Geophysical Research Abstracts
Vol. 16, EGU2014-16389, 2014
EGU General Assembly 2014

Soil pore structure and substrate C mineralization

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Our aim was to investigate the complex interactions between soil pore structure, soil biota and decomposition of added OM substrates. We report on a lab incubation experiment in which CO_2 respiration from soil cores was monitored (headspace GC analysis) and an X-ray CT approach yielded soil pore size distributions. Such combined use of X-ray CT with soil incubation studies was obstructed, until now, by many practical constraints such as CT-volume quality, limited resolution, scanning time and complex soil pore network quantification, which have largely been overcome in this study.

We incubated a sandy loam soil (with application of ground grass or sawdust) in 18 small aluminium rings (Ø 1 cm, h 1 cm). Bulk density was adjusted to 1.1 or 1.3 Mg m-3 (compaction) and 6 rings were filled at a coarser Coarse Sand:Fine Sand:Silt+Clay ratio. While compaction induced a strong reduction in the cumulative C mineralization for both grass and sawdust substrates, artificial change to a coarser soil texture only reduced net C mineralization from the added sawdust. There thus appears to be a strong interaction effect between soil pore structure and substrate type on substrate decomposition. Correlation coefficients between the C mineralization rates and volumes of 7 pore size classes (from the X-ray CT data) also showed an increasing positive correlation with increasing pore size. Since any particulate organic matter initially present in the soil was removed prior to the experiment (sieving, ashing the >53μm fraction and recombining with the <53μm fraction), the added OM can be localized by means of X-ray CT. Through on-going image analysis the surrounding porosity of the added grass or sawdust particles is being quantified to further study the interaction between the soil pore structure and substrate decomposition.