Variations on a theme of gravity coring:

K-B, Glew and TechOps corers with core extrusion and high-resolution sectioning of shallow aquatic sediments

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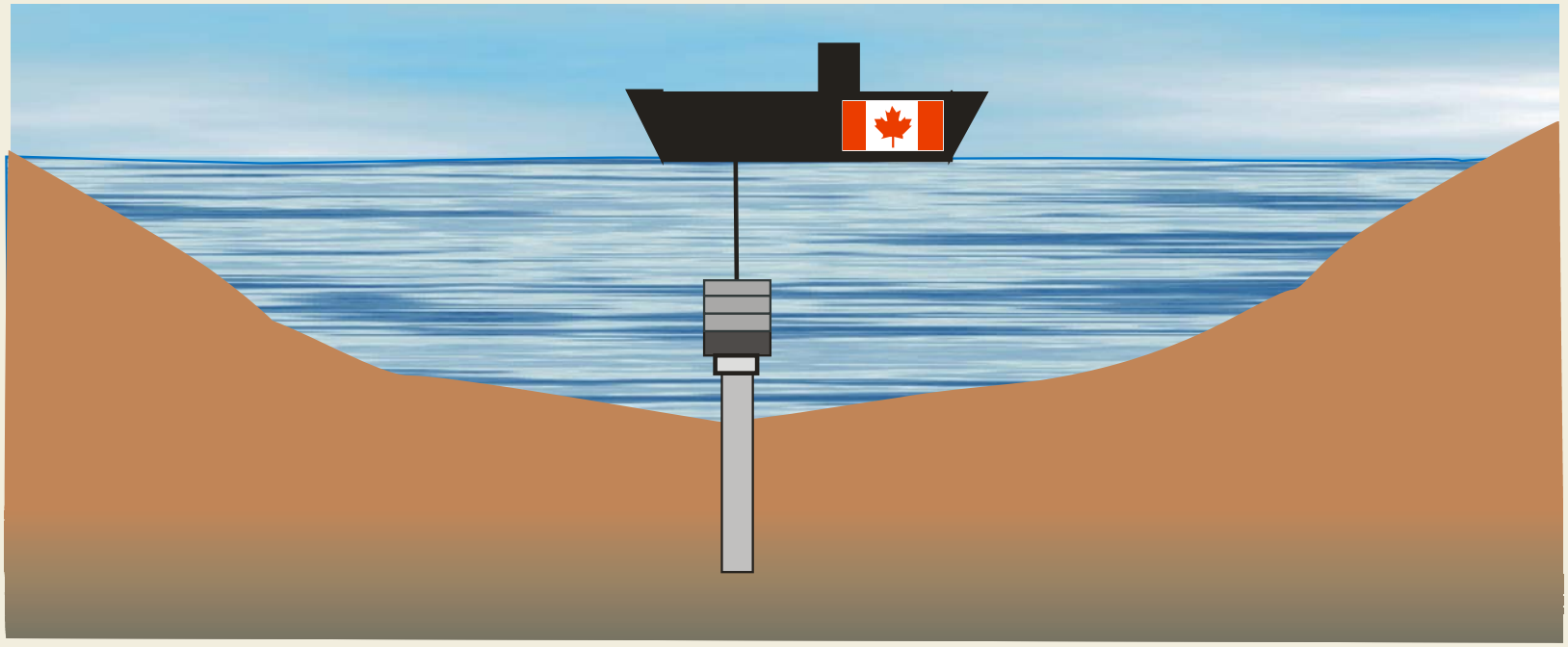
Outline

- What is gravity coring?
- Information before doing it ...
- Why gravity coring?
- Principles of gravity coring
- Types of gravity corers
- Operation of gravity corers
  - K-B corer
  - Glew & modified Glew corers
  - TechOps corer
- Core extrusion and sectioning
  - Types of high-resolution vertical extruders
  - Fixed interval, high-res Glew extruder, high-res hydraulic extruder
- Practical considerations for gravity coring and extrusion methods
- References

What is gravity coring?

- Gravity coring devices drive core tubes or cylinders into the bottom sediments and withdraw them back to surface intact.
- They are operated on a single line from surface and allowed to penetrate the sediments using gravity either under the weight of the device or by free fall.



Information before doing it …

For environmental studies of contamination, identify:

- bathymetry (e.g., marine charts)
- sub-bottom profiling
- spatial contamination gradient
- sediment/contaminant transport pathways

Typically the profundal zone of a lake or basin is chosen for coring where sediment deposition is thick and continuous.

Surface sediments are of greatest interest for environmental investigations to compare recent activity with pre-industrial “background”.

Principles of gravity coring

- A core tube open at both top and bottom is driven into the sediments.
- Once the tube has penetrated the sediments, the top is sealed and pulled back to surface.
- The sediment core remains in the core barrel by:
  - closing the top of the tube (partial vacuum),
  - cohesion of sediments inside the tube, and
  - closing the bottom of the tube *before* breaking the water surface upon retrieval.
- Gravity corers (a.k.a. open barrel corers and open drive samplers) have two types of mechanisms to close the upper seal.

Types of gravity corers

Messenger operated

- The operator drops a weight attached to the line as the trigger to close the top seal.

Close-on-contact

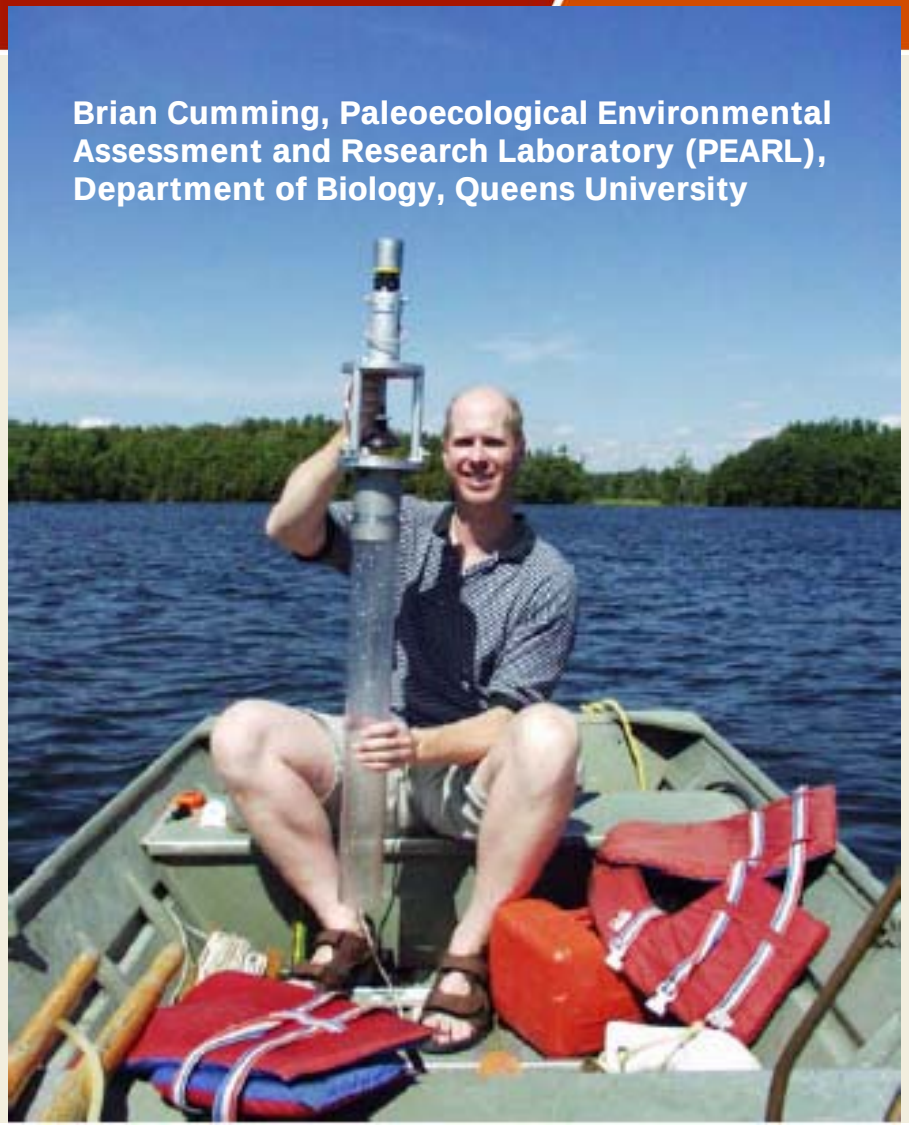
- The top seal is automatically closed either once the corer penetrates the sediment or when the operator applies a force on the line to lift the core.

GSC has examples of these two types of gravity corers.

See Glew et al., 2001;
Mudroch and MacKnight, 1991.

Operation of gravity corers

- Principles of operation are similar for all types of gravity corers available.
- Example of a Maxi-Glew gravity corer
- Full instructions at: http://post.queensu.ca/~pearl/Maxi.pdf
- Uses clear polycarbonate core tubes



Operation as defined for paleolimnological studies

Step 1: Corer Preparation

Ensure the top of the core tube (flat end, not tapered end) and the area where the plunger and corer housing meet have been sealed with Vaseline (this typically only needs to be done once per coring day, unless corer is not sealing correctly).

Attach core tube to corer. Make sure flat end of corer is square against ring seal. Tighten hose clamp on tube housing using nut driver, do not over tighten. Core tube should not move within the housing.

Make sure plug fits securely in bottom of core tube.

Note: additional weights may be added to core tube if needed e.g., if sediments are fairly dense). However, this tends to make corer more top-heavy and likely to fall over on its side.

Step 2: Testing Corer and Lowering

Raise plunger of corer to "loaded“ position. Test to see if corer is properly sealed by lowering into water, triggering the corer, and lifting it to see if the tube is filled and holds water. (If water leaks out, re-check seals and Vaseline, and ensure hose clamp is tightened sufficiently around the core tube). Release water and re-set corer to "loaded“ position.

Slowly lower corer into water. Lower slowly until corer penetrates into sediment (max. speed ~ 0.5m/sec). It is important not to let the corer freefall, as this can “blow away" surface sediments.

When core tube has entered sediments to required depth, send messenger down the line to trigger corer.

After plunger is triggered, raise slowly to surface.

DO NOT ALLOW BOTTOM OF CORE TUBE TO BREAK SURFACE OF WATER!

Step 3: Retrieval of Corer

While core tube is submerged, insert core plug (black rubber or orange bung) to form a seal in bottom of corer.

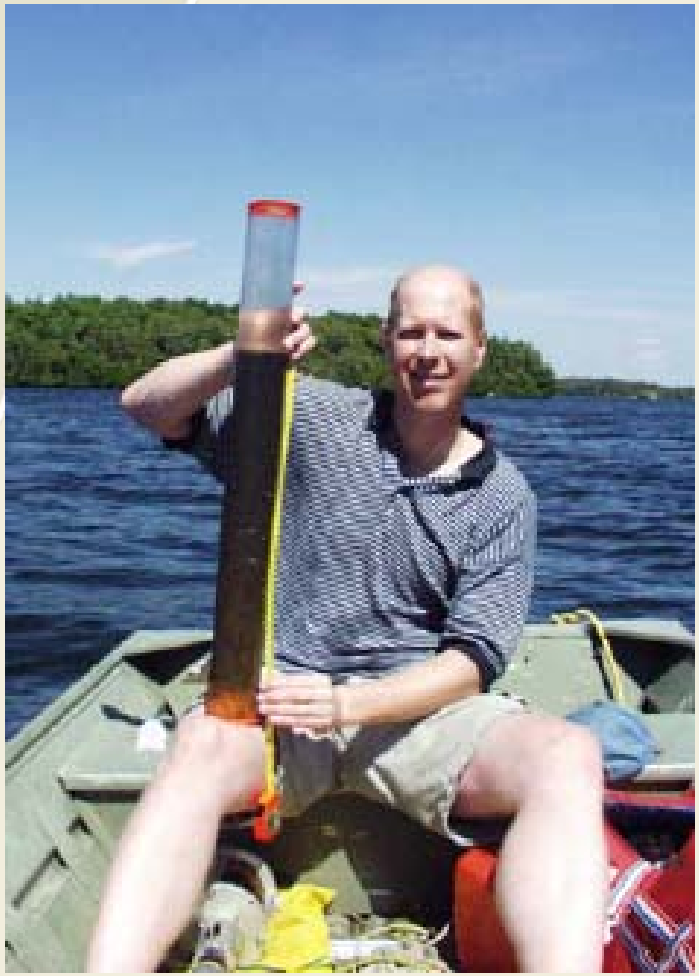
Holding bottom of core tube and plug to prevent plug from falling out (which would lead to lost sediment), lift corer slowly out of water.

Be careful not to disturb sediment-water interface.

Check for clarity of water directly above sediment surface and presence of chironomid tubes or algal mats (signs of a good sediment core).

Ensuring the core is secured, loosen hose clamp securing core tube to corer, and remove corer form core.

Be careful not to disturb core.



Add cap to top of core. Secure plug at bottom of core tube with electrical tape to prevent plug from accidentally slipping. Label core tube with masking tape and permanent ink. (lake name, core, top/bottom, date).

Place core in secure position in boat, ensuring core remains vertically upright.

Take new cores back to shore.

NOTE- if multiple cores are being taken, a bucket with a lid with holes to hold cores vertically can be useful.

Adapt technique to study requirements.

Gravity corers for shallow aquatic sediments (≤ 1 m)

What do we have in the Northern Canada Division?

K-B corer

Kajak-Brinkhurst corer

- Easy use with a winch; aircraft cable
- Optimal for stiff aquatic sediments
- Yield deeper cores
- Can be used in deeper lakes
- Can be used with up to a 10-m free fall
- Can be used in combination with box core to capture both deeper sediment strata and the sediment-water interface
- Messenger-operated
- 9 cm (3½”) ID

Wildco K-B corer; www.wildco.com

See also Mudroch & MacKnight, 1991

Glew and modified Glew corers

Photo of John Glew from http://post.queensu.ca/~pearl/people.htm →

↑John Glew, inventor, preparing for test operation of the modified Glew corer → QUBS 2001

- Lightweight
- Operable from any platform
- Good preservation of sediment-water interface
- Easy penetration to pre-industrial strata
- Modified version limits oxidation of uppermost sediments
- Messenger-operated
- 6.4 cm (2½”) ID

TechOps corer

- Versatile; weights can be added
- Any platform
- Preservation of sediment-water interface
- Penetration to pre-industrial strata
- Yield deeper cores
- Core stiff aquatic sediments
- Close-on-contact operation; floating piston
- 10 cm (3.9”) ID; wide diam. = more sediment material

Core extrusion and sectioning

- Most shallow cores taken by gravity coring methods will require extrusion and sectioning on site because of the high water content and likelihood of physical disturbance during handling and transport

- Vertical core extrusion and sectioning requires:
  - the core be maintained in a vertical position,
  - advancing the core material through the core tube so that sections can be expelled, and
  - removal of the extruded sections that can be transferred to sample containers.

Types of extruders: Fixed interval extruder

- Mechanical operation
- Levelling adjustment
- For use with the K-B corer (9 cm ID)
- Fixed 1-cm sectioning intervals

High-resolution Glew extruder

- Mechanical operation with high reproducibility
- Section intervals are set by the operator
- For use with the Glew (or modified Glew) corers (2½” ID)

See Glew, 1988.

Full instructions at
http://post.queensu.ca/~pearl/extruder.pdf

High-resolution hydraulic extruder

- Smooth operation with pressurized water to advance core
- Section intervals are defined by the operator
- For use with the TechOps corer (10 cm ID)

See Mudroch and MacKnight, 1991

High-resolution hydraulic extruder

Practical considerations for gravity coring and extrusion methods

- Goals of the aquatic sediment study
- Analytical techniques required; analytes of interest
- Amount of sediment required per interval
- Moisture content of the sediment
- Depth of core required; sedimentation rate
- Sediment type
- Field logistics
- Adaptability of the equipment
- Preservation of the sediment-water interface
- Skill and experience of the operator

References

- Glew, J.R. 1988. A portable extruding device for close interval sectioning of unconsolidated core samples. J. Paleolimnology 1: 235-239.

- Glew, J.R., Smol, J.P. and Last, W.M. 2001. Sediment core collection and extrusion. pp. 73-105. In: Last, W.M. and Smol, J.P. [Editors]. Tracking Environmental Change Using Lake Sediments. Vol 1: Basin Analysis, Coring, and Chronological Techniques. Kluwer Academic Publishers, Dordrecht.

- Mudroch, A. and MacKnight, S.D. 1991. Bottom sediment sampling. pp. 29-95. In: A. Mudroch and S.D. MacKnight [Editors] CRC Handbook of Techniques for Aquatic Sediments Sampling. CRC Press, Boca Raton, Florida.

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