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Estimating turnover times of soil organic carbon fractions based on natural C-14 abundance

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The knowledge of turnover times of different well defined and meaningful soil organic carbon (SOC) fractions is valuable to better understand SOC dynamics in contrasting land use systems. The aim of the present study was to determine turnover times of SOC fractions as separated by a combination of physical and chemical methods. Soils from three different land uses (woodland, native grassland and cropped land) and two soil types (Chromosol and Vertosol) were collected from northern cropping region of New South Wales, Australia. Each soil sample was first physically fractionated into particulate organic carbon (POC) (>53 μm) and silt+clay (s+c) (<53 μm) fractions by dispersion with 5% sodium hexametaphosphate followed by sieving. Second, the chemically resistant SOC fraction or inert organic matter (IOM) was separated from s+c fraction by oxidation with 6% sodium hypochlorite (NaOCl). Natural C-14 abundances in the SOC fractions were measured by accelerator mass spectrometer (AMS).The POC fraction had the shorter turnover times (10 to $\sim$370 yr) compared to those of other SOC fractions. The s+c fraction (excluding IOM fraction) had intermediate turnover times (230 to $\sim$3100 yr), with radiocarbon ages ranging from modern to $\sim$1100 yr BP (before present). The IOM had the oldest carbon compared to that of other SOC fractions, with radio carbon ages ranging from modern to $\sim$1950 yr BP. Organic carbon in almost all the fractions in cropped soils were older compared to native woodland and grassland. In cropped soils, turnover times of different SOC fractions were longer compared to woodland and native grassland.