Geophysical Research Abstracts
Vol. 15, EGU2013-4694, 2013
EGU General Assembly 2013

Holocene sedimentary environments in Smeerenburgfjorden, Spitsbergen

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Multi-proxy analyses of six sediment cores and analyses of swath bathymetry and chirp data were integrated to elucidate the Holocene sedimentary processes and palaeoenvironments in Smeerenburgfjorden, northwest Spitsbergen. Three basins separated by two sills define the present-day large-scale bathymetry. A transverse ridge in the innermost part of the fjord represents the Little Ice Age (LIA) maximum position of Smeerenburgbreen. Slide scars along the fjord sides and mass transport deposits in the basins indicate repeated mass wasting. Recessional moraines deposited during the last deglaciation suggest a mean annual retreat rate of 140 m/year. Another set of recessional moraines deposited between the maximum LIA position of Smeerenburgbreen and its present day terminus indicate a mean retreat rate of the ice front of ∼87 m/year. Strong out-fjord decreasing trends in magnetic susceptibility and Fe-content indicate that these properties are related to material originating from the Hornemantoppen granite in the catchment of Smeerenburgbreen and are, thus, useful proxies for the reconstruction of the activity of the glacier. Relatively little ice rafting, most likely related to warmer surface water conditions, occurred between 8650 and 7350 cal. years BP. Ice rafting from both sea-ice and icebergs increased around 6200 cal. years BP and peaked at ∼5200 cal. years BP, associated with a regional cooling. Smeerenburgbreen became more active around 2000 cal. years BP. It probably retreated during the Roman Warm Period (50 BC – AD 400) and advanced during the Dark Ages Cold Period (AD 400 – 800). From AD 1300 – 1500 (late Medieval Warm Period), ice rafting, sedimentation rates and productivity increased in the inner fjord. The Little Ice Age was characterised by reduced ice rafting, possibly linked to an increased sea-ice cover suppressing iceberg drift. An increase in Ice Rafted Debris (IRD) commencing around AD 1880 is suggested to represent the beginning of Smeerenburgbreen's retreat from its LIA maximum towards its present position.