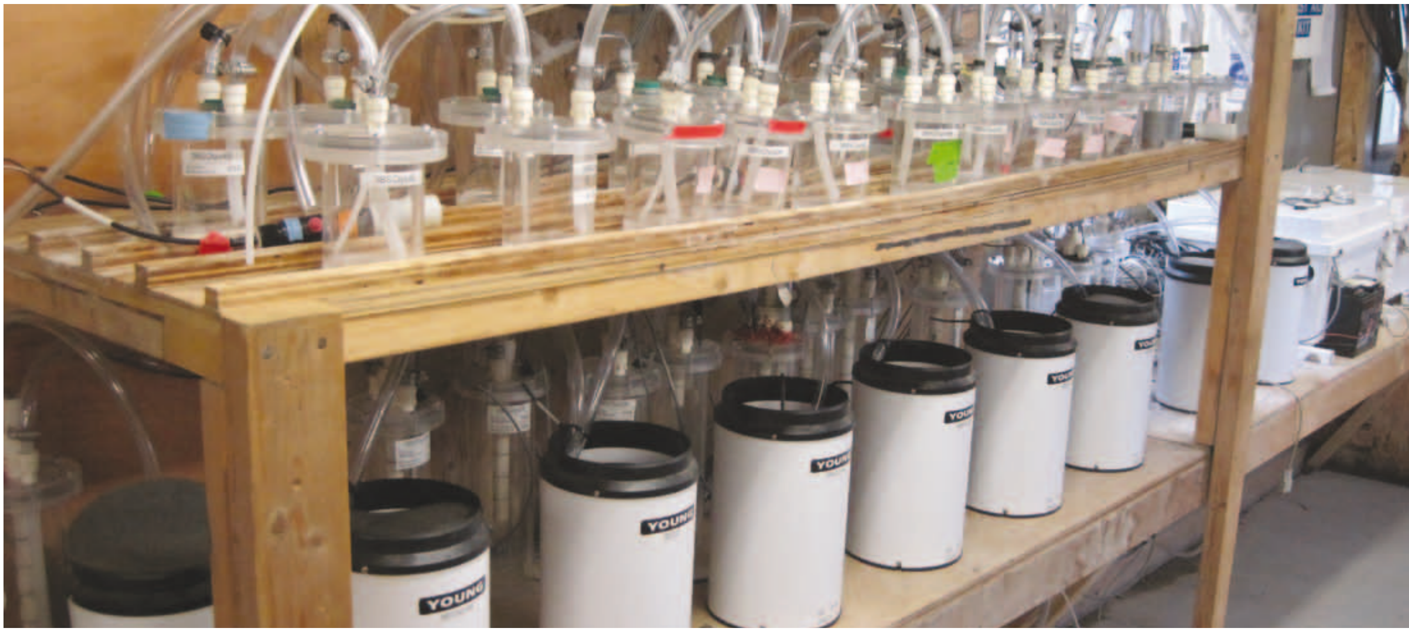
Waste rock study – a major research opportunity



The base of each test pile is graded and lined with an impermeable geomembrane liner so all water draining to the base of the test piles is collected and measured. Water flowing from each drain is directed to an instrumentation trailer that houses collection containers for measurements of pH (acidity), geochemical analysis, and water quantity measurements.

All open-pit mines have waste rock piles – Diavik's is comprised of Canadian Shield granite we remove to access our kimberlite ore – but very few mines have large scale test rock piles constructed to study how the main waste rock pile performs.

"Our test waste rock piles research project is a collaboration of Diavik, three Canadian universities, industry, and science agencies," said Diavik Senior Specialist, Mineral Waste, Lianna Smith.

Ours is one of only a handful of large scale waste rock test piles globally and it was the first large scale test pile to be constructed, she added.

Prior to large scale projects like Diavik's, studies were done with very small samples in the lab environment. Lab studies are still common and useful, but the data generated from larger structures is invaluable.

The study team includes involvement of professors and graduate students from the Universities of Waterloo, Alberta, and British Columbia. Funding comes from mining industry groups, including the International Network for Acid Prevention, the Mine Environment Neutral Drainage program, and the

Stacey Hannam, graduate student at the University of Waterloo, measures oxygen and carbon dioxide levels within the test pile.

Canadian government's Natural Sciences and Engineering Research Council of Canada.

The project started in 2004. To date, Diavik's cash and in-kind investment totals over $2.5 million.

In all, we have three test piles: two measuring 50 metres by 60 metres by 15 metres high and a third measuring 80 metres by 120 metres by 15 metres high. The test piles, like areas of their larger counterpart, are outfitted with instrumentation.

"Diavik's waste rock test piles project is designed so we can study the physical and geochemical processes that happen to our waste rock," Smith said.

For example, we can study the speed which permafrost migrates into rock and how water moves through the rock and the quality of that water. This knowledge will assist in designing, engineering, and constructing our waste rock pile to be part of a successful mine closure, she explains.

Another aspect of the test piles is to measure the quality of water draining from the Type III waste rock. Type III waste rock contains some biotite schist, a type of rock that contains suphide minerals and has the potential to generate poor quality seepage water.

At Diavik, we test our waste rock for sulphur percentages and segregate it into three categories:

- Type I (0% to 0.04% sulphur)
- Type II (0.04% to 0.08% sulphur)
- Type III (greater than 0.08%)

Our percentages of sulphur are very low, even in Type III waste rock, but to protect the environment we place this rock type in specific areas of the waste rock pile.

At closure, an option is to cover the Type III rock with till layer and the very low sulphur Type I waste rock. The test piles reflect this design.

The program provides information about how much of the waste rock will freeze with and without a cover, how much water will move through the piles, and what the quality of the water could be.

"Our initial results indicate the waste rock pile is freezing," Smith said.

A series of instruments are installed within each test pile to measure temperature water flow, water chemistry, oxygen and carbon dioxide levels, microbiological populations, thermal conductivity, and permeability to air. Outflow from the base of each pile is directed to the instrumentation trailers. The three test piles are to the left, centre bottom and right, with the access ramp (top).

Understanding if poor quality drainage forms from our low sulphur waste rock is a key part of the test piles research and will help us better manage it.

Overall, we get leading edge scientific analysis of how our test waste rock piles perform under conditions specific to Diavik and we can apply that knowledge to the larger waste rock pile to protect the environment.

In terms of academics, graduate and undergraduate students gain unique research experience in environmental geochemistry, geotechnical engineering, and hydrology. They also gain experience at an operating minesite and learn first-hand our minesite health and safety procedures.

Stacey Hannam, a University of Waterloo student completing a master's in geochemistry and mineralogy, has been working at the Diavik minesite during the last three summers, and is among the several graduate students taking part in the program.

Her work includes geochemical analysis of water collected from the test piles as well as supporting work on the water movement and temperature profile projects. She also supervises university summer co-op students tasked with collecting all types of samples.

"This is one of the best opportunities," she said, noting that this research project demonstrates that there are "many career opportunities in mining."

"It's been a real eye opener. Academically, there is a lot of data and research potential," she added.

Hannam will use the data to generate a thesis and research papers on geochemistry and mineralogy, which will be a part of an overall research project which Diavik will use to manage our waste rock pile responsibly and safely. More broadly, this project has the potential to improve how future developments manage waste rock in arctic environments, and world-wide.