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Using stable C isotopes to measure the movement and turnover of dissolved organic matter in deep unsaturated profiles

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Stable carbon isotope analysis is a useful tool in soil sciences, and has been applied increasingly in the recent years. Taking advantage of the distinct photosynthetic carbon fractionation differences, between C3 and C4 plants, we aim to understand the transportation and turnover of plant derived dissolved organic matter (DOM). It is important to get a better understanding of the transport, turnover and sequestration of DOM in the unsaturated zone, as these mechanisms have a direct effect on the protection and quality of groundwater below.

For this purpose water practices for extracted organic matter (WEOM) collection and stable isotope analysis, was refined. In addition, soil batch incubations were established to study vertical C decomposition patterns

Soil samples down to 1.5 meters depth were excavated from a location near Gadbjerg, Eastern Jutland, Denmark (55.747007, 9.282627). Samples were taken from a maize field (C4 monoculture from 2010-2016) classified as an ambic arenosol, and from a nearby wheat field (kept with C3 plants), classified as a cambic arenosol.

Incubation experiments on field moist soil revealed significant respiratory CO_2 production from all soil horizons below the maize field. For the wheat field, soil horizons up to 1.2 meters depth showed a significant respiratory CO_2 production. Thus, the Gadbjerg soils sustain microbial activity well below the top Ap horizon.

The respired $CO_2$from the two soil profiles showed a clear difference in δ^{13}C to the depth of 1 meter. The distinct isotopic signatures are likely due to the different crop histories. Therefore, it is implied that the organic matter originating from the maize crops, has been sequestered in significant amounts at least down to 1 meter depth over the course of 8 years.

Results of whole soil and DOM δ^{13}C are still being processed. In addition, results of incubation experiments determining the nitrate reduction capacity of the various soil depths will be achieved.

Additional fieldwork, including core drilling down to 5 meters, will take place on the Gadbjerg site this year, offering a better spatial and vertical resolution of the soil variations, and will account for any seasonal variability.