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Weathering fluxes under moderate erosion rates – the case of the Black Forest, Germany

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Chemical weathering modulates Earth's carbon cycle on geologic time scales. Weathering rates depend on the climatic conditions (especially temperature and precipitation) and the availability of minerals, which are, in turn, influenced by uplift and erosion rates. The impact of weathering on the carbon cycle depends on the type of mineral that is being weathered. Whereas weathering of silicate rocks produces alkalinity and draws down carbon dioxide (CO_2), the oxidation of sulfide consumes alkalinity and acts as a CO_2 source. A recent analysis suggests that the weathering of silicate, carbonate and sulfide minerals have varying sensitivity to erosion rates. These differences imply that the CO_2-drawdown-flux from silicate weathering is highest in landscapes of moderate relief and erosion rates. However, weathering-rate data from such landscapes remains rare and important uncertainties in the behaviour of the "CO_2-drawdown maximum" remain.
Here, we investigate the link between erosion and weathering in the Black Forest (Schwarzwald) in Germany. The southwestern Black Forest exposes relatively homogeneous granites and gneisses with catchments draining across a relief of between 100 m and 1000 m. We use solute chemistry and runoff data to derive weathering fluxes of silicate, carbonate, and sulfide, and we estimate erosion rates from existing cosmogenic nuclide data and topographic metrics. Our data will quantify fluxes of CO_2-drawdown under moderate erosion rates, which is key to understand the evolution of the Earth's carbon cycle on anthropogenic and geologic timescales.

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