The Role of Phenolic Compounds, Aromatics and Black Carbon Controls on Decomposition, GHG losses in Peatlands Along a Latitudinal Gradient from Minnesota to Panama

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Peatlands have persisted through changing climate over millennia and continue to accrete peat in many globally warmer areas even under accelerated climate driven conditions of drought, warming and fire. Our main hypothesis is that a dual control or "latch mechanism" reduces decomposition in shrub/tree communities in subtropical and tropical peatlands due to (1) higher production of polyphenol and aromatic compounds than found in northern *Sphagnum/Carex* communities, and (2) the buildup of recalcitrant organic matter (black carbon, BC) by light fire in the native-fire-adapted communities leads to a reduction in microbial decay of peat. Here, linking intensive biological and chemical analysis in a series of field and microcosm experiments along our north to south bog gradient from Minnesota to Panama we show how previously unrecognized interactions between these dual mechanisms regulate C sequestration in peatlands. Key findings to-date include (1) a N to S gradient of phenolics exists with NC Pocosin peats having the highest concentrations due to the dominance of high-phenolic shrubs; (2) Peat soil in Pocosins with fire-adapted shrubs also contained the highest BC with the highest hydrophobicity; (3) Fungal communities principally responsible for lignin decomposition were significantly different between northern and Pocosins. Archaeorhizomycetes dominante in Pocosins (11%~52%), while comprising < 1% in northern peatlands, which indicates that long-term drought/fire adapted shrubs may culture fungi with low decomposition ability; (4) Using FTIR and ^{13}C NMR on solid soil samples, we observed increased aromaticity and lower carbohydrate content at lower latitude sites, which indicate that peat in warmer climates lose carbohydrates more rapidly or initially contain lower carbohydrates with higher aromaticity; (5) DOC results obtained with FT-ICR mass spectrometry and EEMS fluorescence spectroscopy indicated lower aromaticity and lower molecular weight compounds at Everglades sites consistent with greater microbial production of the DOC; (6) Recent prescribed fires at the Pocosins strongly decreased carbohydrate content but exposing soil directly to sunlight stimulated CO_2 production by increasing soil temperature. Such priming effects may disappear later, as our in-lab heating experiment shows lower CO_2 emission from burned peat after an initial pulse; (7) Fungal communities in Pocosins were most diverse shortly after the prescribed burn but declined over time. Next year based on current results, we will conduct more in-depth microbial, biological and chemical analysis to explore the potential effects of climate change, like drought and warming, on peat/litter accumulation in boreal, temperate and tropical peatlands, and will further test a phenol/black carbon model.