^{10}Be concentration in sediment indicates exposure, erosion, and transportation along the Greenland Ice Sheet Margin

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Abstract

We measured the concentration of ^{10}Be in fluvial sediment collected in 2011 from rivers draining the Kangerlussuaq (n=11) and Narsarsuaq (n=12) regions on the west and south coasts of Greenland. The concentration of ^{10}Be, measured in quartz, can be used as a tracer of sediment transport from the ice margin across the landscape. In Kangerlussuaq, we collected samples along the length of the Watson River, which flows from the ice margin to the fjord mouth. Concentrations of ^{10}Be in Watson River sediment were 2.3, 2.9, and 2.1 x 10^4 atoms/gram. Watson River sediment had lower concentrations of ^{10}Be than sediments from the ice margin, other drainages, and the fjord mouth, where concentrations were between 3.3 and 5.7 x 10^4 atoms/gram of ^{10}Be. One interpretation is that sediment coming out of the ice today has ^{10}Be concentrations between 3 and 6 x 10^4 atoms/gram. Lower ^{10}Be concentrations in Watson River sediment may be due to jökulhlaup events in 2007 and 2008, which significantly increased river discharge, mixing higher concentration sediments from the ice margin with lower concentration sediments from bank material stored in lake and channel bottoms. In Narsarsuaq, sediments from two rivers flowing from the ice margin to the fjord mouth had concentrations between 2.1 and 6.4 x 10^4 atoms/gram of ^{10}Be. In both rivers, ^{10}Be concentration increased downstream, likely because as the rivers approach the fjord, they drain an increasingly large area of deglaciated terrain, which has been accumulating ^{10}Be during the current interglacial. Sediments from rivers draining exclusively deglaciated landscapes had greater abundances of ^{10}Be than sediments from partially glaciated terrain with concentrations ranging between 8.6 and 34.7 x 10^4 atoms/gram. Initial results suggest that sediment being discharged by the

Greenland Ice Sheet today contains relatively low levels of ^{10}Be because much of the landscape from which this sediment is sourced has been shielded from cosmic rays since the last interglacial. The sediments do contain some ^{10}Be, however, which could have accumulated during a period of mid-Holocene ice sheet retreat or been inherited from a previous interglacial, particularly if preserved under non-erosive cold-based ice. As the margins of the ice sheet continue to retreat, the exposed landscape will accumulate more ^{10}Be. Most sand-sized sediment discharged from the GIS is likely to remain stored within lakes and fjords until the next period of glacial advance, when the ice sheet will erode and transport surficial materials off shore. Understanding this dynamic relationship between sediment erosion and transportation on Greenland will enable us to decipher sediment records from the deep ocean, potentially providing a 5-6 million year history of ice sheet dynamics.

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