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Construction of reliable radiocarbon-based chronologies for speleothems

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Speleothems have become one of the most widely applied archives for paleoclimate research. One of their key advantages is their amenability for U-series dating, often producing excellent high precision chronologies. However, stalagmites with high detrital Th or very low U concentrations are problematic to date using U-series, and sometimes need to be discarded from further paleoclimate analysis. Radiocarbon chronologies could present an alternative for stalagmites that cannot be dated using U-series, if offsets from the "dead carbon fraction" (DCF) can be resolved. The DCF is a variable reservoir effect introduced by the addition of ^{14}C-dead carbon from host rock dissolution and soil organic matter. We present a novel age modeling technique that provides accurate ^{14}C-based chronologies for stalagmites. As this technique focuses on the long-term decay pattern of ^{14}C, it is only applicable on stalagmites that show no secular variability in their ^{14}C-depth profiles, but is independent of short-term DCF variations. In order to determine whether a stalagmite is suitable for this method without direct knowledge of long-term trends in the DCF, we highlight how other geochemical proxies (δ^{13}C, Mg/Ca) can provide additional information on changes in karst hydrology, soil conditions, and climate that would affect DCF. We apply our model on a previously published U-Th dated stalagmite ^{14}C dataset from Heshang Cave, China with excellent results, followed by a previously 'undateable' stalagmite from southern Poland.