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Late Holocene climate record from Sırtlanini Cave (central west Anatolia) stalagmite: implications from U-series dating, mineralogy and isotope data

Ezgi Ünal İmer[1], İsmail Ömer Yılmaz[1], Mehmet Oruç Baykara[2], and Jian-Xin Zhao[3]
[1]Middle East Technical University , Department of Geological Engineering , Turkey (eunal@metu.edu.tr)
[2]Pamukkale University, Department of Geography, Turkey
[3]The University of Queensland, School of Earth and Environmental Sciences, Australia

Turkey lies along the transition zone between northerly and southerly climate regimes such that it provides opportunity for a good understanding of Holocene climate that impacted ancient Eastern Mediterranean civilizations. Within the scope of the EU-funded SPELEOTOLIA project, 7 caves from western and southwestern Anatolia were visited and several stalagmite samples were collected. Detailed mineralogical and geochemical analyses performed on samples from one of the target caves, the Sırtlanini Cave (Karacasu, Aydın), helps to reconstruct the regional Holocene climate and gives insights on living conditions of Anatolian civilizations, mainly including Roman and Ottoman Empires.

The 450 m-long Sırtlanini Cave (max. depth of ~40 m; ~1060 m a.s.l.) developed within the Mesozoic marbles of the Menderes Massif. We focus on the first set of U-series age, stable and radiogenic isotope (C, O, and Sr) and mineralogical data performed on the stalagmite (SRT-5) from this cave. The drip water isotope data ($\delta^{18}O_{VSMOW}$ = -7.8‰, δD_{VSMOW} = -41.6‰) indicated depletions in O and H isotopes compared to other cave waters in the region. The U-series age results of SRT-5 show that the 423 mm-long stalagmite was deposited fast (0.25 mm/y) between 0.111±0.034 kyr and 1.825±0.421 kyr (BP) spanning the Roman, Byzantine and Ottoman periods. SRT-5 seems to have grown intermittently with at least two possible hiatuses (at around 291 and 401 years BP) based on mineralogical studies. It is mainly composed of fine- to medium-grained columnar calcite, with occasional dendritic fabric and visible annual layering, particularly at the older bottom section of the stalagmite. Stable isotope profiles ($\delta^{13}C$: -10.5 to -8‰ VPDB, $\delta^{18}O$: -7 to -5.5‰ VPDB) constructed using 423 sub-sample analyses along the stalagmite demonstrate significant hydroclimatic variability through the Little Ice Age and Medieval Warm Period between 195 and 1909 CE. This variation correlates well with previously documented drought and related famine and migration events in western Anatolia primarily in the 19th century. Further investigations (e.g., high-resolution LA-ICPMS trace element analyses) will be performed specifically to constrain the anthropogenic sources and distinguish these from recent Aegean or possible global (e.g., southeast Asian) volcanogenic signals.

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