

Iron minerals in peat areas of Iceland: modelling, phase transformation and environmental impact

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Peat lands cover huge areas in the sub-arctic and store vast amounts of organic carbon. Their soil waters are reduced and rich in dissolved carbon, metals and nutrients. Peat lands buffer natural floods as well as metal- and nutrient-fluxes to the oceans. These fluxes are affected by climate change and man-made drainage channels. Here we propose to define the *in situ* mineralogy and soil water composition in Icelandic peat, under variable dust fluxes, and their evolution along oxidation, pH and salinity gradients. The dust is mostly basaltic glass, which is the main source of metals, and tends to increase the pH of the soil solutions when it dissolves.

The PHREEQC program was used with the MINTEQ.V4 database and additional thermodynamic data on green rust phases to model the stability fields of iron-containing minerals and aqueous species as a function of pH and Eh. The stability fields were constrained by measured compositions of peat solutions and the observation that the formation of hematite and magnetite rarely occur in these waters. Furthermore, adsorption/desorption properties of ferrihydrite were determined along oxidation and salinity gradients. Ferrihydrite dominates most of the Eh-pH-space of the *in situ* peat waters along with the Fe^{2+} species at low Eh. It is just under the most reducing conditions ($\text{Eh} < -0.1$ V) and relatively high pH (>7.3) that green rust (GR1(CO₃)) and siderite are stable. Pyrite is only stable in soil solutions with relatively little total dissolved Fe at low Eh. When these solutions are exposed to oxygen in natural and man-made trenches, the aqueous Fe^{2+} is largely transformed into ferrihydrite; although it has been shown that green rust can form as metastable intermediate phases. According to the model, the precipitation of ferrihydrite leads to the near complete adsorption of P, As, Pb and Cu and then, in descending order, Zn (85%), Cd, Ni and Mn (18%). When the ferrihydrite enters the ocean, some of these metals will be immediately released to the coastal waters, though Pb and As are last after mixing more than 1:100,000 with seawater. These model results will be tested by field and laboratory experiments.

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