Geogenic CO_2 affects the composition of soil organic matter

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The presence of geogenic CO_2 has been recently identified as a soil-forming factor in soil on mofette sites. Studies on soil along a transect on a "moderate" mofette site (with CO_2 concentrations in the soil atmosphere < 52%) have shown clear effects on the quantitative and qualitative composition of soil organic matter, SOM [1, 2].

Topsoil samples (pH 3.4-4) were subjected to physical fractionation, resulting in free particulate OM (fPOM), occluded particulate OM (oPOM) (both sieved to < and > 20 µm) and particle-size fractions. All fractions were studied by elemental analysis, and ^{13}C NMR and DRIFT spectroscopy.

The larger part of total SOC was allocated to the mineral fractions (up to 76%). However, the proportion of SOC in POM fractions increased linearly with increasing $c(CO_2)$, and decreased in the clay fractions. At $c(CO_2)$ = 15-20%, these proportions remained almost constant. These results point to a smaller extent of SOM stabilization by interactions with minerals of the clay fraction at increasing $c(CO_2)$. The ratio of alkyl C to O-alkyl C, derived from ^{13}C NMR spectroscopy and indicating the extent of decomposition, was largest for the oPOM fractions and smallest for the fPOM fractions. As derived from DRIFT spectroscopy, $c(CO_2)$ also affected the compositon of SOM in the fractions. The presence of carboxyl groups was negatively correlated with $c(CO_2)$ for the fPOM fractions, and so was a parameter indicating oxidative transformation. For the oPOM < 20 µm, a negative correlation was detected for $c(CO_2)$ and an indicator of metal complexation, pointing to pure physical encapsulation. Soil OM in the clay fraction was transformed to small extent. Further, the indicator of oxidative transformation was negatively correlated with the contents of exchangeable Al, pointing to preferential interaction of transformed SOM with minerals of the clay fraction by Al bridging.

These clear effects of $c(CO_2)$ on allocation of SOM to fractions and their composition may also occur in soils with enhanced $c(CO_2)$ (approx. 15%) of biogenic origin, for instance within aggregates of compacted soils. Thus, these results may be also transferred to other soils, not affected by geogenic CO_2, but on a smaller spatial scale.

[1] Rennert & Pfanz (2015), *Eur. J. Soil Sci.* 66, 838-846.
[2] Rennert (2018), *Soil Res.* 56, in press.