Long-term erosion and interglacial period exposure in Western Greenland from meteoric ^{10}Be in ice-bound sediment

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Authors	Graly, J A*, Geology, University of Vermont, Burlington, VT, USA Corbett, L, Geology, University of Vermont, Burlington, VT, USA Bierman, P R, Geology, University of Vermont, Burlington, VT, USA Neumann, T, NASA Goddard Space Flight Center, Greenbelt, MD, USA Rood, D H, Lawrence Livermore National Laboratory, Livermore, CA, USA Finkel, R C, University of California, Berkeley, CA, USA
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Abstract

To examine the history of surface exposure and erosion in areas of Western Greenland presently covered by ice, we measured the concentration of meteoric ^{10}Be in ice-bound fine sediment at three locations: Kangerlussuaq (67.1°N), Ilulissat (69.4°N), and Upernavik (72.5°N). Meteoric ^{10}Be concentrations at Ilulissat and Upernavik range from 2×10^6 to 2×10^8 atoms/g and are statistically indistinguishable from each other. Meteoric ^{10}Be concentrations at Kangerlussuaq range from 2×10^6 to 5×10^7 atoms/g and are significantly lower than the values found at the northern two sites. Through comparison to typical meteoric ^{10}Be distribution in soils, source soil ages can be estimated at each of these locations. These estimates suggest on the order of 10^5 years of exposure at the northern sites and on the order of 10^4 years of exposure at Kangerlussuaq. Because meteoric ^{10}Be is lost from the soil system both by erosion and isotope decay, these exposure ages represent a minimum length of cumulative interglacial exposure. This exposure signal likely developed over several Late Pliocene and Pleistocene interglacial periods and prior to the onset of Northern hemisphere glaciation, ~2.7 Ma before present. To further constrain the glacial history of Western Greenland implied from the meteoric ^{10}Be data, we constructed forward models of interglacial period exposure and glacial period erosion. The high levels of meteoric ^{10}Be at Upernavik and Ilulissat imply erosion rates below 5 m/My and some preservation of pre-glacial regolith. The lower levels of meteoric ^{10}Be at Kangerlussuaq can be explained with erosion rates as high as 20 m/My. Because of the substantial debris fluxes in modern Kangerlussuaq glaciers [Knight, et al., 2002], erosion rates greater than 10 m/My are likely. Meteoric ^{10}Be inventories at Kangerlussuaq under 10-20 m/My of long-

term erosion imply substantial interglacial exposure and the slow evacuation of sediment by glacial transport. These results suggest that the Southern Dome of the Greenland Ice Sheet is substantially more effective at eroding subglacial sediment than the ice sheet's north. The meteoric ^{10}Be data are consistent with models and other evidence suggesting substantial exposure of southern Greenland during the mid-Holocene and Eemian interglacial periods. Reference Cited: Knight, P. G., et al. (2002), Discharge of debris from ice at the margin of the Greenland ice sheet, Journal of Glaciology, 48, 192-198.

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