Geophysical Research Abstracts
Vol. 17, EGU2015-2918, 2015
EGU General Assembly 2015

Last glacial ice-sheet dynamics and deglaciation on Svalbard inferred from fjord records

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Various glacigenic landforms and sedimentary processes identified in the Spitsbergen fjords provide valuable insights into the dynamics of the northwestern parts of the Svalbard Barents Sea Ice Sheet during the last glacial.

Glacial linear features oriented parallel to most fjord axes are identified on swath-bathymetry and high-resolution sub-bottom profiler data. They provide evidence of locally fast-flowing grounded ice draining the northwestern parts of the Svalbard Barents Sea Ice Sheet to the shelf breaks off north and west Svalbard. Eskers overlying glacial lineations reveal the existence of englacial or sub-glacial drainage systems that developed after the termination of fast ice flow. Iceberg ploughmarks suggest that parts of the deglaciation occurred by iceberg calving. Multiple transverse ridges, e.g. grounding zone wedges and moraines, indicate that multiple halts and/or readvances interrupted the deglaciations of the fjords. This includes relatively small moraines, probably deposited during halts and/or readvances in consecutive winters, thus, allowing the calculation of annual retreat rates of the ice fronts in certain fjord areas. Their regular spacing may suggest that e.g. parts of Billefjorden, Smeerenburgfjorden and Woodfjorden were deglaciated at relatively constant rates of at least 140 m/year. However, the deglaciation of van Keulenfjorden accelerated from approx. 80 m/year to about 190 m/year.

Lithological analyses allow the study of sub-glacial, glacier-proximal and glacier-distal sedimentary processes and environments, as well as the identification of influences from various sediment sources. They reveal, furthermore, that the deglaciations of multiple fjords terminated quasi-synchronously around 11,200 cal. years BP, but that significant local delays of up to several thousand years occurred.