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Dating the demise of permafrost in South-Western Britain with cryogenic cave carbonates

Marc Luetscher (1,2), Gina Moseley (2), and R. Lawrence Edwards (3)

(1) Austrian Academy of Sciences, Interdisciplinary Mountain Research (marc.luetscher@uibk.ac.at), (2) University of Innsbruck, Institute of Geology, Austria, (3) University of Minnesota, Department of Earth Sciences, USA

Achieving a robust reconstruction of the evolution of permafrost in space and time is essential to characterize landscape dynamics in response to climate change. Because of erosion processes affecting surface sediments, access to potential archives of past permafrost is, however, limited. Cryogenic cave carbonates (CCCcoarse), which form by segregation of solutes during the freezing of cave water, provide a unique opportunity to investigate temporal changes in the regional permafrost distribution of South-Western Britain.

CCCcoarse samples were found in Reservoir Hole and Wookey Hole, two extensive subhorizontal cave systems in the Mendip Hills (Somerset, UK). The samples comprise loose calcite spherolites, 1-5 mm in diameter, deposited on flowstones and/or breakdown blocks between 50 and 200 m below the ground surface. The cave passages are poorly ventilated and the modern temperatures averages ca. 11°C. Nine MC-ICPMS U-series analyses reveal ages clustering around 30.9±0.1, 29.4±0.1 and 14.7±0.1 ka, consistent with rapid climate changes associated with transitions into interstadials. We examine the significance of these ages with respect to the local hydrology and conclude that the area was exposed to widespread permafrost during the Late Pleistocene, largely inhibiting groundwater recharge.