EGU22-3176
https://doi.org/10.5194/egusphere-egu22-3176
EGU General Assembly 2022

Role of Basalt in Green Mining

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The growth of the world population pressures for an increasing demand for the extraction of the Earth's non-renewable mineral resources, which are essential for modern living. The heavy mining operations associated with this extraction have several negative environmental and societal impacts, including the emission of greenhouse gases and the production of large volumes of solid waste. Green mining aims to adapt the mining operations to reduce the negative impacts, while maintaining the interests of stakeholders.

Basalt is a mafic volcanic rock that is widely available in the Earth's surface and often occurs in a variety of ore deposit systems. Traditionally, basalt is used in various ornamentation and construction purposes. However, recently, novel agricultural, environmental and even industrial applications of basalt emerged. When basalt is crushed to a reasonable size (preferably ≤250 µm) and applied to soils in an adequate application rate (5 to 20 t ha^{-1}), it acts as a natural fertilizer. Basalt is predominantly composed of Ca-rich plagioclase, pyroxene and olivine. These rock-forming minerals have a fast weathering rate compared to other silicate minerals. When they come in contact with water and CO_2, from the atmosphere, they dissolve releasing a broad spectrum of macronutrients, micronutrients and beneficial elements (e.g., Si, Fe, Ca, Mg, Mn, Na, K, P, S, Ti, V, Cu, Zn, Co & REEs), which are important for plant growth. During this natural enhanced weathering process, an adequate amount of CO_2 is sequestered from the atmosphere.

Here, a novel green mining technique is proposed for ore deposits, hosted in or associated with basalt. This technique proposes the separation of the barren or very weakly mineralized basaltic bodies from the remaining solid waste. These bodies should be further crushed and distributed over local farmlands and forests. Crushed basalt will act as a slow release, natural fertilizer, which will rejuvenate weathered soils, boost soil fertility, neutralize soil acidity and enhance plant growth. This will increase the green cover and yield and will reduce the farming costs, which will have positive socio-economic impacts on the local community. More importantly, this green mining technique will reduce the amount of solid mining waste and will sequester a considerable amount of CO_2 from the atmosphere, during the enhanced weathering process, which could compensate for the CO_2 emitted from the mining operations. Although the process appears straightforward and of high benefit for the environment, the mining sector and the local society, a special monitoring program should be initiated to assess the heavy metal content of the distributed basalt dust to avoid contaminating soils, especially in the case of high application rates

(>5 t ha^{-1}).

This ongoing research aims to develop sustainable green mining programs to recycle and reuse the solid mine waste for CO_2 sequestration and for the development of natural, slow release, low cost, eco-friendly fertilizers.