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High-precision loess chronologies by ^{14}C-dating of small molluscs

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Despite that loess records provide a wealth of information on abrupt climatic and environmental changes, almost all such records have low precision chronologies. Age-depth models of loess sequences have uncertainties reaching thousands of years thereby rendering proxy interpretations highly ambiguous on millennial/sub-millennial timescales. This is partly because OSL/IRSL dating techniques, commonly applied to eolian deposits, yield imprecise ages on such timescales. Also, ^{14}C-dating of organic matter, secondary carbonates and humic acids provide questionable and mostly unreliable dates, for reasons not detailed here. At the same time, charcoals that are regarded as phases yielding reliable ages rarely occur in loess sequences and ^{14}C-dates of molluscs are often anomalously old due to dead carbon incorporation during shell formation.

Here we show that some species of molluscs having small ($\leqq$ 10 mm) shells incorporate very low amounts of ^{14}C-deficient carbon into their shells and provide reliable ages as revealed by testing against charcoal ages and against a Bayesian age-depth model. 56 AMS radiocarbon ages were generated from a loess profile at Dunaszekcso (Hungary). Of these ages four originate from charcoals and are taken as reference. Comparison of mollusc shell ages with those of charcoals reveal that *Succinella oblonga* and *Vitrea crystallina* give statistically indistinguishable ages, while *Chondrula tridens* and Clausilia sp. shells show age anomalies ranging from 500 to 900 ^{14}C yr. Testing against a Bayesian age model resting on 48 ^{14}C ages at different depths (2-3 ages from each depth), highlights that, beyond *S. oblonga* and *V. crystallina*, species like *Orcula dolium*, *Discus ruderatus*, *Euconulus fulvus*, *Pupilla muscorum* and *Vallonia costata* yield relatively accurate ages (anomalies mostly within ±300 cal BP yr). This investigation also demonstrates that *Trichia hispida* is best avoided in ^{14}C-dating studies and that micrographitization of shells, in case of low carbon contents after preparation, always results in anomalous ages.