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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.

Environmental factors slowing the recovery of Yellowknife area lakes from legacy arsenic pollution

The landscape around Yellowknife was contaminated by gold mining activities during a 60-year period between 1938 and 1999. More than 20,000 tonnes of arsenic trioxide were released into the air and spread across the region from the roasting of arsenopyrite ore at local mines, mostly in the early years of operations (1948 to 1958). Research shows a persisting environmental footprint as local lake waters, lake sediments and soils continue to show elevated arsenic concentrations. Working with the Yellowknives Dene First Nation, this study examined how arsenic moves within contaminated watersheds and the processes that affect the time needed for natural recovery.

Why is this research important?

Arsenic pollution has been a concern since production began at Con and Giant mines. This information will be important as communities, governments, and environmental management agencies look ahead to future land and water uses in the Yellowknife area.

What did we do?

- We investigated several lakes near Giant Mine, including Lower Martin Lake, the last lake in the Baker Creek watershed before Baker Creek passes through the Giant Mine site and discharges into Yellowknife Bay of Great Slave Lake.
- We measured the amount (flux) of arsenic moving through contaminated watersheds to better understand which sources of arsenic are most important and when.
- Measured fluxes included arsenic coming into and leaving a contaminated lake through lake inflows and outflows, but also running off the land during snowmelt and high rainfall events. We also measured the amount of arsenic moving between sediments and overlying water.
- We sampled across all seasons to better understand when arsenic is most mobile.

What did we find?

- ***Lake sediments continue to supply arsenic to overlying lake waters.*** A large reservoir of legacy arsenic remains in lake sediments and arsenic continues to move into overlying water. This movement is greatest in winter for small shallow lakes (<4m).
- ***Arsenic continues to wash off the landscape and into lakes in the region.*** Arsenic from soils continues to be washed off the landscape and into surrounding waterbodies in the region. Most of the runoff happens during the snowmelt period, but large amounts of arsenic can run off the landscape in very wet years with lots of rain.
- ***Local hydrology influences the recovery of lakes from arsenic pollution.*** The amount of streamflow, particularly in winter, and rainfall affect the relative importance of arsenic loads from soil runoff and contaminated lake sediments.

What does this mean?

- The recovery of lake waters is delayed because of continued release of mining-derived arsenic from surrounding soils and, internally, from contaminated lake sediments.
- Altered streamflow patterns with climate change will have an important influence on chemical recovery of lake waters.

What's next?

Future work will look at how changing streamflow and precipitation patterns with climate change will alter levels of arsenic in lake waters.

Streamflow and levels of arsenic were measured at the lake outflow to estimate the amount of arsenic leaving the lake over the study period. (Credit: M. Palmer)

Water samples were collected in the study lake across all seasons. (Credit: M. Palmer)

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Recommended Reading

Palmer, M.J., Chételat, J., Jamieson, H.E., Richardson, M., and Amyot, M. **2021**. *Hydrologic control on winter dissolved oxygen mediates arsenic cycling in a small subarctic lake.* Limnology and Oceanography, 66. https://doi.org/10.1002/lno.11556

Palmer, M.J., Jamieson, H.E., Radková, A, Richardson, M., Maitland, K., Oliver, J., Falck, H. **2021**. *Mineralogical, geospatial, and statistical methods combined to estimate geochemical background of arsenic in soils for an area impacted by 60 years of mining pollution.* Science of the Total Environment, 776. https://doi.org/10.1016/j.scitotenv.2021.145926

Palmer, M.J., Chételat, J., Richardson, M., Jamieson, H.E., Galloway, J. **2019**. *Seasonal variation of arsenic and antimony in surface waters of small subarctic lakes impacted by legacy mining pollution near Yellowknife, NT, Canada*. Science of the Total Environment, 684: 326-339. https://doi.org/10.1016/j.scitotenv.2019.05.258

Map of Arsenic Concentrations Measured in Water Bodies in the Yellowknife Area with Corresponding Public Health Advice
www.hss.gov.nt.ca/sites/hss/files/resources/english_pha_map_-_zoomed_in_-_june_2018.pdf

Arsenic in Lake Water Around Yellowknife
www.hss.gov.nt.ca/en/newsroom/arsenic-lake-water-around-yellowknife