Unexpected Delivery of Meteoric ^{10}Be to Critical Zone Soils, Front Range, Colorado

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Abstract

Using meteoric ^{10}Be in geomorphic studies requires knowing its long-term delivery rate to the earth surface. Delivery rates vary by latitude due to the influence of geomagnetic field intensity and solar activity and locally due to differences in precipitation and rates of dustfall accumulation, which are responsible for depositing primary and recycled meteoric ^{10}Be to geomorphic surfaces, respectively. Because influences on delivery rate vary in space and time, recent studies emphasize the use of inventory sites where the total concentration of meteoric ^{10}Be is measured on stable landforms of known age to determine site-specific, long-term delivery rates. To date, measured long-term delivery rates typically have fallen within the range of expected rates for the site's latitude and modern annual rate of precipitation, including minor contributions of dust to the total inventory of meteoric ^{10}Be. Here, we present the results of a meteoric ^{10}Be inventory measured on a Pinedale (~15 ka) moraine within the Boulder Creek Critical Zone Observatory, Front Range, Colorado. We report a long-term delivery rate of meteoric ^{10}Be for this site of 4.2 to 4.6 × 10^6 atoms/cm^2/yr, significantly higher than the expected delivery rate (1 to 1.3 × 10^6 atoms/cm^2/yr) for it's latitude (40 degrees) and annual precipitation rate (85-95 cm/yr). A detailed analysis of soils in the Front Range (of various age) indicate that long-term dust accumulation rates are less than ~0.1 grams/cm^2/kyr and therefore do not significantly influence the total amount of meteoric ^{10}Be delivered to geomorphic surfaces. When applied to measured concentrations of meteoric ^{10}Be in soils within the Gordon Gulch CZO catchment, our high, inventory-based delivery rate

suggests that hillslopes are 10 to 40 ka younger (all post-LGM) than suggested by published precipitation based delivery rates. Furthermore, this result, combined with a long-term delivery rate calibrated nearby on the High Plains (1200 m lower in elevation and half the modern precipitation), indicates a different scaling between meteoric ^{10}Be and precipitation than recent studies would suggest.

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