Geophysical Research Abstracts
Vol. 20, EGU2018-2794, 2018
EGU General Assembly 2018

Organic matter decomposition during remediation of acid sulfate soils

Angelika Koelbl (1), Petra Marschner (2), Rob Fitzpatrick (3), Luke Mosley (3), Ingrid Kögel-Knabner (1,4)

(1) Chair of Soil Science, Technical University of Munich, Freising, Germany, (2) School of Agriculture, Food and Wine, The University of Adelaide, Adelaide, Australia, (3) Acid Sulfate Soils Centre, The University of Adelaide, Adelaide, Australia, (4) Institute for Advanced Study, Technical University of Munich, Garching, Germany

When acid sulfate soils with hypersulfidic material dry, oxidation of pyrite can cause strong acidification (pH $<$4) to form sulfuric material. Re-saturation of acid sulfate soils with sulfuric material can lead to re-formation of pyrite and pH increase through activity of sulfate reducing bacteria (SRB), which require available organic carbon (OC).

We investigated why acid sulfate soils with sulfuric material in the Lower River Murray regions in Australia have not recovered from acidification after the severe millennium drought over a decade ago. Chemical characterization of OC by solid-state ^{13}C NMR spectroscopy revealed small proportions of easily degradable carbohydrates and proteins, but high proportions of hardly degradable lignin and lipids. The low quality and availability of OC likely limits the activity of SRB. To overcome substrate limitation, we added different amounts of OC to an acid sulfate soil with sulfuric material (approx. pH 3.5) in anoxic laboratory incubation experiments. Beside a control treatment without any OC addition, wheat straw and cattle manure were added at 4 mg g^{-1} soil and 18 mg g^{-1} soil, corresponding to 10% and 50% of the original soil OC, respectively. The results demonstrate that pH neutralization is clearly faster in treatments with high OC addition, reaching pH $\geq$6.0 within 3 weeks. Treatments with low OC additions showed a distinctly slower pH increase, reaching values between pH 5.5 and 6.0 after one year of anoxic incubation. The control treatment had pH values $<$ 5.0 at the end of the experiment. Thus, remediation of acid sulfate soils with sulfuric material can be significantly accelerated by high OC additions.

After one year of anoxic incubation, the experiment was terminated. OC concentrations were measured before and after incubation to determine OC loss during incubation. OC composition was analyzed before and after incubation by solid-state ^{13}C NMR spectroscopy to assess its chemical degradation. OC losses ranged between 10 and 20% of bulk soil OC, with higher proportion in treatments with high OC additions. OC composition changed little compared to the start of the experiment, showing slightly reduced proportions of carbohydrates ($\leq$ 10% loss) and associated higher proportions of lipids and lignin. The results indicate that only a small proportion of OC was decomposed, whereas a larger proportion remained unchanged.