Latitudinal Differences in Peatland Organic Chemistry observed by FTIR, UV/Vis Absorption, and Fluorescence Spectroscopies

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The existence of peat deposits at low latitudes, where warm temperatures would be expected to prevent peat accumulation, is thought to be enabled by a combination of phenolic release from plants and the formation of refractory black carbon during low intensity fires. The extent to which these mechanisms may attenuate warming feedbacks in northern peatlands poses a major research question. In this study, we analyzed the chemistry of solid phase peat and dissolved organic matter (DOM) from across a broad latitudinal gradient, which included a thawing permafrost peatland in subarctic Sweden (Stordalen Mire), boreal peatlands in northern Minnesota (Marcell Experimental Forest and Glacial Lake Agassiz Peatlands), a temperate pocosin in North Carolina with frequent fires, a subtropical peatland in the northern Everglades (Loxahatchee), and tropical peat domes in Panama and in Brunei, Borneo. Solid phase peat chemistry was analyzed by Fourier transform infrared (FTIR) spectroscopy, for which novel methods of data analysis are presented. Ratios of peak absorbances to the total spectral area, which reveal quantitative changes in functional group relative abundances, revealed lower carbohydrate and greater aromatic content in southern compared to northern peatlands. Carbohydrates decreased with depth at all sites, and this decrease was accompanied at most sites by increases in aliphatics and slight increases in aromatics with depth. DOM chemistry was examined with UV/visible absorption spectroscopy and excitation-emission matrix spectroscopy (EEMS). Compared to other peatlands, DOM from the Everglades had greater fluorescence/absorbance ratios and absorption spectral slopes consistent with lower molecular weights, as well as shorter fluorescence emission wavelengths consistent with lower aromaticity. This result contrasts with the Everglades' slightly higher solid phase aromaticity compared to northern peat, and suggests that this site's greater minerotrophy may result in greater contribution of recent plant production and microbial activity to the DOM pool. Within the pocosin site, unexpected trends with fire history were observed, in which DOM from locations with recent fires (0–5 years prior to sampling) had lower aromaticity than DOM from a site that had not been burned in 30 years. Overall, the solid phase peat results confirm our hypothesis that southern peat has greater aromaticity and lower carbohydrate content than northern peat. Trends in DOM composition were less straightforward, suggesting that a broader range of factors controls DOM chemistry.