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Evaluating carbon storage and release potential in mine wastes as part of an ML/ARD study

CARLOS PAULO[1], MR. JULIEN DECLERCQ, MSC, PH.D.[2] AND KIRSTY KETCHUM[1]

[1]SRK Consulting (Canada) Ltd
[2]SRK Consulting (UK) Ltd

Presenting Author:
carlos.fernandesesilvapaulo@mail.utoronto.ca

With geochemical carbon removal technologies (e.g. Heirloom and Carbfix projects) ramping up quickly globally, the mining industry is emerging as a partner of choice for CO_2 capture and storage (CCS) projects. Most of these technologies utilize rocks to support mineral carbonation and enhanced weathering processes. Mine waste, crushed in the mining process, represents an ideal feedstock to support accelerated weathering reactions, provided it is geochemically and mineralogically suitable for reacting with CO_2 and producing stable carbonate minerals. Although these processes occur naturally in mine wastes, optimizing carbon removal processes in mine waste can help mining companies and their stakeholders develop both carbon-neutral activities and provide additional CO_2 storage potential when geology is favorable.

However, the use of accelerated weathering technologies in some cases can increase sulphide oxidation or metal release rates from rocks, posing a greater risk of releasing hazardous constituents from mine waste into the environment. These processes can even hinder carbon removal rates, if promoting carbonate dissolution and the release of geologically trapped CO_2 back into the atmosphere. Therefore, the selection and characterization of carbon removal feedstocks is a critical design criterion for the success of carbon removal technologies.

The mining industry extensively uses geochemical protocols for the characterization of mine waste, to understand its mineralogy and elemental composition, its potential for acid or alkalinity generation (acid base accounting and net acid generation testing), and its potential for metal leaching (humidity cell testing). These standard and industry recognized tests provide valuable information on rock weathering processes and rates. Since mineral carbonation is primarily controlled by mineral dissolution, we propose that geochemical testing can be readily adapted to support CCS programs. We demonstrate in this study that mine waste screening for carbon removal technologies, the prediction of carbon removal rates, and the evaluation of risks associated with accelerated weathering technologies can be assessed via typical geochemical prediction program protocols designed for metal leaching and acid rock drainage (ML/ARD) characterization. The results from this work will be supporting mining companies' decision-making process for the implementation of CCS technologies in the mine or off-site mine.