Goldschmidt 2023 Abstract
https://doi.org/10.7185/gold2023.18885

Utilization of X-Ray Absorption Fine Structure to Identify Iron Speciation in an Experimentally Warmed Bog

MARICIA PACHECO[1], CAROLINE PIERCE[1], RANDALL KOLKA[2], STEPHEN SEBESTYEN[2], STEVEN HALL[3], WILLIAM ARNOLD[1] AND BRANDY M TONER[1]

[1]University of Minnesota - Twin Cities
[2]USDA Forest Service Northern Research Station
[3]Iowa State University

Presenting Author: pache028@umn.edu

Peatlands store 500 petagrams of soil carbon due to cold and wet conditions that limit microbial and oxidative activity[1][2]. Projected climate change is likely to alter these soil dynamics, with unknown consequences for future carbon cycling. Recent work at the Spruce and Peatland Response Under Changing Environments (SPRUCE) site identified iron in significant concentrations (300-4000 mg Fe/kg peat)[3]. Iron impacts carbon cycling by stabilizing organic carbon or decomposing organic carbon through redox processes [4][5]. The objective of this study was to identify how soil and atmospheric warming (0 to +9°C) influenced iron speciation for solid peat and near-surface lateral runoff in an experimentally warmed bog. Field samples were collected from the SPRUCE site, located in the USDA Forest Service Marcell Experimental Forest (MEF) in northern Minnesota, USA. Publicly available datasets from the MEF (i.e, Total Fe, Fe(II), Fe(III)) were utilized to enhance our findings. We predicted that Fe(II) concentrations in samples would be the greatest at moderately elevated temperatures (+4.5) due to greater Fe(III) reduction and plateau at extreme temperatures (+ 9 C) due to drier soil conditions[6][7]. Samples were analyzed at the Advanced Photon Source using Fe X-Ray Absorption Near Edge Spectroscopy and Extended X-Ray Absorption Fine Structure spectroscopy. Preliminary results suggest that Fe(III) and Fe(III)-organic complexes are important iron species in samples. The present work provides information on how iron speciation changes under elevated temperatures.

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