Soil organic matter stabilisation and turnover from different perspectives

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Understanding the persistence of organic matter in soils can draw on a range of techniques, from studies of detailed molecular-scale interactions to the modelling of turnover rates based on radiocarbon.

At the molecular scale, natural organic matter interacts with protons and metals depending upon the chemistry of the soil. These interactions can be modelled using chemical equilibrium speciation codes such as WHAM [1]. Metal binding affects other physico-chemical properties of the organic matter, notably its tendency to sorb to mineral surfaces.

The dynamics of organic matter in soil also need to be taken into account. In a modelling study of DOM production and transport in forest soils at the plot scale [2], the best explanation of the observed pools, fluxes and ^{14}C values of organic matter was obtained if, following sorption of DOM to A and B horizon mineral surfaces, a "maturing" reaction occurred, to form mineral-associated soil organic matter with a turnover time of several hundred years.

Recent modelling of global topsoil radiocarbon data [3] showed that the soil organic matter can on average be partitioned equally between 20-year and 1000-year turnover pools. Although the soils showed considerable variation in the partitioning proportions, no strong relationships to temperature, pH or soil mineral matter content could be identified. Therefore other factors are presumably also operating to cause differences in organic matter stability among soils.

[1] Tipping *et al* (2011) *Environ. Chem.* **8**, 225-235. [2] Tipping *et al* (2012) *Biogeochem.* **108**, 91–107. [3] Mills *et al* (2014) *Biogeochem.* In press.