Comparing the effects of temperature and oxyge exposure time on decomposition in boreal peatlands

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Boreal peatlands store organic carbon for millennia, mainly due to low rates of decomposition. We used a series of biochemical indicators, including amino acids, carbohydrates, and lignin phenols, to assess the extent of decomposition in peat cores from the West Siberian Lowland, Russia, and the James Bay Lowland, Canada. Spatial and temporal variability in the extent of decomposition were used to determine the relative influence of temperature and oxygen exposure time on peat decomposition. First, a latitudinal transect of peat cores from the West Siberian Lowland was analyzed. This exploited spatial variability in temperature and oxygen exposure time: mean annual temperature at the northern sites in the transect were as much as 7°C cooler than the southern sites, but the southern cores had higher peat accumulation rates, resulting in faster burial beneath the water table and lower oxygen exposure time. The northern cores were more extensively decomposed, indicating the importance of oxygen exposure time in decomposition. A core from the James Bay Lowland experienced temporal variability in environmental conditions during the last 7000 years. Oxygen exposure time (indicated by a reconstruction of the water table depth) was highest in a 100-cm section in the middle of the core, which was significantly more decomposed than peat above and below. Warmer temperatures during the Medieval Climate Anomaly and Holocene Climatic Optimum did not appear to have any effect on the extent of decomposition of peat deposited during these periods. Both spatial and temporal comparisons indicate oxygen exposure time is an important control on peat decomposition, while temperature appears to be of secondary importance.

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