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Stable isotopic, petrographic and trace element analyses of two stalagmites from Sirtlanini Cave, SW Turkey: insights into Mid-Late Holocene environmental and climatic change

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Palaeoclimatic and palaeoenvironmental reconstructions from two Holocene stalagmites (HY-8 and HY-9) from Sirtlanini Cave, southwest Turkey have been created using petrographic, stable isotope and trace element analyses where the stratigraphy of the stalagmites overlaps from ∼6 ka. The cave elevation is 830 metres a.s.l., located 100 km northwest of Lake Golhisar, which has yielded a low resolution Holocene isotopic record (Eastwood et al. 2007), and 120 km northwest of Caltilar Höyük, the site of one of the earliest urban settlements in the region (Momigliano et al., 2011).

Both stalagmites contain prominent dark grey-blue layers up to a few mm thick. Trace element analysis reveals that these layers contain elevated Fe, Mn and Zn concentrations suggesting enhanced mobilization of these elements, possibly adsorbed to organic matter on 100 nm to 1 μm soil particles (Hartland *et al.* 2012). Raman spectroscopy identifies the presence of soot within the layers and evidence for plant material has been identified by SEM along with detritus (clay, quartz). This suggests increased infiltration though the karst, probably due to decreased vegetation cover, a conclusion supported by positive δ^{13}C excursions associated with some grey layers. It is likely that episodes of burning occurred above the cave either due to natural wild fires or anthropogenic activity.

The δ^{18}O record of HY-8 shows no long term trend but fluctuates about a mean of -6.3 ‰Ḣowever it is punctuated by several shorted lived excursions of 1 ‰ - 2.5 ‰ amplitude. δ^{13}C decreases steadily (-6‰ to -10 %¸) through the Mid/Late Holocene with numerous short lived excursions, many >2‰ and some (not exclusively) associated with grey layers . Carbon and oxygen are poorly correlated, although sympathetic trends are seen during some excursions. δ^{18}O values have probably responded to changes in winter rainfall amounts with δ^{13}C likely reflecting fluctuating vegetation density above the cave, particularly when δ^{18}O corresponds.

Petrographic examination of HY-8 reveals a complex fabric. The majority of the stalagmite shows an open fabric of dendritic calcite. Calcite is believed to be primary based on continuous presence of spikey inclusions though dendritic fabric may indicate isotopic disequilibrium. Laminations are defined by compact dendrites but grey layers are defined and bound by dissolution layers. The fabric of the grey layers is mostly microcrystalline believed to be caused by the presence of organic material (Frisia and Borsato 2010). However one prominent layer is defined by equant calcite, implying a thicker film of water. Analysis of the transition between grey layer microcrystalline and dendritic calcite will further resolve the effects on calcite precipitation caused by the inclusion of organics and detritus. Generally petrography will allow investigation into the effects of using fabrics which may potentially alter the environmental signal for stable isotopic interpretation.

Further study seeks to establish age models, examine petrography in more detail and to compare stable isotopic records from both stalagmites. We aim to clarify the links between climatic and environmental changes in the region and the temporal isotopic, trace element and petrographic changes observed in the speleothems.

References

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