Geophysical Research Abstracts, Vol. 9, 02731, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-02731

Principles and potential of 14C labeling for studying re-crystallization of soil carbonates

Y. Kuzyakov (1), E. Schevtzova (2), K. Pustovoytov (2)

(1) Dep. of Agroecosystem Research, University of Bayreuth, Bayreuth, Germany kuzyakov@bayreuth.de, (2) Institute of Soil Science and Land Evaluation, University of Hohenheim, Stuttgart, Germany

CO2 production by microbial and root respiration is the main factor controlling the dissolution of primary (lithogenic, geogenic) carbonates in soil and the formation of secondary (pedogenic) carbonates. Although several estimations of soil age and many paleo-environmental reconstructions are based on the radiocarbon age and d13C and d18O of secondary carbonates, their formation rate remains unknown. We used the isotopic exchange between primary carbonates of loess and 14C respired from the rhizosphere of wheat that was labeled in a 14CO2 atmosphere. Wheat was labeled for 2 hours in a Plexiglas chamber with artificial 14CO2 atmosphere. 14C released in the rhizosphere as 14CO2 by root and rhizomicrobial respiration exchanged isotopically with CO32- of CaCO3 of loess. Subsequently, 14C activity in CaCO3 was measured by scintillation counting. An ascending number of 14CO2 pulses (1Ĕ4) showed a linear increase of rhizosphere 14C recovered in the CaCO3 of loess. Based on this linear regression, the initial re-crystallization rates of loess carbonate were calculated: for loess containing 27% CaCO3, the initial rate of carbonate re-crystallization was 0.000029 day-1. Subsequently, using linear and exponential approaches with different lengths of growing season, we extrapolate the observed CaCO3 re-crystallization on longer time periods. The calculations show that at least 100 years, but probably between 400 and 2000 years, are necessary for full (99%) re-crystallization of the CaCO3 of loess. We suggest a general equation for calculating the remaining not re-crystallized CaCO3 depending on time (t) of soil formation: %CaCO3(t) = 100 . exp(-t . 0.00078 . GrowingSeasonLength . 365-1 . initialCaCO3percentage-1) We conclude that despite the high analytical precision of radiocarbon dating and d13C and d18O mass spectrometry of secondary carbonates (used, e.g. for paleo-environmental recon-

structions), the methodological resolution cannot be better than the periods necessary for $CaCO_3$ re-crystallization.