Atmospheric Carbon Dioxide from Peat Wetland Ecosystems

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Peat soils release carbon into the atmosphere when land is drained for use or warmed by a changing climate. The potential for carbon dioxide (CO_2) gas formation by aerobic microbial conversion depends on the soil's organic carbon source. Soil content is determined by mean annual temperature, vegetation type, and land-use conditions.

In this research, soil samples were obtained from 125 global peatland ecosystems for analysis by solid-state nuclear magnetic resonance spectroscopy (ssNMR). A subset of 11 sites revealed that oxygen-alkyl chemistry (i.e., carbohydrates) are the strongest predictor of aerobic CO_2 production.

This research supports and extends previous studies of temperate and boreal peatlands that linked CO_2 production to polysaccharide or oxygen-alkyl carbon composition. _This research also suggests that climate models can be improved by using oxygen-alkyl carbon content to predict risk of increased CO_2 production_.

Facilities and instrumentation used: Peat samples were analyzed by magic angle spinning (MAS) ^{13}C NMR spectroscopy at the MagLab's AMRIS Facility using a 3.2 mm E-free H/C/N probe built to a specialized MagLab probe design that protects the sample from chemical degradation.

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Peatland locations and sites tested

Sites
- 1
- 2-3
- 4-6
- 7-9
- 10-13
- 13-16

- Peatland <5%
- Peatland 5-10%
- Peatland >10%

Peat soils vary by mean annual temperature (−3 to 26°C); vegetation (mossy §, herbaceous †, or woody ‡), and land-use by humans (nonimpacted and long-term impacted*).

Spectral regions correspond to carbon functional groups: alkyl (0–45ppm), methoxyl (45–60ppm), oxygen-alkyl (60–110ppm), aromatic (110–160ppm), and carboxyl (160–220ppm).