



Temperature and precipitation variations in the mid-Holocene based on combined evaluation of stable isotope compositions of speleothems and freshwater bivalve shells in Hungary

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This paper presents stable C and O isotope data, as well as water contents and stable hydrogen isotope compositions of inclusion-hosted water, of ²³⁰Th-dated stalagmites collected from Leány and Pálvölgyi Caves of Central Hungary, within and about 50 km to NW from Budapest, respectively. Combined with stable isotopic compositions of *Unio* bivalve shells collected from a fluvial section of east Hungary, regional thermal and hydrological evolutions during 10-5 ky BP (before 1950 AD) were reconstructed. A good replication of contemporaneous stalagmite oxygen isotope records and agreement of $\delta^{18}\text{O}$ records between our samples and the COMNISPA record from the Eastern Alps suggests that the stalagmite oxygen isotope variation reflects past climate change. The stalagmites show strong negative excursions for two cold periods at 9-8 and 6-5.5 ky BP. The oxygen isotope data are relatively high with several peaks in the period of 7.5-6 ky BP, representing warmer conditions during the Holocene Climate Optimum. The stalagmite hydrogen and D-excess series positively correlate with the COMNISPA record, indicating that contribution of Mediterranean moisture was significant during weak North Atlantic circulation activity. Both stalagmite and shell isotope records show that the strong North Atlantic circulation (NAO+ mode) is associated with a wet climatic condition in the Carpathian Basin.

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