Effect of elevated CO2 and temperature on abiotic and biologically-driven basalt weathering and C sequestration

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Abstract

Weathering of primary silicates is one of the mechanisms involved in carbon removal from the atmosphere, affecting the carbon cycle at geologic timescales with basalt significantly contributing to the global weathering CO2 flux. Mineral weathering can be enhanced by microbiota and plants. Increase in both temperature and CO2 in the atmosphere can directly increase weathering and can also affect weathering through impact on biological systems. The goal of this research was to quantify direct and indirect effects of temperature and elevated CO2 on basalt weathering and carbon sequestration. In order to achieve this goal we performed controlled environment mesocosm experiments at Ecotron Ile-de-France. Granular basalt was exposed to rainfall at equilibrium with two different CO2 concentrations in the air, and kept at two temperatures. Four plant treatments were superimposed on this design. Mesocosms were equipped with solution and gas samplers. To monitor biogenic and lithogenic weathering product concentrations, soil solution samples were collected after each rainfall event and analyzed to determine pH, conductivity, major and trace elements concentrations, anions concentrations, and aqueous phase organic matter chemistry. Plant

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biomass was collected at the end of the experiment to determine dry weight, as well as removal of N and lithogenic elements by plants. Solid samples were collected to connect the measured weathered fluxes in solution with the mineralogical evolution. Obtained values for the solution composition, gas fluxes and solid phase changes will be used to determine dissolution rates, weathering incongruence and carbon sequestration using multicomponent reactive transport modeling.

Keywords: global change, soil weathering, biogeochemistry