The composition and origin of hydrolysable and mineral-protected lipids in shrub-dominated soil profiles

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To understand the properties and dynamics of subsoil carbon and the importance of mineral association for soil organic carbon (SOC) storage, we chose nine shrub-dominated sites in North and South China and used gas chromatography-mass spectrometry to analyze mineral-bound lipids released after HF dissolution of soil minerals in the depth profiles. We further compared their molecular composition with that of hydrolysable lipids isolated from the same soils before HF treatment. It is found that compounds derived from cutin in leaf epidermis and suberin in roots and bark periderm decreased with increasing soil depth of up to 1 m, whereas microbial-derived short-chain lipids showed the opposite trend. This suggests that subsoil SOC consists more of microbial carbon than the topsoil. In addition, mineral-protected lipids were mainly of microbial sources indicated by the high abundance of short-chain fatty acids and alkanols, likely resulting from the clustering of soil microorganisms at mineral surfaces. Interestingly, a relatively high amount of alkanes became extractable after HF treatment, especially even-numbered alkanes which are not enriched in plants but may indicate degradation products of other alkyl lipids. Overall, our detailed molecular investigation on mineral-associated lipids provides direct evidence for the importance of microbial-derived or -processed carbon in the "stabilized" SOC pool.