GENOMICS & MINING

ENHANCING EXTRACTION, PRODUCTION AND ENVIRONMENTAL MANAGEMENT

1344 Summer Street
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GenomeAtlantic
Life Sciences. Life Solutions.

genomeatlantic.ca
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GENOMICS: A TRANSFORMATIVE TOOL

THE POTENTIAL FOR GENOMICS TO TRANSFORM OUR KEY INDUSTRIES IS REAL.

Genomics is the powerful combination of biology, genetics and computer science that gives us unprecedented insight into all the DNA code that makes living things what they are.

When we understand how things work at this molecular level, it opens up a world of possibilities. Genomics is already making a difference in a wide range of areas, such as:

- Increased production of plants and animals with fewer inputs
- Reduced damage from pests and disease
- Improved ability to extract valuable elements from the earth and ocean without disrupting the fragile ecological balance
- Better ability to provide the right treatment at the right time to the right patient

Genome Atlantic is working with a wide range of partners to ensure that genomics helps Atlantic Canada be more competitive in the following sectors:

- Agriculture
- Aquaculture and Fisheries
- Environment
- Forestry
- Human Health
- Mining
- Energy

BRINGING GENOMICS TO THE REAL WORLD

With the help of a range of experts in genomics and other areas, Genome Atlantic is working with companies and government departments in all of these sectors to:

1. Identify areas where genomics can provide benefit, and
2. Facilitate the relevant research and development to achieve those benefits.

We welcome the opportunity to talk to you about these opportunities.

To learn how genomics can be applied to these sectors, please visit our website:

www.genomeatlantic.ca/transformers

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GENOMICS & MINING

A wealth of metal and mineral deposits makes Canada one of the world's top five producers of essential commodities for industry. In the next 20 years, the accelerated industrialization of nations such as Brazil, Russia, India and China will add the needs of 800M 'middle class' citizens. This growth will expand the market for metals and minerals, making this important Canadian sector indispensable to the projected needs of global development.

Canadian mineral production operations in 2011 produced $45B from commodities such as potash, uranium, nickel, cobalt, titanium, aluminum and platinum. Ranking first in global exploration spending, more than 800 operations account for almost 20% of Canadian exports.

And like other sectors, the mining industry faces a variety of challenges in extraction, resource use, and environmental remediation that can be addressed through genomics.

ENHANCING RECOVERY

Successful application of microbial organisms can dramatically enhance recovery of gold and copper. By providing a greater understanding of the microbial activities known to operate in natural resource environments, omics sciences can improve the effectiveness of biotechnological solutions and ensure that recovery rates rise well above current low and diminishing levels. As suppliers resort to extraction from low-grade accessible ore and waning hydrocarbon reserves, these incremental improvements in recovery rates for mature operations will become more attractive.

ADDRESSING RESOURCE-INTENSIVE EXTRACTION

Large amounts of water and energy are used for a range of extraction and processing activities in the energy and mining sector, including concentration of metals and minerals. Recovery of metals can reduce the consumption of large volumes of water through irrigation-style bioleaching of heaped ore, or stirred-tank biooxidation of millions of litres of crushed ore.

Increased omics knowledge could also help mining industries improve metal leaching rates and extent of extraction, or help develop bacteria better suited to optimal leaching environments (withstanding agitation of stirred-tank treatments, higher processing temperatures, acidity, metal toxicity, etc.)

ACCELERATING REMEDIATION

Bioremediation employs biological agents to treat contaminants, such as naphthenic acid from tailings ponds or heavy metals from effluents, to a suitable level for reuse, discharge or disposal. Phytoremediation utilizes the most effective associations of plants with bacteria or fungi to decontaminate polluted sites. Such treatments can benefit the federal government in particular, who oversees more than 20,000 contaminated sites retired from historical mining activities.

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Already, a full-scale bioremediation plant operates in the Netherlands to remove heavy metals from mining effluents, and both Canada and the US have successfully utilized microbial degradation to remove cyanide from metal mining effluent. Further study of indigenous organisms at polluted sites will provide important knowledge on microbial diversity in extreme conditions, identify new isolates with contaminant resistance, and make genetic information available to determine the best remedial symbionts.

MITIGATING ACID ROCK DRAINAGE (ARD; OR ACID MINE DRAINAGE, AMD)

The dissolution of sulphide-bearing waste rock and tailings may form acidic run-off containing dissolved heavy metals. Remediation typically involves either treatment with a basic compound, or more recently manipulating the oxidizing bacteria.

Bacterial treatment of ARD can substantially reduce the need for expensive chemical neutralizers; in this way, Japan saved 70% on the remediation of a copper smelter. Combinations of neutralizing chemicals and laboratory cultured microbes have now been patented for application in the US and Canada. Studies at the University of Wisconsin revealed that two naturally occurring bacteria catalyze ARD to varying degrees, creating opportunity for development of a predictive tool based on natural levels of microbial consortia at the site. A deeper understanding of the effect of chemical inhibitors on the microbial constituents will determine the tool's true predictive capabilities for managing mine site conditions.

ADVANCING BIOLEACHING/ BIOOXIDATION

Particularly effective bacteria are used to leach valuable metals into solution for electroplate recovery (bioleaching), or to concentrate valuable solids through the leaching of low value impurities (biooxidation). These biohydrometallurgy processes become increasingly important for extracting metals and minerals from low-grade ore as high-grade reserves are depleted.

Bioleaching currently produces almost a quarter of the world's copper, and biooxidation enables 20-fold concentration of gold prior to extraction. In the interest of advancing this field, bacteria that thrive in both high and low temperatures are being explored, with the aim of using them in diverse climate sites such as Canada's Arctic.

ADDRESSING REGULATORY REGULATIONS

There are increasing regulations around the use of certain mining practices and their environmental impact. For example, countries around the world, including Hungary, Germany and the Czech Republic have banned the use of cyanide leach mining. Microorganisms that can perform similar leaching activities result in dramatically reduced environmental impacts. Genomics technologies can help to identify and manage the most effective organisms for these and other less invasive processes.