Researchers tap into CO2 storage potential of mine waste

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It's time to economically value the greenhouse gas-trapping potential of mine waste and start making money from it, says mining engineer and geologist Michael Hitch of the University of British Columbia (UBC).

Hitch studies the value of mine waste rock for its CO_2-sequestration potential, or "SP." He says mining companies across Canada will, in future, be able to offset CO_2 emissions with so-named "SP rock," and within 25 years could even be selling emissions credits.

Digging, trucking and processing make mining an energy-intensive industry that emits greenhouse gases. However, mine waste rock that is rich in the mineral magnesium silicate has an inherent ability to react with CO_2 and chemically "fix" it in place as magnesium carbonate—an ability that can be greatly enhanced with some processing. Hitch and his colleagues note that this capacity for CO_2 fixation can be five to ten times greater than total greenhouse gas production from some mine operations. Nickel, diamond, copper, chromite, platinum, palladium, talc, and asbestos mines could all be contenders. Some large mines, the researchers add, could fix 5 million tonnes or more of CO_2 per year.

"I don't like waste," asserts Hitch. "I like to see efficient use of the resources."

Instead of using just 1 per cent of the materials from a big mining pit, he explains, a company could receive value from the non-commodity rock. "All of a sudden this material starts having value, and this material starts

taking on a position in the company's cash flow as a byproduct," says Hitch, adding, "It really kind of changes the dynamics of the mining operation."

With the global price of carbon emissions credits expected to rise, SP rock could become even more valuable. However, in order to achieve substantial CO_2 sequestration in SP rock, the somewhat sluggish chemical reactions that naturally fix CO_2 require a jump start.

Hitch is working on this problem alongside researchers Greg Dipple, team lead, and Ulrich Mayer, both of UBC's Department of Earth, Ocean and Atmospheric Sciences, and Gordon Southam, with the University of Western Ontario's Department of Earth Science. The collaboration is being funded by Carbon Management Canada, a Network of Centres of Excellence that funds research to produce the technology, knowledge, and human capacity that will reduce carbon emissions in the fossil energy industry and in other large-scale emitters.

Two of the team's primary goals are to measure the rate of CO_2 fixation in mine waste rock and tailings in a lab setting and to speed up the process. Team members have already observed that CO_2 fixation is greatly accelerated in mine tailings, presumably due mainly to the large surface area exposed and available to react after rocks are crushed into small particles.

Dipple's lab reports that their previous research has demonstrated that CO_2 is trapped in mineral precipitates at rates of up to 50,000 tonnes per year within tailings during mine operations, and continues to be sequestered after mine operations cease. Rates of fixation are limited by the dissolution of CO_2 in water and one area of investigation involves increasing the concentration of CO_2 supplied to a slurry similar in chemical composition to tailings process water. Results show a 200-fold rate of increase over atmospheric weathering of some minerals by

increasing the concentration of CO_2 in the air passed through the slurry to 10%.

Hitch's lab is currently grinding rock and pre-treating the material in order to change its physical and chemical properties. Dipple's group will then examine the material's ability to fix CO_2. The collaborating researchers hope to move to field trials in five years.

Meanwhile, Southam's UWO research group is studying the role of microbes in fixing CO_2 and precipitating carbonate minerals, in particular as sedimentary rock. They are also working on methods to accelerate this process.

Another important goal is to use computer modeling to predict the sequestration potential of rocks at specific mining sites. To that end, Hitch is designing a way to use mining planning software to put a dollar value on the amount of SP rock that could be obtained at particular locations. These data, coupled with Mayer's modeling of CO_2 uptake in mine wastes at the environmental and climate conditions of specific mine sites, could allow for comprehensive evaluation of CO_2 fixation capacity and rate for individual mine sites around the world.

"None of this (work) is done in isolation," notes Hitch, adding that carbon management is not an easy solution. "It requires lots of different perspectives and lots of different skill sets," he says.

The safe storage of CO_2 in mine waste and tailings for thousands of years is an exciting idea that could refresh the public image of the mining industry. One day, Hitch and his colleagues add, research findings from mining could even be applied to CO_2 sequestration projects underground and in marine basins.

Provided by Carbon Management Canada