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Impact of atmospheric CO_2 rise on chemical weathering of the continental surfaces

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Continental weathering consumes atmospheric CO_2. Recent analysis of field data has shown that this flux is rapidly reacting to ongoing climate (ref 1) and land use changes (ref 2), displaying an increase of up to 40 % over a few decades. Weathering processes are thus a potentially important component of the present day global carbon cycle.

We developed numerical model describing continental weathering reactions based on laboratory kinetic laws and coupled to numerical model of the productivity of the biosphere (B-WITCH)(ref 3,4). This model is able to simulate the chemical composition of streams for both small and large continental watersheds. In this model, we emphasized the role of land plants in controlling belowground hydrological fluxes and decreasing the pH of percolating water through root respiration, both of which heavily impact weathering rates.

Both climate change and increasing atmospheric CO_2 concentrations affect the productivity and biogeography of the terrestrial biosphere through direct climate effects and CO_2 fertilization. With our weathering model coupled to a dynamic global vegetation model, we have the capability to explore the impact of CO_2 and climate change on rock weathering.

With regards to CO_2 fertilization, we calculate that the overall weathering rate may potentially rise by 20 % when CO_2 increases up to 8 times the present day pressure for a large tropical watershed (Orinoco). This change is driven by a decrease in evapotranspiration when CO_2 rises, and thus by an increase in the weathering profile drainage. We extend our sensitivity tests to the fertilization effect to 20 sites all over the world under various climatic, biospheric and lithologic conditions, and the results will be discussed.

ref 1: Gislason et al., EPSL, 277, 213-222, 2008
ref 2: Raymond et al.,Nature, 451, 449-452, 2008
ref 3: Goddéris et al., Geochim. Cosmochim Acta, 70, 1128-1147, 2006
ref 4: Roelandt et al., Global Biogeochem. Cycles, submitted