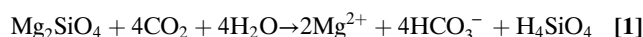
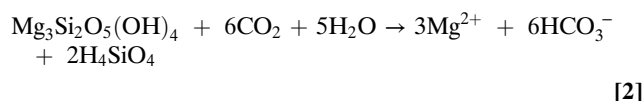


Enhanced silicate weathering is not limited by silicic acid saturation

Enhanced weathering of olivine as a means of sequestering carbon is investigated by Köhler et al. (1). Specifically, the study discusses the potential distribution of fine olivine powder, obtained from dunite mines, in the humid tropic regions of the Amazon and Congo River catchments. Olivine (forsterite) dissolution (Eq. 1) implies the sequestration of 4 moles of CO₂ for each mole of olivine (2).



Köhler et al. (1) suggested that the saturation of silicic acid (H₄SiO₄) in river runoff would crucially limit olivine dissolution. As an example of the weathering of pulverized ultramafic rock, Wilson et al. (3) present evidence that the ultramafic tailings of the Clinton Creek asbestos mine in Yukon, Canada have sequestered significant amounts of CO₂. A suite of magnesium carbonate minerals has formed from crushed serpentized peridotite tailings in a pile that occupies ≈0.5 km². These tailings have sequestered a minimum of 82,000 tons of atmospheric CO₂ as solid carbonate minerals between 1978 and 2004, which equates to ≈1,700 g C m⁻² y⁻¹. An equivalent amount of carbon (total C = 3,400 g m⁻² y⁻¹) is likely sequestered as aqueous bicarbonate in tailings runoff waters (Eq. 2).



Therefore, carbon sequestration is at least 40 times greater than that calculated by Köhler et al. (1) of 85 g C m⁻² y⁻¹. Enhanced weathering in the Amazon or Congo catchments would be much greater than in Yukon given the favorable climate. Although this is not explicitly stated, the model of Köhler et al. (1) describes the equilibrium dissolution of olivine in a closed system under exclusion of all biotic factors. Weathering typically proceeds in open systems and is promoted by many biotic factors.

Inorganic reactions that remove silicic acid include precipitation of opaline silica and overgrowths on quartz, or neoformation of clay minerals. Uptake of silicic acid by vascular plants is a significant biological sink. However, the most important biological sinks for silicic acid in lakes and rivers are diatoms, given their proliferation in a wide range of environmental conditions (4). At the Clinton Creek mine, dissolved silicon concentrations are low in a pond (2.6–5.0 mg L⁻¹) that is partially fed by tailings runoff waters and in the open mine pit pond (0.5 mg L⁻¹) compared with local streams (5.9 mg L⁻¹) (5). Both ponds support an abundance of diatoms (3) that act as sinks for silicic acid. These observations suggest that the saturation concentration of silicic acid is never approached in natural weathering of pulverized ultramafic rock.

The Clinton Creek site, although not intended as such, is an example of the implementation of the enhanced weathering scenario proposed by Schilling and Krijgsman (2). The observations of Wilson et al. (3) and Power et al. (5) confirm that enhanced weathering and carbonation of pulverized ultramafic rock proceed at a much greater rate than estimated by Köhler et al. (1) without limitation by saturation of silicic acid.

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