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Sediment re-distribution beneath surging ice and its impact on landform architecture

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On millennial or even centennial time scales, the activity of rapid flowing ice can affect climate variability and global sea level through release of meltwater into the ocean and positive feedback loops to the climate system. At the surge-type glacier Brúarjökull, an outlet of the Vatnajökull ice cap, eastern Iceland, extremely rapid ice flow was sustained by overpressurized water causing decoupling beneath a thick sediment sequence that was coupled to the glacier.

Digital Elevation Models (DEMs) have been erected from aerial photographs recorded in 1945 and 2003. The elevation difference between these terrain surfaces verify that coupling occurred between the ice and its bed as significant sediment has been eroded and deposited in larger coherent areas. In order to compensate the flux of sediment above the decoupled surface, sediment thickens down glacier through soft-bedded subglacial deformation. The result is seen in a ramp-like build-up towards terminal moraines over a distance of more than 500 m.

These newly discovered mechanisms has far reaching consequences for our understanding of fast flowing ice and its integration with sediment discharge and meltwater release and the development of glacial landscapes.