In a groundbreaking development, researchers at the **University of Waterloo** have introduced a novel mining technique that employs microbes to extract metals and store carbon in the waste generated by mining activities. This innovative method of reusing mining waste, known as tailings, has the potential to revolutionize the mining industry by paving the way for a greener and more sustainable future.

Tailings are a by-product of the mining process, consisting of fine-grained waste materials left after extracting the target ore mineral. These residual materials are then accumulated and stored using a technique called dry-stack tailing.

As mining practices have evolved over time, they have become more efficient; however, the escalating climate crisis and the growing demand for critical minerals necessitate the development of new ore extraction and processing technologies.

Old tailings tend to contain higher amounts of critical minerals that can be extracted with the assistance of microbes through a process known as bioleaching. In this eco-friendly process, microbes break down the ore, releasing valuable metals that were not fully recovered, at a rate that is significantly faster than natural biogeochemical weathering processes.

What the researchers learned

Dr. Jenine McCutcheon, an assistant professor in the Department of Earth and Environmental Sciences, explained: “We can take tailings that were produced in the past and recover more resources from those waste materials and, in doing so, also reduce the risk of residual metals entering into local waterways or groundwater.”

Beyond enhancing resource recovery, the microbes also capture carbon dioxide from the atmosphere and store it within the mine tailings as new minerals. This process aids in counterbalancing some of the emissions released during the mine’s active period and assists in stabilizing the tailings.

If applied to an entire mine, microbial mineral carbonation could offset over 30% of a mine site’s annual greenhouse gas emissions. Moreover, this microbial-driven technique adds value to historical mine tailings that are otherwise classified as industrial waste.

“This technique makes better use of current and past mine sites. Rethinking how future mine sites are designed in order to integrate this process could result in mines that are carbon neutral from the get-go rather than thinking about carbon storage as an add-on at the end,” said McCutcheon.

“This technology is a potential game-changer in the fight against climate change, and the mining industry has a unique opportunity to play a significant role in the future of green energy.”

McCutcheon explained that the microbial-driven processes could propel the industry towards carbon-neutral or carbon-negative mining. However, to transition this technology towards large-scale deployment, active engagement from the industry is crucial.

Dr. McCutcheon published this research alongside co-author and associate Professor Ian Power of Trent University in the journal PLOS Biology.

More about the environmental impact of mining

Mine tailings are the waste materials generated during the extraction and processing of valuable minerals from ores. They typically consist of finely ground rock particles, water, and various chemicals used in the mineral separation process.

These waste materials are stored in tailings storage facilities (TSFs) or tailings dams, which can occupy vast tracts of land and pose significant environmental risks.

The environmental impact of mining and mine tailings can be considerable and includes the following:

Water pollution

The chemicals and heavy metals in tailings can leach into groundwater and surface water, contaminating water sources and causing harm to aquatic ecosystems. Acid mine drainage (AMD) is a common problem, which occurs when sulfide minerals in the tailings react with air and water, forming sulfuric acid that dissolves heavy metals. This can lead to waterways becoming highly acidic and toxic to aquatic life.

Soil contamination

Tailings can also contaminate soil with heavy metals and chemicals, which can adversely affect plant growth and the health of soil-dwelling organisms. This may result in the degradation of local ecosystems and reduced agricultural productivity.

Air pollution

Dust from tailings storage facilities can become airborne, contributing to air pollution and posing health risks to nearby communities. Moreover, the extraction and processing of minerals often involve the release of greenhouse gases, contributing to climate change.

Habitat destruction

Mining operations often require the clearing of large areas of land, leading to the destruction of habitats and the displacement or loss of plant and animal species. This can also result in the fragmentation of ecosystems and loss of biodiversity.

Tailings dam failures

The structural failure of tailings dams can lead to catastrophic environmental disasters, as large volumes of toxic waste are released into the environment. This can cause widespread devastation to ecosystems, farmland, and nearby communities.

Long-term environmental risks:

Mine tailings can pose long-term environmental risks due to their potential to leach contaminants and generate AMD even after mining operations have ceased. This necessitates ongoing monitoring and remediation efforts to prevent environmental damage.

Given these environmental impacts, there is a growing need for more sustainable and responsible mining practices. Techniques such as bioleaching, as mentioned in the previous answer, can help minimize the environmental footprint of mining activities by extracting valuable metals from tailings in an eco-friendly manner, reducing the need for new mines, and mitigating the risk of pollution.

Additionally, the use of microbes to capture carbon dioxide and store it as minerals within the tailings can help offset some of the greenhouse gas emissions associated with mining.

Source: earth