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The effect of mining, abandonment, and restoration on carbon dioxide and methane exchange between peatlands and the atmosphere and porewater dissolved organic carbon in eastern Canada

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Ombrotrophic bogs have been harvested for the production of peat moss in eastern Canada and some abandoned sites are now being restored. To determine the effect of drainage and harvesting, abandonment and restoration measures on the carbon (C) cycle during different phases of the restoration process, we the measured the exchange of carbon dioxide (CO2) and methane (CH4) by a static chamber method and determined pore water dissoved organic carbon (DOC) concentrations at 9 successional sites sites from 59 collars near Rivière du Loup, Québec and Shippagan, New Brunswick.

Net Ecosystem CO2 Exchange (NEE) depended on successional vegetation communities, but also water table. Eriophorum vaginatum tussocks in dry peat released up to 20 g CO2-C m-2 d-1, but sequestered >10 g CO2-C m-2 d-1 during full light conditions in a wet environment. The only other vegetation communities that were able to sequester CO2 during full light were dominated by Sphagnum spp. Patches dominated by shrubs, lichens or litter were CO2 sources even during full light.

Measurements of CH4 exchange for individual collars ranged from small uptake rates of less than 5 mg m-2 d-1 to emission rates of over 10000 mg m-2 d-1. There was a weak but significant relationship to the position of the water table when the flux was measured. Corttongrass in wet environments as well as Acutifolia mosses released the most CH4.

Average concentrations of pore water DOC ranged from 28 to 365 mg L-. DOC concentrations at the natural site in Rivière du Loup were greater than at the natural site at Shippagan and at the block-cut trench sites, this difference was even stronger. Mean DOC concentrations in Rivière du Loup were twice those at corresponding depths in Shippagan and reached 365 mg L-1 at a depth of 150 cm, which is one of the highest DOC concentrations reported for natural environments.

Our examinations show that the successional vegetation communities as well as biophysical conditions (water table, temperature and development of adapted decomposer communities) control carbon cycling during a successional chronosequence in restoring peat bogs.