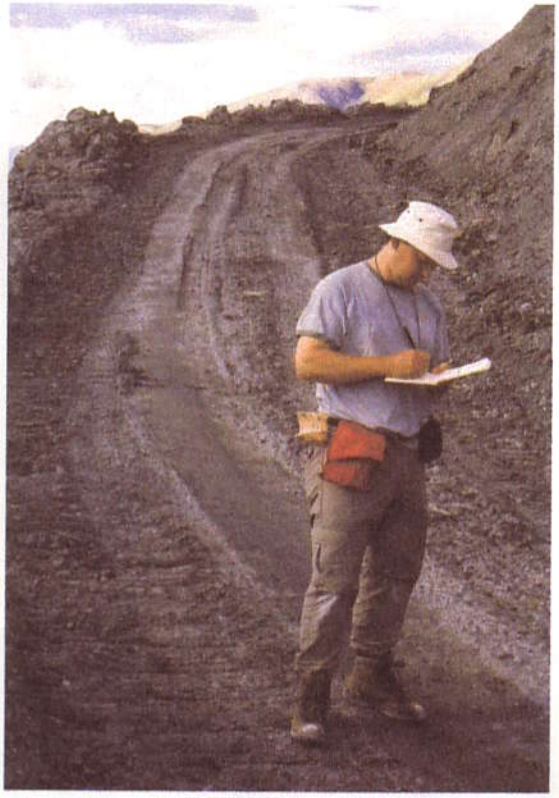
By Heather Kent

The crushed leftover material of mining operations could have a surprising benefit — an ability to absorb greenhouse gases.

Tailings

Turning mine tailings into carbon credits under the Kyoto agreement is a tantalizing possibility. But for Dr. Greg Dipple, a geologist, geochemist and associate professor at the University of British Columbia, "It's not really a question of *can* you make a mine greenhouse-gas neutral, it's [a question of] how much is it going to cost?" The decommissioned mines he has studied so far are chrysotile, but later this year, Dipple will continue his research at Western Mining Corporation's Mt. Keith nickel mine in Western Australia and at the Diavik diamond mine in the Northwest Territories.



Greg Dipple at the Cassiar Mine in northern B.C. The tailings' mineral crusts have bound atmospheric carbon dioxide.

An associate professor at UBC's Mineral Deposit Research Unit, Dipple began studying the absorption of carbon dioxide from tailings in 2002. Working with Laval University researchers at a Quebec mine, he was investigating the waste rock for its suitability as feed stock for a chemical reactor. "While we were doing that, we discovered that the mine waste was already reacting, that mineral products were forming naturally on the surfaces of the tailings," he explains. Through atmospheric reaction, the tailings were producing a magnesium carbonate crust.

Dipple's further investigations later found that the same reaction was occurring at three other mines in B.C. and the Yukon. How long the crust takes to form is one question Dipple and his colleagues are trying to answer. "The amount is not substantial — not tons a day which is the kind of rate that you want to be looking at for carbon sequestration," he says. "We do find thin crusts that are so fragile they wouldn't survive a rainfall event. So the crusts are forming actively, probably in surges in response to precipitation events."

Dipple and his colleagues have mapped the tailings' surface to see where the crusts form and have analyzed samples in his laboratory. "We have to identify that the CO_2 is chemically bound within a mineral form — that's what is going to provide this long-term storage." Auger samples up to one metre in depth are also collected to see whether the crust material is distributed in different ways. Additional testing is carried out to determine which carbonate minerals in the tailings are binding with the atmospheric carbon.

The process of carbon mineralization occurs naturally in mountains on a geologic time scale, so it occurs much more rapidly in the crushed tailings, says Dipple. "In mine tailings you have increased the surface area immensely, by about a million-fold, so it is not surprising that the rates of reaction have correspondingly increased. It's perfectly logical that it's happening: we just hadn't thought through that process."

Accelerating the mineral carbonation process is his goal. "I think what is limiting the reaction rates we are seeing right now is the water. We are relying on natural rainwater to do the dissolution. What we are talking about doing is actually circulating water through tailings piles to drive the dissolution phase. The way to do it is to move water and play with the water chemistry," he explains.

The entire mining operation at Mt. Keith produces about 300,000 tons of CO_2 annually.

The carbonation process does not need to be applied to all the tailings, explains Dipple. "If we were to react 10% of the tailings production of Mt.

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team designed and built "core units," or "mesocosms" — the smallest units within a subsurface constructed wetland. In one study, wastewater containing nutrients and sodium bromide tracers was passed through mesocosm columns containing pea-gravel medium. Planted, unplanted and abiotic (all biological organisms removed) models were compared.

Every 3.5 days, the mesocosms were fed a synthetic wastewater mixture of molasses, urea, sodium phosphate, magnesium sulphate, potassium carbonate and yeast extract, and once a month, an injection of 1% activated sludge from the Waterloo Regional Wastewater Treatment Plant was added. Legge and his colleagues have so far found that re-aeration did not significantly affect the rates of removal for abiotic contaminants such as metals. The presence of plants did not seem to affect the rates of removal of pathogens or contaminants either. However, they found that higher bioactivity (presence of bacteria, microbes, etc.) had a significant effect on the removal of pathogens.

More study of the plant aspect is in the works. **CCE**

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Keith, that would consume the equivalent of all greenhouse gas emissions of the entire mine," he says. Treating a similar percentage of Diavik's tailings would produce the same result.

At Mt. Keith, where the tailings are dumped as slurry, Dipple and his team will document the existing extent of natural carbonation and whether changing the chemistry of the water has any effect on the rate of CO_2 absorption. Developing a geochemical model will provide predictive information on how to accelerate the carbonation process most cost-effectively, he says.

"I think the biggest expense will be the cost of moving water, and we have only begun to look at that. At Mt. Keith, you might have to double the amount of water they are using on an annual basis," he says. Compounding these costs is the mine's desert environment. However, says Dipple, if the carbon credits were sold for $10 per ton, a standard rate in Europe, the return would be $3 million. "Can you do it for $3 million? That's totally unknown at this stage," he says.

How is the Canadian mining industry responding to Dipple's research? While Australia's Western Mining Corporation is helping to fund the research at the Diavik Mine, so far Rio Tinto is the only Canadian company to provide funding. "I think there's a lot of interest, but it's such a weird idea that a lot of people are waiting to see if it really bears fruit," says Dipple. **CCE**

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