Assessing influences on speleothem ^{14}C variability: Implications for speleothem-based ^{14}C calibrations

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Reconstructing past atmospheric radiocarbon ($\Delta^{14}C$) concentration is essential for improving the calibration of the radiocarbon timescale, investigating past variations in solar activity and Earth's paleomagnetic field, and investigating the redistribution of carbon between terrestrial, atmospheric, and marine reservoirs that occurred over the past 50,000 years. Previous work suggests that U-Th dated speleothems hold great potential for improving the record of atmospheric $\Delta^{14}C$, but may be complicated by changes in dead carbon proportion (DCP) derived from bedrock. To address this issue, we have conducted a detailed study of radiocarbon systematics in a modern cave system at Heshang Cave, China (30°27'N, 110°25'E; 294 m), the site of ongoing, extensive modern calibration and paleoclimate reconstruction efforts. We will present ^{14}C results from soil CO_2, dripwater DIC, and modern calcite samples collected monthly to seasonally from 2007 - 2011 to investigate how seasonal environmental changes impact carbon cycling at our site. In addition, we will present a high-resolution DCP record from a U-Th dated stalagmite (HS-4), spanning 0.5-9.5 ka, representing the longest period of overlap between a speleothem-based reconstruction of atmospheric ^{14}C and the robust Holocene tree-ring ^{14}C record to date.

Dripwater, soil, and modern calcite results show clear seasonal variability, with higher $\Delta^{14}C$ values in the summer, likely reflecting increased respiration of young, bomb ^{14}C rich soil organic matter (SOM) during the summer monsoon months. HS-4 DCP appears fairly constant over the Holocene, at 10 ± 1%, though increases observed during the wet mid-Holocene interval and decreases during the dry 8.2 ka event are suggestive of some minor climatic influence. Unlike the modern seasonal ^{14}C cycles, which likely reflect SOM dynamics, we demonstrate that these DCP shifts are more likely caused by shifts in closed vs. open system dissolution in response to changing soil moisture.