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Silicon in peatland biogeochemistry: the one to rule them all?

Jörg Schaller (1), Gloria Reithmaier (1), Klaus-Holger Knorr (2), and Britta Planer-Friedrich (1)

(1) Environmental Geochemistry, University Bayreuth, Germany (Joerg.Schaller@uni-bayreuth.de), (2) Institute of Landscape Ecology, University of Münster, Germany

Peatlands perform important ecosystem services, such as carbon storage, nutrient and trace element retention, and water quality regulation, all of which are influenced by peat decomposition. Since decomposition of organic material was recently shown to be accelerated by silicon (Si), the aim of this study was to examine how Si influences the decomposability of organic matter and the production of CH4 and CO_2 in peatlands. Consequently, a Si fertilization experiment was conducted at a German fen site, increasing natural concentrations 4-fold. Under enhanced Si availability dissolved organic carbon, carbon dioxide and methane concentrations increased significantly in the porewater, indicating that Si negatively affects carbon storage. Dissolved nitrogen, phosphorus, iron, manganese, cobalt, zinc, and arsenic concentrations were also significantly higher under Si enriched conditions. This enhanced mobilization of major and trace elements may result from Si competing for binding sites and stronger reducing conditions, caused by accelerated decomposition. The stronger reducing conditions also increased reduction of arsenate to arsenite. In summary, increased Si concentrations negatively affected nutrient retention and induced mobilization of toxic elements. In a survey of 18 nearby fens, Si concentrations were found to cover a range from $\sim$1 to 9 mg/L, suggesting peatland processes and related ecosystem services to be strongly affected by Si availability.