PEAT CORING AND SAMPLING TECHNIQUES USED AT GEOLOGICAL SURVEY OF CANADA (1993-2003)

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Peatland Distribution

- Peatlands are wetlands with organic matter accumulations of at least 40 cm in thickness (National Wetlands Working Group, 1988).
- Peatlands cover nearly 12% of the Canada landmass (Tarnocai, et al., 2000).
- 1056×10^3 km^2 is the total peatland area in Canada
- 544×10^3 km^2 is the total area of France!!!
- Most peatlands are bogs or fens. However, in places, swamps and marshes have sufficient organic matter accumulation to be classed as peatlands.
- The common average maximum thickness of peat in Canada ranges between 2 and 7 m (Martini and Gooschenko, 1985).

Bog

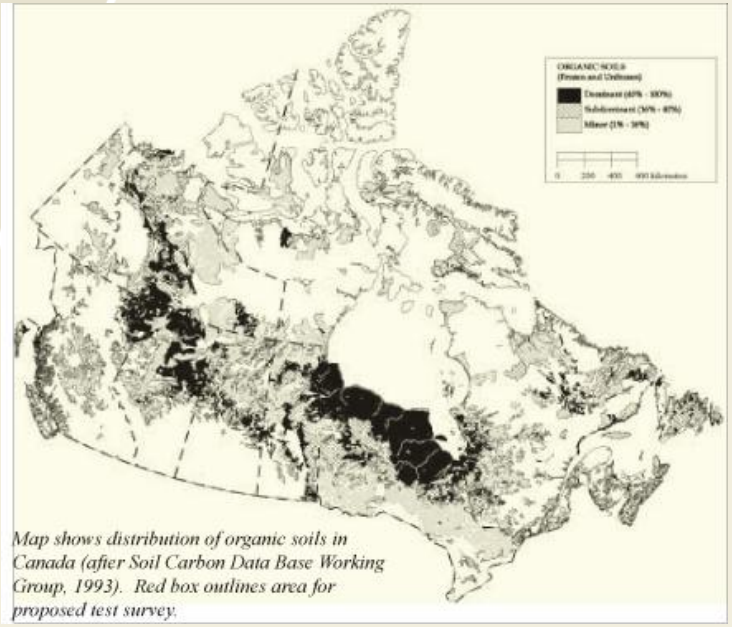
Fen

Swamp and Marsh

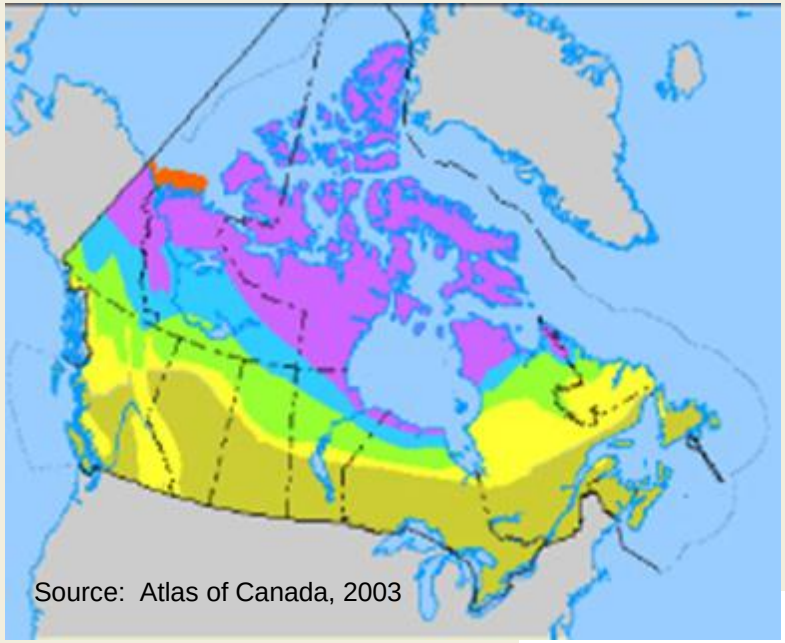
Swamp

Marsh

Peatlands and Permafrost

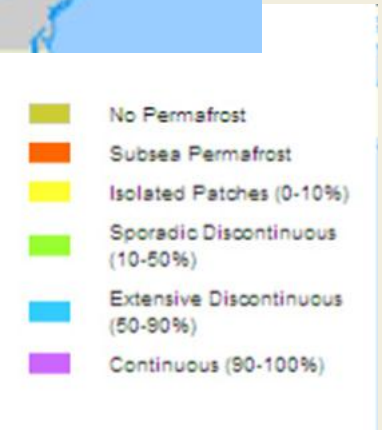


Map shows distribution of organic soils in Canada (after Soil Carbon Data Base Working Group, 1993). Red box outlines area for proposed test survey.

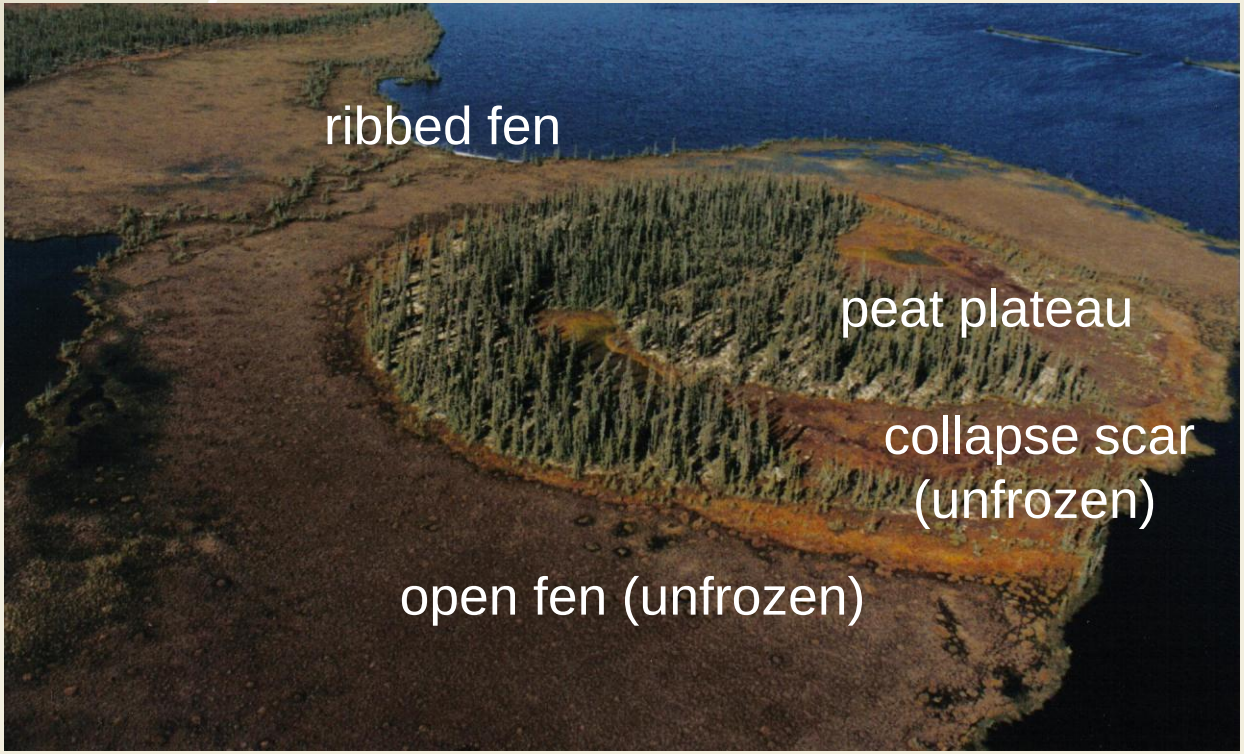


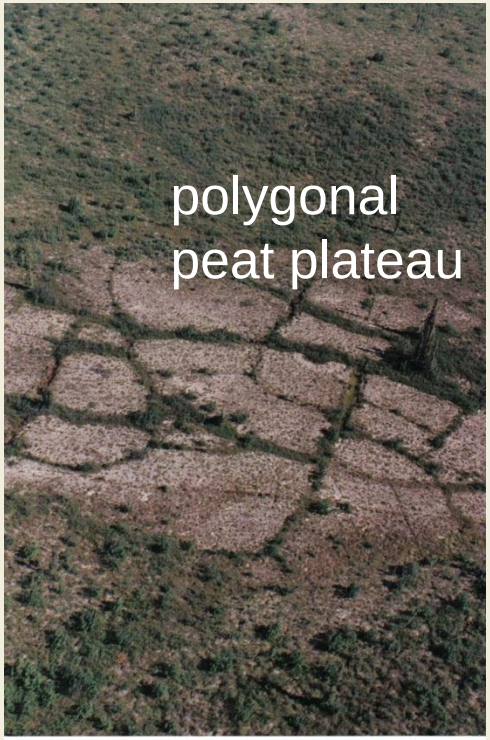
Source: Atlas of Canada, 2003

There are strong interrelationships between the distributions of peatlands and permafrost because of the insulating properties of peat and the poor drainage conditions in peatlands (Zoltai, 1988).



Peatlands and Permafrost





Permafrost-bearing peatland forms

For more information on peatland landforms, see Zoltai et al. (1988) and Tarnocai and Zoltai (1988).

Testing a Potential Coring Site

A soil probe with sufficient extensions was used to test the depth and character of peat deposits prior to coring.

In peat plateau (frozen bog), it was possible to estimate the depth of peat accumulation by probing the adjacent unfrozen fen, where present.

Probing a fen near Noranda, Quebec.

CRREL Coring in Frozen Peat

Produces frozen undisturbed cores in segments of around 10 to 20 cm in length.

Coring polygonal peat plateau on the Horn Plateau, Northwest Territories.

- Device is based on a CRREL design (Cold Regions Research and Engineering Laboratory).
- It was used and modified at GSC by W. Blake, J. Veillette, and M. Nixon in the 1960s and 1970s.

CRREL Coring in Frozen Peat

- CRREL system is relatively portable
- Produces high quality frozen cores
- Heavy work for 2 or more people
- Potential for problems with the cutting head freezing into the hole.

CRREL coring near Antoine Lake, Northwest Territories.

CRREL Core Segment

Segment from CRREL coring collected from polygonal peat plateau on the Horne Plateau, Northwest Territories. Core is measured in cm.

CRREL Coring Kit

1 T-bar handle
2 Tool box
3 Barrel head for 3 in (7.62 cm) core barrel
4 Extension rod, 18 in (45.72 cm) long
5 Tool kit:
- Screwdriver, flat tip
- Pliers, long nose
- Pliers, side cutter
- Hammer
- Allen keys
- Magnet

6 Core barrel, 3 in (7.62 cm)
7 Core barrel, 2 in (5.08 cm)
8 Core catcher for 3 in (7.62 cm) core barrel
9 Core catcher for 2 in (5.08 cm) core barrel
10 Barrel head for 2 in (5.08 cm) core barrel
11 Adapter for Stihl power head
12 Auger, spiral, 2 in (5.08 cm) diameter x 18 in (45.72 cm) long
13 Extension rods, 36 in (91.44 cm) long

Also needed:
Toggle pins, 3 in (7.62 cm) long
Extension pins (Clevis)
Metal clips (hitch pin style)
Drive pins, 3 3/8 in (8.6 cm) long for 2 in (5.08 cm) core barrel
Cutters for 2 in (5.08 cm) core barrel
Cutters for 3 in (7.62 cm) core barrel
Roll pins (spring tension) 1/8 in (0.32 cm) x ½ in (1.27 cm)
Socket cap screw, ¼ in (0.64 cm) x ½ in (1.27 cm)
Drive pins 4 1/4 in (10.8 cm) long for 3 in (7.62 cm) core barrel

Source of photo and information: Natural Resources Canada - Technical Field Support Services Catalogue

Further Information on the CRREL System

- System used at Geological Survey of Canada

  Veillette, J.J., and Nixon, F.M., 1980. Portable drilling equipment for shallow permafrost sampling. Geological Survey of Canada Paper 79-21. 35 p.

- Description of an updated device modified from GSC design

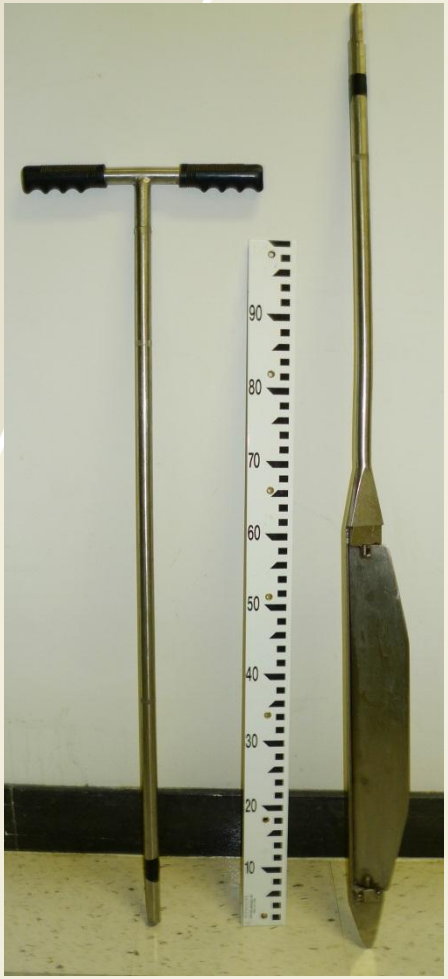
  Nornberg, T., Goodsite, M.E., and Shotyk, W., 2004. An improved motorized corer and sample processing system for frozen peat; Arctic, v. 57, p. 242-248.

Coring in Unfrozen Peatlands

Methodologies used for coring and collecting samples from unfrozen peatlands varied depending on the purpose of the research and the depth of sampling required.

Coring permafrost-free bog in the Noranda region, Quebec.

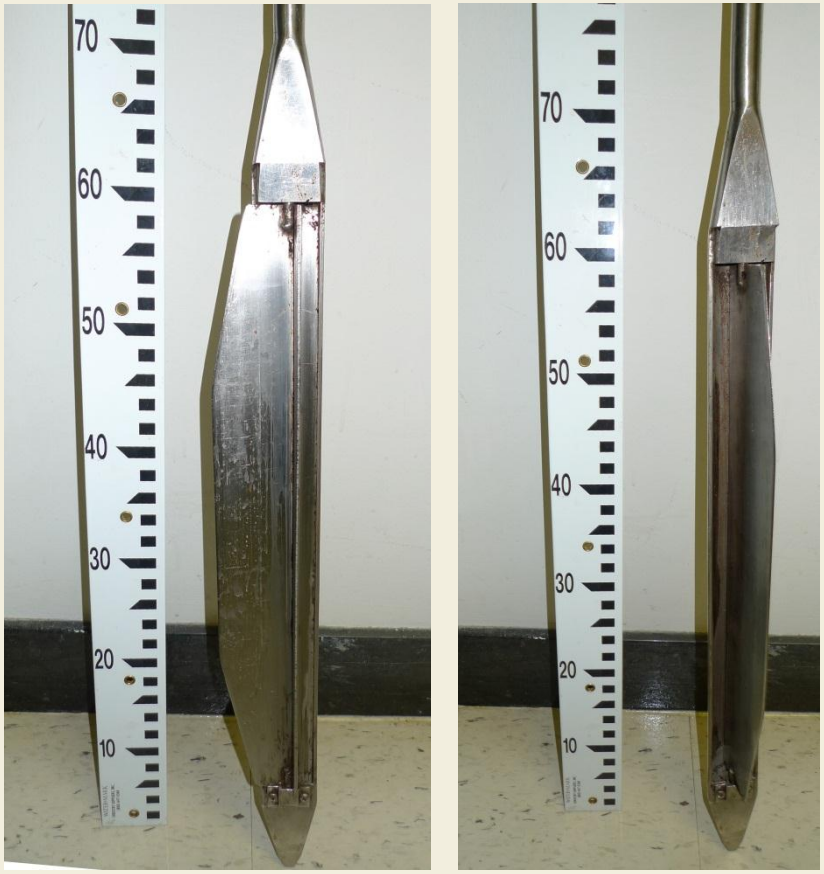
Macaulay Corer



The Macaulay corer, also referred to as the modified Russian borer, is used to core unfrozen peat below depths of around 0.5 m from the surface.

Continuous cores are collected in 50 cm long segments. Segments are semi-circular in shape with diameters of 4.5 cm. Extension rods (1 m long) are flush mounted.

This type of corer is available commercially but the device shown was custom-made for GSC.

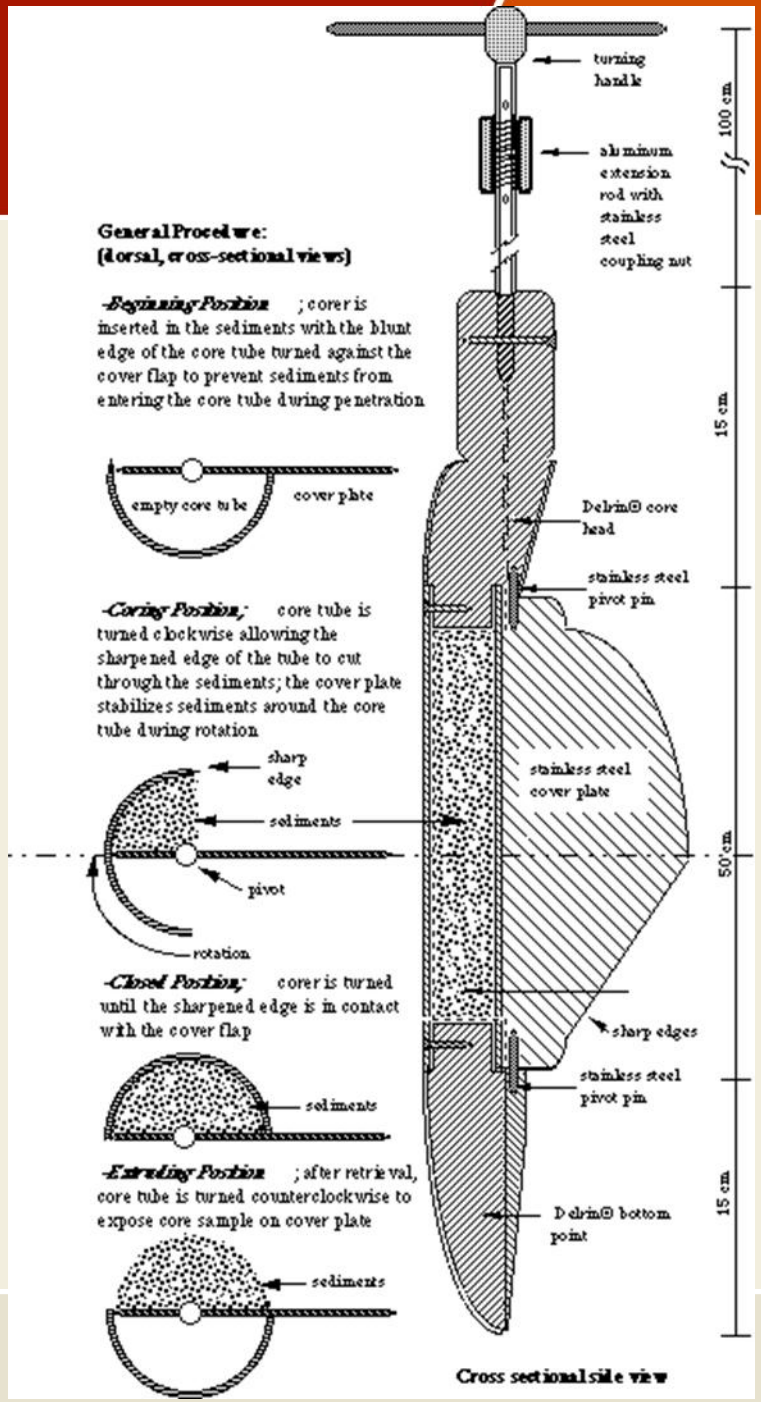


Blade in sampler is shown in starting and mid-point positions.

Macaulay Corer

Diagram shows the construction and operation of a Macaulay-style corer.

Source of diagram:
http://www.aquaticresearch.com/russian_peat_borer.htm



Macaulay Corer

- A continuous core is collected in 50 cm segments to the target depth or the contact with mineral sediment.

- The point at the end of the device is pushed to the desired depth, with the chamber being closed and empty. The T-bar handle is turned clockwise to start cutting the sample. The pivotal cover plate supports the cutting action of the sampler. As the device is turned 180 degrees, the edge of the bore longitudinally cuts a semi-cylindrical shaped sample until the opposite side of the cover plate is contacted.

Peatland in James Bay Lowlands

- The contained sample is recovered without risk of contamination by overlying materials. The sample is extruded from the bore by a counterclockwise rotation where, at the end, the sample rests on cover plate ready for sectioning. Core segments are wrapped in plastic wrap and then rolled in aluminum foil, with segment tops and bottoms clearly labelled on the inside of the foil.

- To collect enough material to meet the analytical needs of the project, it is often necessary to collect cores from multiple holes in the vicinity of the first one.

Macaulay Corer

Macaulay core collected to mineral sediment near Detour Lake in northern Ontario.

The core segments were wrapped first in plastic and then in aluminum foil. The sample number, top and bottom of core segment and the depth measurement of the segment were carefully marked on the inside of the aluminum foil prior to wrapping.

Macaulay Corer

- Very portable
- Fairly easy to use and effective below depths of 0.5 to 1.0 m from the surface
- Collects a relatively undisturbed sample
- After 1 or 2 extension rods are added, two or more people were needed to pull the sampler up to the surface.

Further Information

Jowsey, P.C., 1966. An improved peat sampler; New Phytologist, v. 65, p. 245-248.

Sampling at the Surface of the Peatland

- Neither the CRREL nor the Macaulay systems work for collecting peat at or near the surface of the peatland.
- Methodology used for collecting surface cores and samples varied depending on the goals of the research project.

Wardenaar-style Corer

- Wardenaar-syle corer is portable.
- Used for the uppermost 90 cm of peat
- The two-piece corer is pushed down into the peat deposit using a see-sawing motion.
- Corer has sharp edge at its base for cutting.
- Produces a square-shaped core.

Sampling at Kinosheo Lake in Northern Ontario.

Wardenaar-style Corer

Corer is available commercially but one shown above was custom-made for GSC.

Reference: Wardenaar, E.P.C. (1987)

Coûteaux Corer

- Collaborative project was undertaken in James Bay Lowlands with Dr. Michelle Garneau at UQAM; corer is not owned by GSC.
- Used for the uppermost 2 m of peat materials
- Core has a diameter of 10 cm.
- Produces a mostly undisturbed core
- Relatively portable (pulled on a child's sleigh)
- Heavy work

Coûteaux Corer

Further Information

Couteaux, M., 1962. Notes sur le prélèvement et la préparation de certains sédiments; Pollen et Spores, v. 4, p 317-322.

Reference unknown at present

Handcut Surface Blocks

- It is often practical to carefully cut out blocks of surface peat by hand; this method is effective above the water table in unfrozen peatlands and above the permafrost in frozen peatlands.

Coring Peat Hummocks

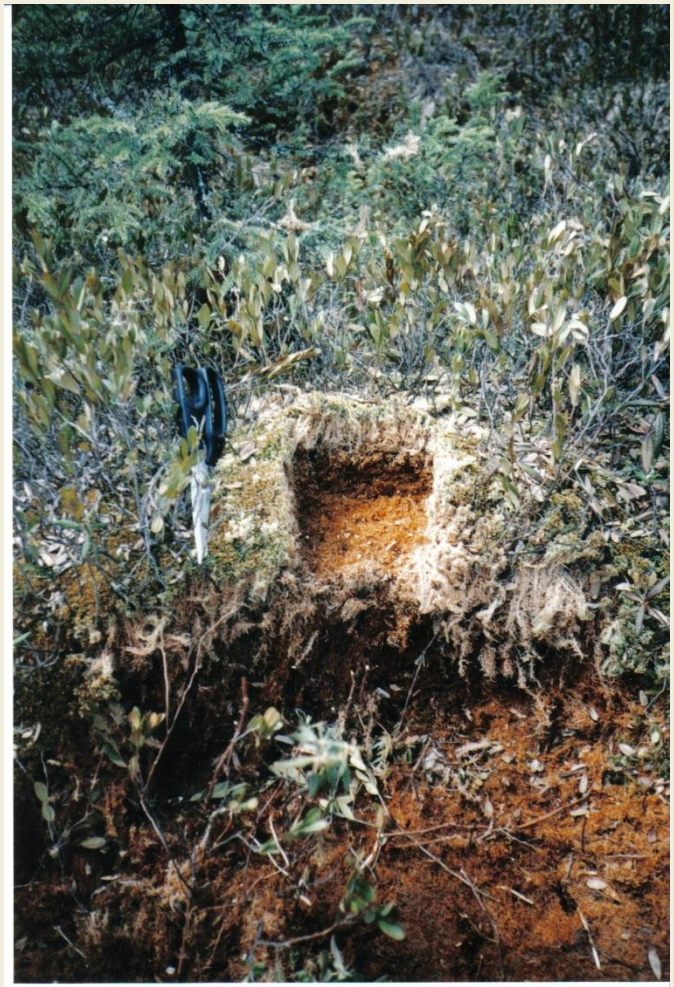
- High vertical accumulation rates and low decomposition rates occur in peat hummocks compared to hollows (flat part of peatland).
- The analysis of profile samples collected from hummocks resulted in a more highly resolved near-surface geochemical record .

Coring Peat Hummocks

- Prior to carrying out profile sampling on a hummock, a core of material, as intact as possible, was carefully collected for reference purposes, as follows.
- A square-shaped PVC tube was prepared prior to sampling by cutting off, but retaining, one side of the tubing.
- The selected peat hummock was cut open using a large knife, small garden clippers and scissors, as needed, and a face prepared for sampling.
- The PVC tube was trimmed to an appropriate length and placed at the hummock face. A column of peat, the size and shape of the PVC tube, was cut out, face by face, and the tube placed around it.
- Once the cored material was inside the tube, the retained side was taped back on and the ends taped to enclose the cored materials. The tube was wrapped in heavy plastic and taped again.

Sampling Peat Hummocks

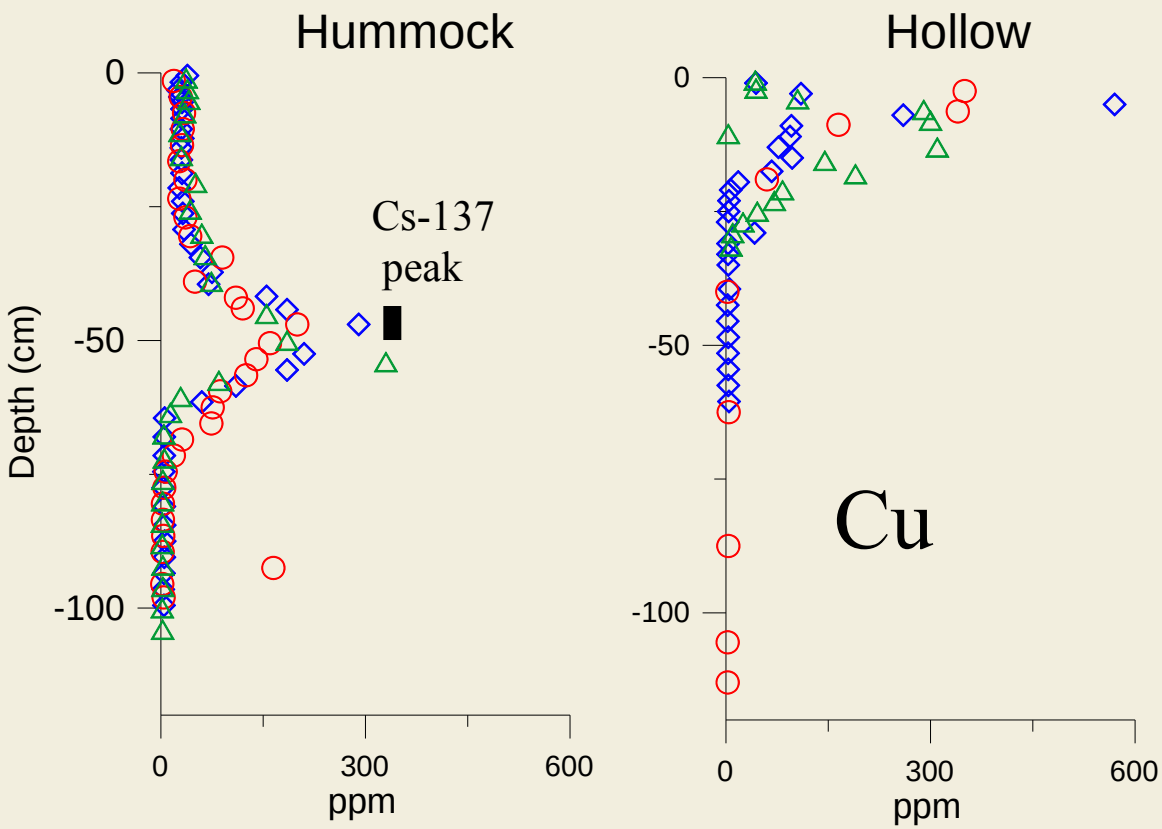
- Profile samples were also hand cut from peat hummocks.
- After the hummock was opened and a face prepared for sampling, bread-size slices were cut as thinly as possible (1-3 cm) in sequence down the hummock face.
- The length, width, and height of each slice were measured and recorded, to be used later for bulk density determinations.
- Samples were then stored in well-sealed zip-lock plastic bags.



Sampling Peat Hummocks and Hollows

Geochemical profiles show the distribution of Cu in peat samples from a hummock and nearby hollow (flat part of the bog).

Samples were hand cut as slices, as described in the previous slide. Three sets were collected from the same large hummock and two sets from the adjacent hollow. A third set in the hollow was obtained by cutting out blocks at the surface and using the Macaulay corer at depth. Each set is represented by a different symbol.



•Site was located 10 km northwest of the Horne Cu-Zn smelter, Noranda, Quebec (Kettles, 2005; Kettles and Bonham-Carter, 2005).

Selected GSC Contributions Based on Peat Coring (1993-2003)

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- Zoltai, S.C., Wetlands of Subarctic Canada; in in Wetlands of Canada, (ed.) National Wetlands Working Group; Environment Canada, Ecological Land Classification Series, No. 24, p. 55-96.

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