Global carbon cycle feedbacks of glacial weathering

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Chemical weathering is a major long-term control on global climate through its sequestration of atmospheric CO_2. Thus, changes in chemical weathering during glaciations could have feedbacks in the earth system that affect the climate of the glaciation period. The direction of these feedbacks have yet to be resolved. Based on a new compilation of hydrochemical data, we evaluate the dominant chemical reactions associated with chemical weathering, and explore its implications for the carbon cycle. Chemical weathering rates in the compiled glacial catchments exceed the global average, which suggests that glaciers could facilitate weathering. Analysis of the stream chemistry shows that a large proportion of the solute flux originates from carbonate and sulfide minerals.

Based on an inversion method, we show that compared to non-glacial weathering, glacial weathering is more likely to yield alkalinity:DIC ratios less than 1. This suggests that enhanced sulfide oxidation, which acts as a source of CO_2 to the atmosphere, could be a result of glaciation. This flux could have changed atmospheric CO_2 concentration by > 5 ppm during Quaternary deglaciations. Over longer timescales, the CO_2 release associated with sulfide weathering could act as a negative feedback towards glaciations.