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Enhanced bioavailability of dissolved organic matter after artificial soil aggregate disruption

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Dissolved organic matter (DOM) is probably the most bioavailable fraction in soils. Nevertheless a variety of chemical and physical mechanisms is protecting the dissolvable soil organic matter (SOM) against dissolution and microbial degradation. Therefore a main physical aspect is the occlusion of DOM in aggregates. Thus the disruption of soil aggregates via drying - rewetting and freeze - thaw cycles can release large amounts of DOM. On a laboratory scale disruption of soil aggregates by ultrasonication can provide information about the amount and the composition of DOM that was stabilized within aggregates.

The main objective of the study is to discover to which extent DOM released from aggregate interiors via ultrasonic disruption influences heterotrophic soil respiration. Furthermore the quality of the DOM before and after the incubation is of major interest. Therefore bulk soil from the upper 5 cm of an A horizon from an agricultural crop land was treated ultrasonically (energy input: 200 J ml^{-1}) in order to destroy soil aggregates. The obtained material was mixed with sand and incubated in triplicate for one as well as three weeks at 20˚C and constant water content. As a reference the bulk soil and a bulk-soil-sand mixture had been incubated simultaneously. Before and after the incubation experiment the quality of the extractable DOM was specified by UV-absorbance, solid state ^{13}C-CPMAS NMR spectroscopy and sugar analysis via GC/MS. The DOM was extracted with 0.01 M K_2SO_4 solution in order to imitate the ionic strength of natural soil water. For solid state ^{13}C-CPMAS NMR spectroscopy the extracts were freeze dried.

In the extract from the ultrasonically treated soil more dissolved organic carbon (DOC) could be detected. Though the specific UV-absorbance (SUV) normalized for the DOC content showed no differences between the samples before incubation. Also the ^{13}C-NMR spectra indicated a very similar chemical composition of the extractable DOM of untreated and treated samples. Nevertheless during the respiration experiment the treated samples released more CO_2 than the untreated. From the obtained data it can be assumed that the artificial release of DOM from soil aggregates is enhancing soil respiration. The respiration rates provoke the assumption that this only happens on a short timescale until the larger initial DOM fraction of the treated samples is decomposed.