^{14}C labeling approach to understand the dynamics of shell carbonate recrystallizaton

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Isotopic signatures of carbon in mollusc shells are commonly used for reconstructing paleoenvironmet and radiocarbon dating. Recrystallization of shell carbonate in soils, however, re-equilibrates the isotopic signatures of carbon in shell carbonate with soil CO_2. The dynamics of this process remain poorly understood because of the absence of suitable experiments. This study was designed to assess shell carbonate recrystallization rates, to investigate the affecting factors and to calculate the recrystallized amounts as a function of time. Loess and a loamy soil were selected as carbonate-containing and carbonate-free matrixes, respectively, and were mixed with shell particles (2-2.5 mm) of *Protothaca staminea*. The shells were containing and free of organics (removed by heating at 550 °C). Loess and soil in air-tight bottles were incubated in air labeled with $^{14}CO_2$ (pCO_2 = 2%) for two months. At increasing time periods, the measured ^{14}C activity in shells was related to the recrystallization. Recrystallization of shell carbonate already began after one day of incubation and increased exponentially with time. Carbonate recrystallization was higher in loess and in organics-free shells. Eliminating organic compounds increased shell porosity and consequently increased the contact surface of soil solution with shell carbonate. Organics-free shells in presence of loess carbonate showed the highest recrystallization (0.56%). The shell carbonate recrystallization rates ranged between 1.0 10^{-3} and 1.6 10^{-2} % day^{-1}. A model for shell carbonate recrystallization as a function of time was also developed which showed nearly full recrystallization, takes place in 88 years for shells free of organics in loess and up to 770 years for shells with organics in carbonate-free soil. Thus, the recrystallization of shell carbonate may proceed relatively rapidly in terms of geologic time. This is necessary to consider in the interpretation of dating results and paleoenvironment reconstructions.