Light-weight coring in permafrost at GSC – current activities

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Techniques

- Modified CRREL* coring
- Diamond coring

*Cold Regions Research and Engineering Laboratory

Coring Auger Kit –available at TFSS:

I. Konuk

Modified CRREL coring

I. Konuk

Ice-rich silt and clay
I. Konuk

Ice-rich peat
S. Wolfe

One-person power head

STIHL power heads available at TFSS

The Stinkie – frame mounted

Two-person power head

Our experience

- 1-person operation:
  - easily drilled 2m in unconsolidated sediments along Yukon coast
- 2-person operation:
  - easily reached 5m depth in relatively ice-rich silt and clay (time: 3hrs-1day)
  - 4m in palsas (ice-rich peat and mineral soil)
  - fast drilling in frozen sand
- Stinkie:
  - 7.5m in ice-rich silt and clay (time: 3-4 days)

Summary

Advantages

- Snow, ice, fine-grained organic and mineral soil
- High quality, continuous core
- Easily transportable (ski-doo, ATV, helicopter)
- Can be used in a variety of terrain types
- Minimal impact at the site
- Carbide teeth can easily be replaced when dull or broken
- Slow spindle speed allows reaction time when signs of jamming are apparent
- Safer, no kick back (Stinkie)
- Can be operated by 1-person (Stinkie)

Disadvantages

- Gravelly or stony material, unfrozen soils or soils with significant unfrozen water content
- Drilling can be slow: short length of core recoverable each trip down hole – usually 20-50% of barrel length – due to binding between outside of barrel and hole wall
- The 2-person operation can be dangerous, ie. kick backs due to jamming

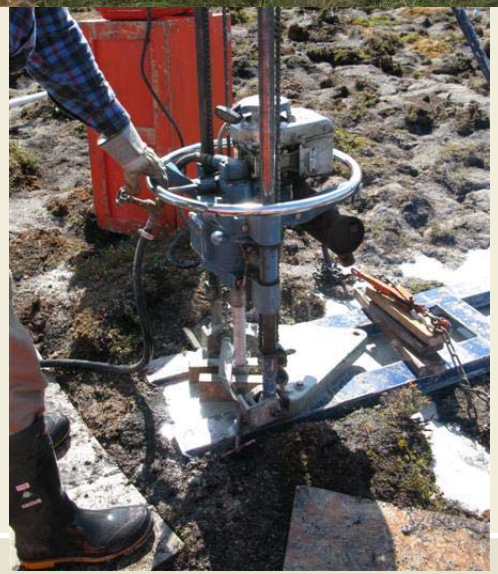
Diamond coring – portable earth drill

Core barrel

Core catcher

S. Wolfe

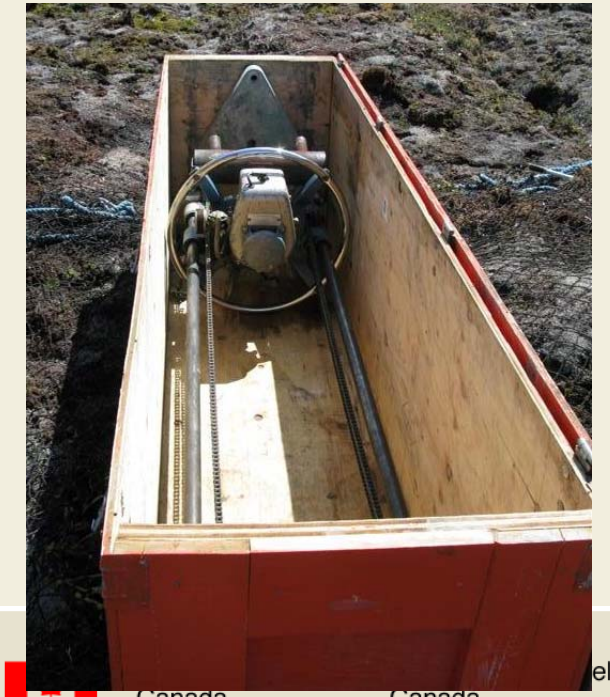
Winkie – frame mounted diamond drill



Ice-rich peat

Ice-rich mineral soil

Easily transportable



Our experience

- Portable earth drill (experience with U. Laval crew):
  - easily drilled 3.3m in ice-rich silts, clays, sands and gravels
- Winkie:
  - easily reached 1.5m depth in ice-rich peat and mineral soil without drilling fluid

Summary

Advantages

- Fine-grained soils with ice, sand, gravel and boulders to 20cm
- High-quality, continuous core
- Easily transportable (ATV, snow machine, helicopter)
- Wide range of terrain types
- Off the shelf equipment
- 2-3 people
- Fast

Disadvantages

- In pure ice, cores tend to break into smaller sections, slowing drilling
- In warmer permafrost (-2 to 0ºC) cores tend to disintegrate due to uncemented sediment and frictional heat
- Ice content below saturation can lead to clogging and caving of hole

Helpful references

- Calmels, F., O. Gagnon, and M. Allard. 2005. A portable earth-drill system for permafrost studies. Permafrost and Periglacial Processes, vol. 16, p. 311-315.

- Nørnberg, T., M.E. Goodsite, and W. Shotyk. 2004. An improved motorized corer and sample prossessing system for frozen peat. Arctic, vol. 57, p. 242-246.

- Veillette, J. and F.M. Nixon. 1980. Portable drilling equipment for shallow permafrost sampling. GSC paper 79-2, 35p.