The Greenland Ice Sheet erodes its bed some places but not in others

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The rate and spatial distribution of erosion done by ice sheets is poorly known. We are using the cosmogenic isotope ^{10}Be as a proxy to understand where and how much the Greenland Ice Sheet (GIS) erodes its bed through isotopic analysis of exposed boulder and bedrock surfaces and sediment transported by the ice sheet. To study subglacial erosion, we measured meteoric ^{10}Be in samples from the basal, dirty-ice zone of the GISP2 ice core and both in situ and meteoric ^{10}Be in >200 samples collected from the ice sheet margin.<br /

Silt in 17 samples from the basal 6.5 meters of the GISP2 ice core (summit of GIS) has high concentrations (0.6 to 3.8 x 10^8 atoms g^{-1}) of meteoric ^{10}Be, far more ^{10}Be than could be accounted for by short, interglacial exposures. The silt contains 0.3 to 1.7% organic carbon and has an average C/N ratio of ~10, consistent with incorporation of a long-lived, cold-region soil. The existence of this ancient soil for several million years after formation of the GIS indicates extremely low rates of subglacial erosion at Summit, Greenland, consistent with the ice being frozen to the bed for most, if not all, of the Quaternary.

Analysis of in situ cosmogenic ^{10}Be in boulders and bedrock around the margin of the GIS indicates that areas near outlet glaciers, where ice is warm-based, are effectively eroded whereas other areas, especially highlands, retain evidence for multiple periods of exposure and burial, indicating that there ice was cold-based and did not erode its bed. Sediment in and leaving the ice today tells a similar story. 86 clasts, collected directly from the ice margin, have measurable but very low levels of *in situ* ^{10}Be indicating they were sourced from areas where both preglacial regolith and rock exposed during interglacial times were effectively eroded by ice. Sand-sized sediment collected from outwash streams exiting the ice margin has more ^{10}Be, suggesting that different grain sizes are sourced from different subglacial locations.

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Early Warning of Glacial Lake Outburst Floods and Climate Change Monitoring in the Karakoram Mountains, P.R. China

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Yarkant River is located in the southwest of Xinjiang Uygur Autonomous Region, at the western margin of the Tarim Basin. In the last decade, 5 glacial lake outburst floods (GLOF) damaged infrastructure and claimed human lives along Yarkant River. The spontaneous floods are a threat for over 1 Mio inhabitants in the floodplains and are causing an annual monetary loss of 10 Mio €. There are 33 recorded flood disasters during the last 50 years. The floods are provoked by melt-water, rainstorms and glacial lake outbursts (peak discharges > 6’000 m^3/s). The largest and most frequent GLOF occur in the area of Keleqin River. Keleqin is one of several tributaries of Yarkant River.

In 2011 a project was launched with the goal to implement an early warning system, allowing authorities and population to take the necessary measures in order to avoid victims, to raise the safety of settlements and livestock and to minimize damages to infrastructure and agricultural land. A further goal is to assess the long-term development of the flood hazard situation in the catchment area of Yarkant River by analyzing past and real-time information on the glacier lake situation. In addition, scenario based forecasts of the future glacial lake developments are elaborated, considering Climate Change.

As a first step, a GLOF early warning system (EWS) was implemented combining satellite remote sensing, an automatic terrestrial observation and warning station. Two automatic gauge and warning stations are operational since autumn 2012. Both water level fluctuations and EWS functionality are continuously monitored. Because the volume of Kyagar Glacier Lake is directly linked to its blocking ice-dam, mass-balance calculations are crucial. Such calculations and climate change monitoring are needed to define future hazard scenarios and to plan protection measures. Flood modelling, the elaboration of a hazard index map and an emergency risk management plan are other key issues of the project.