Relevance of soil-speleothem relationships for paleoenvironmental reconstructions: Example from a Holocene deposit in SW Romania

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Holocene environmental changes are studied from a wide range of terrestrial sedimentary archives such as peat accumulations, lake sediments, speleothems, cave ice accumulations, or guano deposits. In karst regions, there is a close connection between speleothems and the overlying soil cover, based on organically derived CO2 and percolating water. Speleothem growth depends on soil organic activity as a source of CO2 (e.g., Fairchild et al., 2006). If environmental proxies in soil were not reworked there is a high chance that they can bring valuable complementary information regarding past environmental conditions that occurred during deposition.

We present a multi-proxy study of a colluvium-derived soil (2.5-m deep) developed above Ascunsă Cave, in the Mehedinți Mountains, SW Romania, presumably in depositional connection with a coeval stalagmite (Faur et al., 2021). Soil samples, contiguously taken every 5 cm, were analyzed for clay mineralogy, grain size, chemical composition, magnetic susceptibility, and stable carbon isotopes.

Radiocarbon dating revealed the Holocene age of this soil, as well as a depositional hiatus between 5.4 and 2.3 ka. The fine fraction is dominated by silt (averaging 64%), and the clay mineralogical association consists of illite, chlorite, kaolinite, vermiculite, and illite-vermiculite and illite-chlorite mixed layers. The high values and frequency dependence of magnetic susceptibility suggest that erosion has played an important role in sediment provenance, and a change in the intensity of soil formation during the Holocene. Organic matter δ13C in soil averages around -24.5‰ and is well correlated to the δ13C values recorded in POM 2 stalagmite, which could help future studies identify modifications in isotopic fractionation processes within the cave.

The sediment source is represented by a mélange complex in the surrounding area, and by an underlying terra rossa-type deposit, a relict soil widespread in the Mehedinți area. In addition to our soil profile analysis, we performed OSL dating on two terra rossa-type soil samples taken from a more representative location. Results show that this type of Mediterranean soil was formed during the Last Interglacial period. The depositional hiatus

found in the POM 2 soil profile appears to be related rather to a change in local geomorphology than to climate variability.

This study is a first assessment of the origin and characteristics of a soil from the SW Romanian karst, which reflects the depositional conditions throughout the Holocene, while its basal part preserves the signal of a Mediterranean climate during MIS 5.

References

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