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The mining industry's role in enhanced weathering and mineralization for CO_2 removal

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Enhanced weathering and mineralization (EWM) is a suite of geochemical negative emissions technologies that has the potential to achieve CO_2 removal rates at the gigatonne scale yet will require gigatonnes of suitable rock.[1] Consequently, the mining industry will play essential roles in advancing and implementing EWM, including (1) quantifying passive CO_2 removal at their mines, (2) accelerating on-site EWM, (3) exploring opportunities for off-site use of their waste rock powders for CO_2 sequestration, and (4) mining and supplying rock powder for EWM off-site. Here, we discuss how geochemists in EWM fields can collaborate with the mining industry to fulfill these roles, providing examples of each. Passive carbonation is the spontaneous reaction of minerals in mine wastes with atmospheric CO_2 to form stable secondary carbonate minerals that are sinks for CO_2. Geochemists can aid mines in developing geochemical models that reliably quantify CO_2 removal using water chemical data that are routinely collected and ground truth these models through on-site monitoring.[2] Mines are also ideal locations for interdisciplinary teams, including mine staff, to test strategies and technologies for accelerating passive carbonation since tailings impoundments are contained and highly monitored. In addition to on-site EWM, mining companies are crucial for implementing EWM beyond their operations. For instance, some environmentally safe mine wastes may be used off-site as an EWM feedstock,[3] reducing costs and risks associated with their on-site storage. In addition to repurposing mine wastes, numerous new mines will be needed to supply rock powders to reach the gigatonne scale. Large-scale EWM pilots with mining companies are required to progress technology readiness and further develop carbon verification approaches. With its knowledge of geological formations and ore processing, the mining industry can extract the most reactive rocks with the greatest CO_2 removal capacities, create supply chains, and participate in life-cycle assessments. The motivations for mining companies to develop EWM include reputational benefits and carbon offsets needed to achieve carbon neutrality.

1. Power *et al*. (2024) *Environ. Sci. Technol*., 58, 43−53. 2. Paulo *et al.* (2023) *Appl. Geochem.* 152, 105630. 3. Paulo *et al.* (2021) *Appl. Geochem.* 129, 104955.