Stable weathering fluxes into the oceans over glacial-interglacial cycles from $^{10}Be/^{9}Be$ records and global runoff-weathering models

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Throughout the Quaternary, biogeochemical cycles at the Earth surface responded to large oscillations in temperature and precipitation. Such changes are recorded in sedimentary records and radiogenic isotope mass balances [1] [2]. In contrast, climate models combined with the dependence of silicate weathering rates on modern climate indicate minimal change in global weathering rates [3]. To resolve the extent to which the supply of dissolved elements to oceans was altered by glacial-interglacial oscillations, we present a new weathering proxy [4] that uses the ratio of cosmogenic beryllium-10, produced in the atmosphere, to the stable isotope beryllium-9, introduced into the oceans by the riverine silicate weathering flux. Using sedimentary Be records previously used for reconstructing changes in Earth's magnetic field strength, we show that over multiple glacial-interglacial cycles, and over the last 2 Myr, shifts in global silicate weathering inputs are not detectable. Combining climate model simulations of the Last Glacial Maximum [5] with a new model for silicate weathering [6], we show how large regional variability in runoff between glacial and interglacial periods was insufficient to shift global weathering fluxes into the oceans. The observed and modeled stability explains why removal of atmospheric CO_2 by silicate weathering has been balanced to within 2% of net CO_2 degassing over the last 600 kyr [7].

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