Global potential of ore-producing mines for sequestering CO_2

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The IPCC Special Report on 1.5 °C Global Warming highlighted the need for negative emissions to compensate for residual emissions and/or temperature overshoot in efforts to limit global temperature rise to below 2 °C. Enhanced Weathering (EW) is a potential methodology for removing CO_2 from the atmosphere, through accelerated weathering of silicate rocks, and conversion of CO_2 into alkalinity and/or carbonate minerals. Large scale deployment of EW is nevertheless currently hampered by knowledge gaps related to available rock material, environmental impacts, technological efficiency and public acceptability. Dissolution of CO_2 into bicarbonate solution (and/or later carbonate precipitation) is a method of CO_2 sequestration on a scale of thousands of years up to geological timescales.

Due to the increasing demand and production of metal and precious stone commodities worldwide, the mining industry contributes a gigatonne of CO_2 to the atmosphere annually. However, this industry may also provide an opportunity for CO_2 removal. The generation of millions of tonnes of freshly comminuted mine tailings is a potential feedstock for EW, depending on the physico-chemical properties and rates of reaction of the deposit type.

Here we assess the worldwide potential of the mining industry for CO_2 removal. We have compiled a global database on ore commodities associated with large-scale mining, including annual production, and we assess the EW potential of different deposit types based on their chemistry and scale. Preliminary results suggest that Mg-rich deposits, such as layered mafic intrusions, nickel sulphides and kimberlites, are the most suitable materials for CO_2 sequestration. Other deposit types with less favourable chemistry, such as Cu-porphyries, may also be important contributors due to their vast operation scales. EW methodologies, such as direct CO_2 injection or microbial mediation, need to be matched to each deposit type and operation to access full sequestration capacity, forming part of tailings management. The results presented here will aid in future decision making for identification of sites with maximum sequestration potential, and provide an assessment on the upscale potential of individual sequestration projects.