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Relative importance of adsorption versus aggregation for organic matter storage in subsoil horizons of two contrasting soils

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Soil organic matter stabilisation by the mineral phase can take place through adsorption and aggregation. For subsoil horizons, most studies addressed stabilisation by interaction with minerals. In this study, we distinguished both processes, i.e. organic carbon (OC) adsorption onto clay-sized particles and OC occlusion in silt-size aggregates. The objective was to evaluate their relative importance for organic matter storage and stabilisation in soil. We studied two loamy soil profiles (neo luvisol; cambisol overlying a paleo-ferralsol) under agricultural use down to two meters deep. Our conceptual approach is based on two parallel fractionation methods using different dispersion intensities, which yielded a free clay fraction (i.e. non-occluded) and a clay fraction occluded within water stable silt-size aggregates. The two clay fractions were analysed for their carbon content and 14C activity. The proportion of adsorbed OC was estimated as OC loss after HF-demineralisation.

Our results showed an important contribution of occlusion into silt-size aggregates to C stabilization all along the two soil profiles. In the neo-luvisol, OC associated to clay within silt-size aggregates accounted for 34-64% of the total soil OC, whereas in the cambisol overlying the paleo ferralsol, it represented 34-40% of total OC. In the neo-luvisol, more OC was located in silt-size aggregates than adsorbed to clay-size minerals, suggesting that silt size
aggregation might play a dominant role in OC storage in this soil. In the paleo ferralsol, the abundance of adsorbed OC increased with depth and became slightly more important than OC associated with silt-size aggregates. Radiocarbon dating of both clay fractions (occluded within silt-size aggregates or not) suggests, in the case of the paleo ferralsol, a preferential stabilisation of OC within silt-size aggregates.