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Investigating the Possible Paleoclimate Significance of a Subterranean Ice Deposit, Idaho, USA

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Strickler Cavern, a "*static cave with firn*" in the terminology of Luetscher and Jeannin (2004) is a remote cave developed in Permian carbonate in the Lost River Range of Idaho, USA. Local collapse of the cave roof, at an elevation of ∼2500 m, provides access to the cave interior, which has a mean annual temperature <0°C. Winter snow and organic matter accumulating in the vertical cave entrance densifies to firn, and is buried by additional snow the subsequent winter. The result is a body of interstratified ice and organic matter at least 30 m thick, the sides of which are locally accessible through narrow gaps between the ice and cave wall. Dating of organics from the deepest accessible part of the cave yielded a conventional radiocarbon age of 320±70 years, which calibrates to between AD 1430 and 1680 (median of AD 1570) at 2-sigma. Fieldwork in July, 2015 involved the collection of additional samples for radiocarbon dating. In addition, 45 ice samples were collected from accessible exposures at three different depths within the layered ice body, and 35 samples were collected from natural exposures within an ice stalagmite. Analysis of these samples with ICP-MS (after filtration to 0.2 μm) reveals detectable amounts of Na, Mg, Al, K, Ca, Ti, V, Cr, Mn, Co, Ni, Cu, Zn, As, Rb, Sr, Zr, Sb, Ba, and Tb. Values of δ^{18}O and δ^{2}H in the samples are strongly correlated (r^2=0.969). Two ice layers (∼10 cm thick) were subsampled completely yielding strikingly consistent δ^{18}O values (c.v. ∼1.5%) within them. This result, combined with the observation that the ice layers originate through compaction of snow, gives confidence that stable isotope values can be used as a proxy for paleo air temperature. Samples from snow and firn representing the 2013-14 and 2014-15 winters have the highest δ^{18}O values (∼-12%¸) whereas deep ice has δ^{18}O values as low as -18‰Ȧ set of 19 samples taken sequentially across ∼40 discrete layers exhibits fluctuating, but generally rising δ^{18}O from bottom to top, suggesting an overall temperature decline during deposition. In contrast, values of δ^{18}O in the ice stalagmite, which is isolated from the main ice mass and apparently formed through freezing of dripwater, generally rise from bottom to top.