Carbon Chemistry of Peatland Soil Across Climate Zones

Normand, A.E. (UF, Soil and Water Science); Smith, A.N. (UF, Chemistry); Cheesman, A.W. (James Cook University, Marine and Tropical Biology); Reddy, K.R. (UF, Soil and Water Science)

Introduction

Climate change will inevitably dictate the fate of peatland soil organic matter (SOM) stability which stores ~462 Pg carbon (C) – more C than any other terrestrial ecosystem[1]. Destabilization of this large and potentially vulnerable pool of C could have a major impact on climate through microbial respiration producing greenhouse gasses. The stability of SOM is dependent on its chemical composition, yet a holistic study focusing on peatland SOM chemical composition across the globe is lacking. ^{13}C Solid State NMR analysis may provide clarity about the response of SOM from climatic change by differentiating carbon functional groups varying in molecular stability[2].

Experimental

Peat soil samples from top soil (0-10 cm) were collected from 24 peatlands across climate zones: subarctic (5), temperate (7), subtropical (7), and tropical (5). CPTOSS ^{13}C Solid State NMR sprectra of dried, ground samples were obtained using a Bruker Avance II 500 MHz Spectrometer with a 3.2 mm H/C/N MAS probe at the AMRIS Facility. Spectra peaks were integrated to determine percent of C functional groups: carboxyl, aromatic, O-alkyl, methoxyl, and alkyl (Fig. 1).

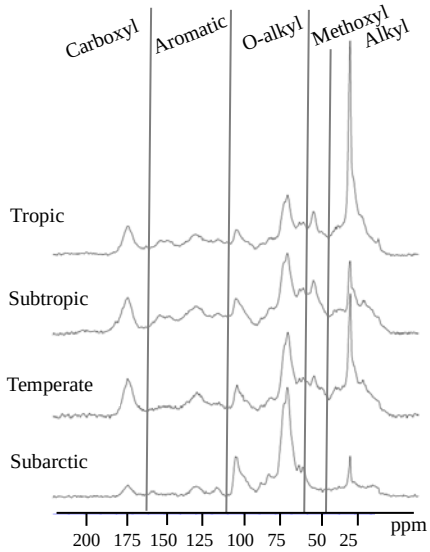

Fig.1 ^{13}C ssNMR spectra of peat across climate zones.

Results and Discussion

Peatland C stocks from northern latitudes had the highest concentration of labile O-alkyl C compromising polysaccharides that are more susceptible to decomposition from climate change (Fig. 2). Northern peatlands accumulate labile carbon due to slow decomposition from inundated conditions, low temperature, limiting nutrients, and acidity[1]. With warmer temperatures, temperate, subtropical, and tropical peatlands have both increased vegetation growth and organic matter decomposition. The carbon stocks of these peatlands had less labile C and contained signatures of more stable soil including lignin and humified SOM (aromatic C), microbial activity byproducts (methoxyl and alkyl C), and persistent carbon forms (alkyl C).

Conclusion and Future Research

^{13}C Solid State NMR revealed contrasting chemical composition of peatland C across climate zones due to environmental conditions. Future research will determine how SOM chemical compositions from climate zones respond to climate change drivers (drought, flooding, warmer temperature, and increased ocean salinity).

Acknowledgements

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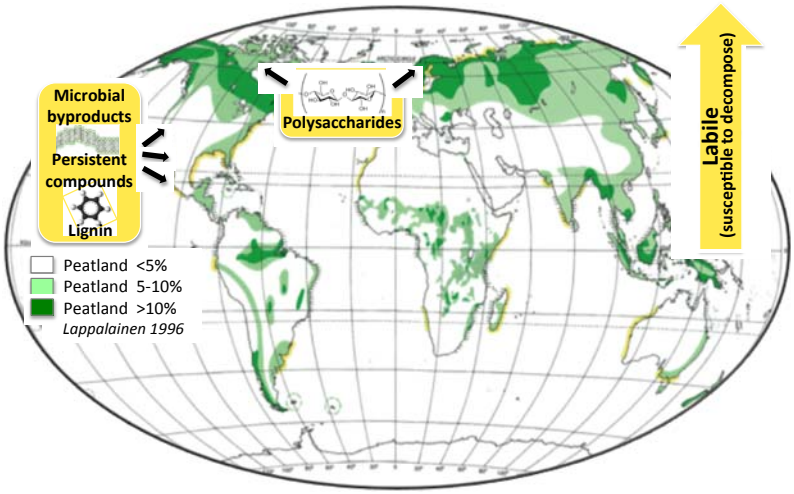

Fig.2 Summary of peat chemical composition across climate zones as determined by ^{13}C ssNMR analysis.

References

[1] Bridgham, S.D., *et al*., Wetlands, **26**, 889-916 (2006).
[2] Derenne, S. and T.T.N. Tu, Comptes Rendus Geoscience, **346**, 53-63 (2014).