Key speleothem paleoclimate results from Fort Stanton Cave

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Stalagmites are the speleothem type primarily used for paleoclimate research. Fort Stanton Cave, New Mexico’s second longest cave, is well-known for its history, cave velvet, and Snowy River. Fort Stanton Cave also hosts exceptional paleoclimate records from its stalagmites and from other speleothem types. The cave is ideally located in the southwestern United States (SW USA) such that cold climatic shifts in the north Atlantic regions during glacial cycles synchronously cause southward sways in the polar storm track that produce climatic oscillations preserved in stalagmites that mimic the north Atlantic climate trends preserved in the Greenland ice sheets. The cave’s position and environment has resulted in speleothem growth occurring only during the last four northern hemisphere (NH) glacial cycles. NH Glacial cycle 1, defined as the Last Glacial Period is well represented in the SW USA by the Estancia basin lacustrine paleoclimate record stretching from ~65 to ~10 ka, where greater effective precipitation during this time not only created Pleistocene Lake Estancia, but also decorated Fort Stanton Cave with calcite speleothems ~55 to ~10 ka. Two Fort Stanton Cave paleoclimate records, one from stalagmite FS-2 and the other from stalagmite FS-AH1 exhibit δ⁻¹⁸O time-series that match the Greenland ice core records remarkably well. The correlation between FS-AH1 and the Greenland ice core δ⁻¹⁸O time-series of R = 0.64 (chronologies are independent and untuned) suggests that Fort Stanton Cave stalagmites that grew during previous glacial cycles could serve as synthetic Greenland ice core δ⁻¹⁸O time-series. Growth and non-growth of speleothems in Fort Stanton Cave provide a regional effective moisture index in that speleothem growth takes place only during the glacial cycles, indicating that glacial cycles are pluvial intervals in the SW USA, something alluded to in the literature, but not well resolved for the previous three NH glacial cycles. Growth of stalagmites, and therefore glacial driven pluvial moisture, ends abruptly at glacial terminations. Our results also show that greater thickness of overburden seemingly interferes with the stable isotope signals.

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