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NWT Environmental Research Bulletin (NERB)

NWT Cumulative Impact Monitoring Program (NWT CIMP)

A source of environmental monitoring and research in the NWT. The program coordinates, conducts and funds the collection, analysis and reporting of information related to environmental conditions in the NWT.

NWT Environmental Research Bulletin (NERB)

A series of brief plain language summaries of various environmental research findings in the Northwest Territories. If you're conducting environmental research in the NWT, consider sharing your information with northern residents in a bulletin. These research summaries are also of use to northern resource decision-makers.

Legacy mining contamination of arsenic in sediments of Yellowknife Bay

Gold mining in Yellowknife during the 20th century released large amounts of arsenic to Yellowknife Bay on Great Slave Lake. Although the greatest releases of arsenic occurred during the early years of mining operations (before 1970) when few pollution controls were in place, surface sediments in the bay continue to have high levels of arsenic. Working with the Yellowknives Dene First Nation, we studied the current footprint, stability, and mineral forms of arsenic contamination in Yellowknife Bay sediments.

Why is this research important?

Yellowknife Bay is important to the Yellowknives Dene First Nation and residents of the City of Yellowknife. More information was needed to support long-term environmental management and to understand how levels of arsenic might change in the future.

What did we do?

In 2018 and 2019, we collected water and sediments from locations throughout Yellowknife Bay, close to the former Giant Mine property and farther away, near the main body of Great Slave Lake. We measured the amount of arsenic and its mineral form in sediments. The mineral form is important because it indicates where the arsenic came from and its stability in the environment. We also determined if arsenic in the sediments was moving up (diffusing) into overlying water.

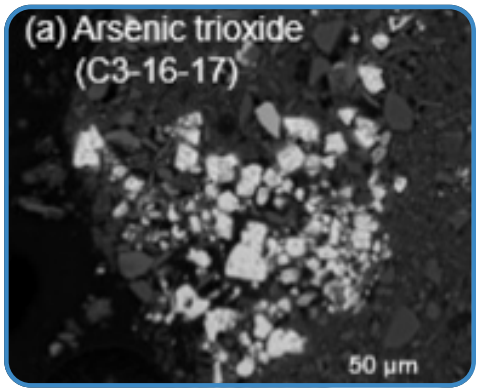
Sediments collected in core tubes from Yellowknife Bay, Great Slave Lake. (Credit: J. Chételat)

What did we find?

- We found evidence of arsenic contamination from mining in sediments throughout the bay, including the farthest sites near the mouth of the bay.
- Arsenic was mainly found in mineral forms that were created from mining, such as arsenic trioxide.
- Arsenic trioxide was detected in some surface and deeper sediment layers throughout the bay. The presence of arsenic trioxide at the sediment surface suggests it may still be entering the bay from the mine property or soils along the shoreline.
- Arsenic moved (diffused) from sediment to overlying water at most locations we studied in Yellowknife Bay. Arsenic was more mobile in sediments at offshore sites compared with near-shore, and at sites closer to the former Giant Mine property where sediment arsenic concentrations were higher.
- Arsenic concentrations are low in surface waters of Yellowknife Bay, due to the large volume of water, which dilutes the arsenic to low levels that are safe for swimming and fishing according to the Department of Health and Social Services. While the arsenic concentrations are typically below drinking water guidelines in Yellowknife Bay, the Department of Health and Social Services does not advise drinking water directly from the lake for reasons unrelated to arsenic, e.g., exposure to waterborne diseases from ingesting untreated water.

What does this mean?

Contaminated sediments of Yellowknife Bay are a leaky reservoir of legacy arsenic, resulting in a slow but continuous release of arsenic to overlying water. As a result, sediments are a relevant source of arsenic to surface waters of Yellowknife Bay. Treated water from the Giant Mine property and runoff from shoreline soils are other sources of legacy arsenic into the Bay.



A magnified image of arsenic trioxide in sediments of Yellowknife Bay. (Credit: K. Paudyn)

What's next?

Future environmental monitoring of Yellowknife Bay should include sediment sampling because it is a source of arsenic to surface waters. Environmental conditions that could enhance arsenic diffusion from sediment should be monitored on a regular basis, particularly the loss of dissolved oxygen and accumulation of organic matter.

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Recommended Reading

Paudyn, K. **2021**. *Characterization of arsenic and antimony minerals in Yellowknife Bay sediments*. MSc thesis, School of Environmental Studies, Queen's University, Kingston, ON. https://qspace.library.queensu.ca/handle/1974/28678