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Soil Organic Carbon Loss: An Overlooked Factor in the Carbon Sequestration Potential of Enhanced Mineral Weathering

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Weathering of silicate minerals regulates the global carbon cycle on geologic timescales. Several authors have proposed that applying finely ground silicate minerals to soils, where organic acids would enhance the rate of weathering, could increase carbon uptake and mitigate anthropogenic CO_2 emissions. Silicate minerals such as olivine could replace lime, which is commonly used to remediate soil acidification, thereby sequestering CO_2 while achieving the same increase in soil pH. However, the effect of adding this material on soil organic matter, the largest terrestrial pool of carbon, has yet to be considered. Microbial biomass and respiration have been observed to increase with decreasing acidity, but it is unclear how long the effect lasts. If the addition of silicate minerals promotes the loss of soil organic carbon through decomposition, it could significantly reduce the efficiency of this process or even create a net carbon source. However, it is possible that this initial flush of microbial activity may be compensated for by additional organic matter inputs to soil pools due to increases in plant productivity under less acidic conditions.
This study aimed to examine the effects of olivine amendments on soil CO_2 flux. A liming treatment representative of typical agricultural practices was also included for comparison. Samples from two highly acidic soils were split into groups amended with olivine or lime and a control group. These samples were incubated at 22°C and constant soil moisture in jars with airtight septa lids. Gas samples were extracted periodically over the course of 2 months and change in headspace CO_2 concentration was determined. The effects of enhanced mineral weathering on soil organic matter have yet to be addressed by those promoting this method of carbon sequestration. This project provides the first data on the potential effects of enhanced mineral weathering in the soil environment on soil organic carbon pools.