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Use of radiocarbon and spectroscopic analyses to characterise soil organic matter pools isolated using different fractionation techniques.

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Experimental division of soil organic matter (SOM) into functional pools has the potential to improve soil C modelling. Soil physical fractionation techniques seek to quantify these pools, however the fractions isolated vary in number, size, ecological role and composition. The use of different techniques to quantify soil C fractions in different studies presents a question – do similar fractions isolated by different methods fit the same conceptual definition?

This study examined a sandy loam from the south-west of Scotland, sampled in summer, which had been under grassland management for at least 20 years.

We compared average 14C ages of SOM fractions isolated using three published and frequently applied physical fractionation methods (1) a density separation technique isolating three fractions – free light (FLF) < 1.8 cm 3, intra-aggregate light (IALF) < 1.8 cm-3 after aggregate disruption, and organo-mineral (O-min) > 1.8 g cm 3 (Sohi et al, 2001); (2) a combined physical and chemical separation isolating five fractions: sand and aggregates (S+A) > 63 μm and > 1.8 g cm-3, particulate organic matter (POM) > 63 μm and < 1.8 g cm 3, silt and clay (s+c) < 63 but > 45 μm, residual organic carbon (rSOC) the residue left after s+c is oxidised with NaOCl, and dissolved organic carbon (DOC) < 45 μm (Zimmermann et al, 2007); and (3) a hot water extraction method isolating two fractions: water soluble C (WSC) at 20 °C and hot water extractable C (HWEC) at 80 °C (Ghani et al, 2003).

The fractions from Method 1 had the most distinct average 14C ages with O-min, FLF and IALF assessed as 206, 1965 and 6172 years before present (BP) respectively. The fractions from Method 2 fell into two age groups, < ∼1000 years BP for s+c, rSOC and S+A and > 4000 years BP for DOC and POM. Both Method 3 fractions were dominated by modern C. The average 14C ages of FLF, IALF, DOC and POM were surprisingly higher than the mineral bound fractions, although they made up a relatively small proportion of the total organic C (8.4 and 12.4 % for Methods 1 and 2 respectively).

These results will be discussed alongside data from FTIR and UV-vis spectroscopy. The characterisation of physically separated organic matter pools is likely to provide improved opportunities for modelling the long term behaviour of SOM on the basis of defined chemical and physical properties.

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