

Adapting methods for sampling clay deposits to river work



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Introduction

- River behavior in the St-Lawrence and the Ottawa River valleys is mostly defined by the sensitivity of clay deposits
- Understanding the fluvial erosion mechanisms of clay deposits can help reduce:
 - The impacts of growing Northern cities on river systems
 - The impacts of climate change on erosion
 - The risks of quick landslides
 - The overdesign of hydraulic structures and their risk of failure
- The **main challenge** researchers face in the study of clay erosion is that it is **hard to obtain undisturbed samples**.

Methodology

- In the geotechnical field, two apparatus were designed to obtain samples of undisturbed clay: the Sherbrooke sampler [1] and the Laval sampler [2].
- Research using the former established standards for high quality samples [3] and allowed to quantify the disturbance related to sampling [4].
- **Issues with river studies:** A **new sampling method** is needed to overcome the technical constraints of the work environment and accessibility.
- The samples obtain need to be large enough to:
 1. Obtain high quality samples for geotechnical and erosion testing;
 2. Test the block erosion process that naturally occurs in rivers [5].

- Study sites:

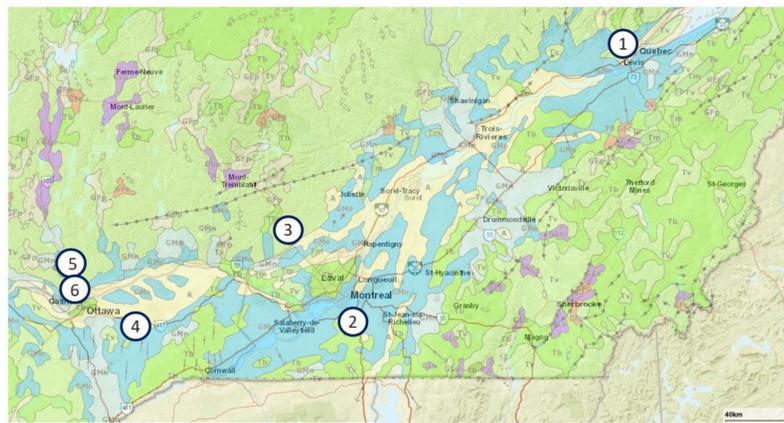


Figure 1. Location of study sites overlying the Surficial Geology Map of the St-Lawrence Lowlands with clay deposits in blue; till deposits in green and alluvial deposits in beige [6]

Methodology (continued)

Table 1. Geologic features and mechanical characteristics of clays at each study site

ID	Site	Deposit	Features	In-situ Erosion	Plasticity
1	Rivière St-Charles tributary	Marine or glaciomarine	Overly-consolidated clay	Plate erosion	Low
2	Rivière de la Tortue tributary	Champlain Sea or glaciolacustrine	Soft homogeneous clay	Block erosion	High
3	Castor River tributary	Champlain Sea	Soft rhythmic clay	Block erosion	Medium
4	Rivière du Nord tributary	Champlain Sea	Soft rhythmic clay	Block erosion	Medium
5	Upper Chelsea Creek	Champlain Sea	Soft rhythmic clay	Block erosion	Medium
6	Lower Chelsea Creek	Glaciolacustrine	Hard varves of clay and silt	Plate erosion	Low



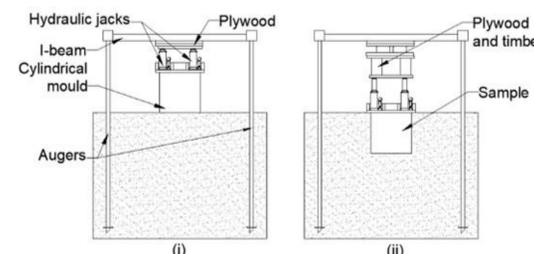
Figure 2. Clay sites

Results

- The new method includes two separate mechanisms:

1. Coring:

A mould is slowly pushed into the deposit using hydraulic jacks mounted against a reaction frame.



2. Extraction of the sample:

A plate is inserted directly under the mould using hydraulic jacks mounted against a reaction plank.

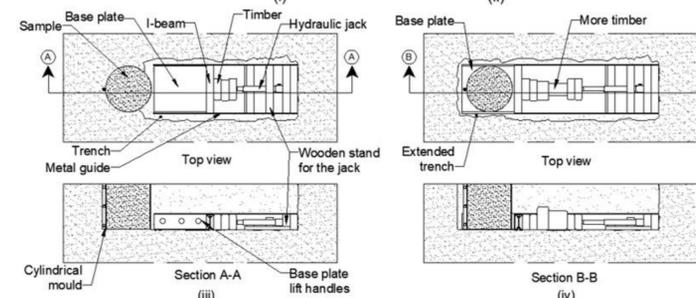


Figure 3. (i) Augers installed to support the reaction frame and hydraulic jacks set up against mould, (ii) jacks drive the mould in the ground, (iii) a base plate setup is installed in a trench in front of the sample, (iv) jack drives the base plate under the sample.

- Other sampling methods for harder clays:



Figure 4. (i) Bottom plate setup at the Rivière St-Charles tributary site; the sample was then cut into a 30x30x20cm block, (ii) naturally eroded steps at the Lower Chelsea Creek site, (iii) carved out block at the Lower Chelsea Creek site.

Results (continued):

- At Rivière de la Tortue, the new sampling method was tested in parallel with the Sherbrooke sampler.



Figure 5: Sample taken with the new sampling apparatus



Figure 6: Sample taken with the Sherbrooke sampler

- Transportation and Storage:

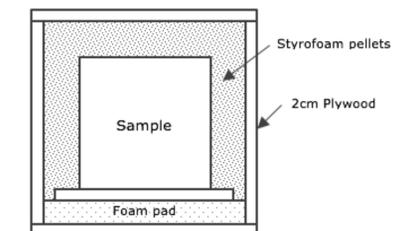


Figure 7. Transportation method based on DeGroot's method [7]



Figure 8. Samples were sealed and stored using the La Rochelle method [8]

Conclusion

- Sampling clay deposits in a river is a technical challenge requiring the adaptation of current sampling methods to create lighter and versatile equipment.
- The sampling apparatus also needs to be adapted to the degree of plasticity and hardness of the clay, while minimizing the disturbance of the samples taken.

References

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