-496.]