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Rock-Aid Experiment: Effects of Grinding Motion in Accelerating CO2-Fluid-Minerals Interaction

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The rate of mineral weathering in natural conditions is relatively slow while the world is running out of time for declining the carbon budget to achieve the 1.5 to 2 ^{o}C goal. However, there are several ways to enhance weathering rate, such as engineering the abiotic conditions or combining them with biotic components. Enhanced weathering is one of the approaches in negative emission technologies (NET) that is prominent to remove carbon dioxide from the atmosphere by accelerating mineral weathering. Yet, there is still much room in enhancing mineral weathering to fill the overshoot gap in the carbon budget. One aspect that is still rarely discussed is the effect of kinetics or motion (grinding effects) in the mixture of minerals and water. This research observes and calculates the impact of grinding effects in mineral weathering. In order to explicate the grinding effects, we utilized kitchen-aid machines as a mechanical mixer. The rotational speed for the machine was 50 rpm and it ran continuously over the week. We evaluated the carbon dioxide drawdown using two types of rocks, i.e., basalt and dunite. We also set different type of scenarios, such as: (a) grain size, i.e., powder/fine (<0.063 μm), medium (<125 μm), and coarse (<1mm); (b) water replacement, (c) rocks treatment. We found that mechanical grinding effects could increase the carbon sequestration up to 2000-folds - compared to the non-grinding state. It also affects the saturation state of each mineral. It seems that the grinding force needs to be considered in carbon capture technology to enhance the rate of carbon absorption by minerals.