High-precision, high-resolution, post-glacial emergence curves for southern Greenland generated with in situ cosmogenic 10-Be *(Invited)*

Details

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Abstract

Post-glacial emergence of coastal landscapes reflects local sea level, set by the complex interplay between eustasy, the history of ice sheet mass over time and space, and mantle dynamics. Emergence curves, which track local sea-level over time, typically rely of 14-C dating of detrital organic material, such as wood on raised beach ridges or shells present in marine deposits into which waves have cut terraces. The scarcity of datable organic material limits where emergence curves can be established; the relationship of such dates to sea level is often indirect, introducing additional age uncertainty. We have used the cosmogenic isotope, 10-Be, produced in situ, to constrain emergence histories at the head of Kangerlussuaq fiord in western Greenland and at the head of Igaliku fiord in southern Greenland. In Igaliku, we sampled two well-preserved gravel beach ridges that are the highest marine deposits. Below one beach ridge, we sampled 4 quartzite outcrops at progressively lower elevations and above a nearby beach ridge, we sampled an erratic boulder and the underlying bedrock. We also sampled a beach ridge at a similar elevation at Qassiarsuk on Tunulliarfik Fiord about 20 km away. The data show rapid emergence after 11 ky. All three beach ridges (average and standard error of 6, 6 and 10 clast ages) have the same age (10.98±0.09, 11.07±0.51ky, and 10.96±0.33 ky). The bedrock/boulder ages from above the beach ridge are slightly younger (10.45 and 10.73 ky, respectively), consistent with minimal inheritance of about 1400 atoms/g 10-Be in beach clasts. Ages of outcrops below the beach ridges are in stratigraphic order and show emergence slowing rapidly; the outcrop just above modern high water has an age of 8.80 ky. To constrain emergence rates at Kangerlussuaq, western Greenland, we collected seven samples from bedrock surfaces along the Watson River. These surfaces were covered and eroded by the Greenland Ice Sheet during the last glacial maximum. After local deglaciation <8.5 ky, the surfaces we sampled were immediately covered by outwash gravels deposited by the paleo-Watson River - part of a large, continuous gravel terrace at an elevation of ~57 m at Kangerlussuaq. As post-glacial uplift continued and local sea level fell, the gravel terrace was incised, sequentially exposing four samples on a bedrock rib - the equivalent of a slip off surface. The rate of terrace incision (gravel stripping and exposure of our sample sites) matched the rate of relative sea-level fall until a bedrock sill downstream was exposed 4500 /- 200 years ago providing a local base-level for the river. The Watson River 10-Be data confirm the inner Kangerlussuaq Fjord emergence curve of Ten Brink (1974), which we calibrated for changes in marine 14-C over time, and provide critical control for the mid-Holocene (2-7 ky) when emergence rates slowed and shell dating becomes less certain.

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