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Anna Hall, class of 2015

High-latitude peatlands store a large stock of carbon in accumulated belowground biomass, estimated at 500 ± 100 Gt C (Yu 2012). For comparison, the atmospheric C pool is estimated at about 775 Gt (IPCC 2007) making the peatland carbon pool a potentially significant player in the global carbon cycle. Peatland carbon storage is controlled by a balance between plant productivity and decomposition, with plant matter produced during the summer months accumulating from year to year rather than fully decomposing. Peatlands are sensitive to changes in climatic regime and have the potential to shift from a net sink of atmospheric C to a net source of C with future disturbance by climate warming (Yu 2012).

There are two major predictions as to how climate change could affect peatland C accumulation. Warmer temperatures could cause faster decomposition of plant biomass and lead to C release to the atmosphere and a positive feedback effect on climate change (Schuur et al. 2008). If this is the case, current warming trends suggest that peatlands could release up to 100 Gt C to the atmosphere by the year 2100 (Davidson and Janssens 2006). Alternatively, warmer summer temperatures and a longer growing season could lead to faster peat production and therefore CO_2 drawdown from the atmosphere, somewhat mitigating the effects of climate change (Schuur et al. 2008). A detailed study of past C accumulation rates over a known historical warm period gives insight into how peatlands may respond to future climate warming.

This project focuses on C accumulation in peatlands in Labrador, Canada, over the past 8,000 years. Because Canadian peatlands store approximately 150 Gt C, approximately 1/3 of the global peatland carbon pool, it is important to understand how the dynamics of these peatlands could be affected by present and future climate warming (Tarnocai 2006). However, the majority of research has focused on central Canada, leaving significant knowledge gaps surrounding coastal Eastern Canada (vanBellen et al. 2012). Particular emphasis in this study was given to the Holocene Thermal Maximum (HTM) which occurred from 4-6 thousand years ago in Labrador, when summer temperatures were 0.5 – 1°C warmer than at present (Kerwin et al. 2004). This study also attempts to determine the effect of fires on rates of C storage in these peatlands. Lightning-ignited peat fires have the potential to consume stored biomass and release significant CO_2 to the atmosphere (Tarnocai 2006).

Six peat cores (out of a total of 14 collected in Labrador in 2013) were used for this study. Throughout the following year, calibrated radiocarbon dates, bulk density, and percent carbon were used to calculate carbon accumulation rates. This summer, areal charcoal concentration (a measure of macroscopic charcoal used as a proxy for fire severity) was used to determine the influence of fires in this region.

From 8,000 years ago to the present, rates of C accumulation averaged 23.1 ± 6.7 gC m^{-2} yr^{-1}. Accumulation rates were highest during the HTM, averaging 29.6 ± 2.4 g C m^{-2} yr^{-1}. Samples containing macroscopic charcoal had an average concentration of 0.62 mm^2 cm^{-3} with a maximum concentration found of 3.51 mm^2 cm^{-3}. These consistently low charcoal concentrations indicate that fire was neither common nor severe in Labrador peatlands. While Kuhry (1994) and Payette et al. (2012) found that fires in Canada occurred twice as frequently during the HTM than at present, no trends in fire severity were found in these cores, and there was no evidence that fires had a significant influence on C accumulation. Therefore, the C accumulation trend we see in Labrador is not controlled by fire and is likely either a direct result of temperature variation or of vegetational and hydrological shifts caused by changes in climate. This work supports a growing body of evidence from high latitude peatlands suggesting that future warming conditions could lead to increased soil C sequestration.

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