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Soil biogeochemistry properties vary between two boreal forest ecosystems in Quebec: significant differences in soil carbon, available nutrients and iron and aluminium crystallinity

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At the northernmost extent of the managed forest in Quebec, the boreal forest is currently undergoing an ecological transition from closed-canopy black spruce-moss forests towards open-canopy lichen woodlands, which spread southward. Our study aim was to determine whether this shift could impact soil properties on top of its repercussions on forest productivity or carbon storage. We studied the soil biogeochemical composition of three pedological layers in moss forests (MF) and lichen woodlands (LW) north of the Manicouagan crater in Quebec. The humus layer (FH horizons) was significantly thicker and held more carbon, nitrogen and exchangeable Ca and Mg in MF plots than in LW plots. When considering mineral horizons, we found that the deep C horizon had a very close composition in both ecosystem plots, suggesting that the parent material was of similar geochemical nature. This was expected as all selected sites developed from glacial deposit. Multivariate analysis of surficial mineral B horizon showed however that LW B horizon displayed higher concentrations of Al and Fe oxides than MF B horizon, particularly for inorganic amorphous forms. Conversely, main exchangeable base cations (Ca, Mg) were higher in B horizon of MF than that of LW. Ecosystem types explained much of the variations in the B horizon geochemical composition. We thus suggest that the differences observed in the geochemical composition of the B horizon have a biological origin rather than a mineralogical origin. We also showed that total net stocks of carbon stored in MF soils were three times higher than in LW soils (FH + B horizons, roots apart). Altogether, we suggest that variations in soil properties between MF and LW are linked to a cascade of events involving the impacts of natural disturbances such as wildfires on forest regeneration that determines the of vegetation structure (stand density) and composition (ground cover type) and their subsequent consequences on soil environmental parameters (moisture, radiation rate, redox conditions, etc.). Our data underline significant differences in soil biogeochemistry under different forest ecosystems and reveal the importance of interactions in the soil–vegetation–climate system for the determination of soil composition.