Basalt denudation and weathering rates across spatial and temporal scales using ^{1}Be(meteoric)/Be in the volcanic Vogelsberg (Germany)

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Abstract

Basaltic lithologies contribute disproportionately to Earth's climate regulation by the CO consumed in their weathering. To evaluate the strength of the negative feedback involved, means to assess the weathering fluxes across scales (space, time, climate) are needed. Fortunately, cosmogenic nuclide methods to quantify basalt denudation (for example by using *in-situ* produced 36Cl) in magnetite) are now emerging. Here, we present a proof-of-concept of the ^{1}Be(meteoric)/Be method, a method independent of target minerals, in the Vogelsberg volcanic province (Germany). We demonstrate the method's capacity by quantifying denudation from river bedload, surface soil, and weathering profiles. Denudation rates in the Vogelsberg area are consistent between the catchment scale (_˜54±13 t km^{2} yr^{1}) and the soil scale (_˜62±8 t km^{2} yr^{1}). Combining these rates with loss balances of chemical weathering we derive a weathering efficiency of basalt with an average CO consumption rate of 19 tCO km^{2} yr^{1}. A comparison with more felsic lithologies shows that these require up to twice the denudation rate to achieve equivalent atmospheric CO consumption. Building on this development, the method's application along a climate gradient will allow for a global quantification of basalt weatherability as a function of climate and denudation.

Keywords: basalt, denudation, erosion, weathering, CO2, climate, weatherability

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