Carbon sequestration via enhanced weathering of peridotites and basalts in seawater

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Enhanced weathering of mafic and ultramafic rocks has been suggested as a carbon sequestration strategy for the mitigation of climate change. This study was designed to assess the potential drawdown of CO_2 directly from the atmosphere by the enhanced weathering of nanoscale peridotites and basalts in seawater. Dunite, harzburgite and olivine basalt were reacted in artificial seawater in batch reactor systems open to the atmosphere for two months. Ultrafine rock powders were produced via ball milling. The results demonstrate that the ball-milled dunite and harzburgite changed dramatically the chemical composition of the seawater within a few hours, inducing CO_2 drawdown directly from the atmosphere and ultimately the precipitation of aragonite. In contrast, pulverized but unmilled rocks, and the ball-milled basalt, did not yield any significant changes in seawater composition. As much as 10 weight percent aragonite was precipitated during the experiment containing the finest-grained dunite. These results, therefore, demonstrate that ball milling can substantially enhance the weathering rate of peridotites in marine environments, promoting the permanent storage of CO_2 as environmentally benign carbonate minerals through enhanced weathering. The precipitation of Mg-silicate clay minerals, however, could reduce the efficiency of this carbon sequestration approach over longer timescales.