Geophysical Research Abstracts
Vol. 12, EGU2010-4371, 2010
EGU General Assembly 2010

Last deglaciation of the Svalbard/Barents Sea Ice Sheet - a swath bathymetric and sub-bottom seismic study from the Kveithola Trough

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Kveithola Trough, an E-W trending cross-shelf glacial trough in the NW Barents Sea, was surveyed for the first time during the EGLACOM cruise between 8th July and 4th August 2008 on board R/V OGS-Explora. EGLACOM (Evolution of a GLacial Arctic COntinental Margin: the southern Svalbard ice stream-dominated sedimentary system) project is the Italian contribution to the International Polar Year (IPY) Activity 367 (Neogene ice streams and sedimentary processes on high- latitude continental margins – NICE STREAMS). Such IPY activity included as well the Spanish SVAIS 2008 cruise on board BIO Hesperides. EGLACOM data acquisition, focused on the Storfjorden Fan and Kveithola Trough, included a multi-channel seismic (MCS) reflection survey and the simultaneous collection of swath bathymetry and sub-bottom CHIRP profiles.
Swath bathymetry in the Kveithola Trough shows that the seafloor is characterized by E-W trending mega-scale glacial lineations (MSGL). These include large-scale ridges about 2 km wide and 15 m high as well as smaller grooves about 100 m wide and a few metres deep. Such MSGL record the fast flow of an ice stream draining the Svalbard/Barents Sea Ice Sheet (SBSIS) during the Last Glacial Maximum (LGM). MSGL are overprinted by transverse sediment ridges about 15 km apart which give rise to a staircase long profile of the trough. Such transverse ridges are interpreted as grounding-zone wedges (GZW) formed by deposition of unconsolidated, saturated subglacial till during ice stream retreat. Sub-bottom (CHIRP) and multi-channel reflection seismic data show that the morphology is controlled by stacked sets of lensoidal transparent units (tills) overlain by a draping glaciomarine unit up to over 15 m thick. Formed during temporary stillstands in grounding-zone position before complete deglaciation, GZW ridges are diagnostic of episodic retreat. Our data allow the reconstruction of deglaciation in the Spitsbergen Bank area, with each stage during deglaciation recorded by deposition of a GZW. Three independent lines of reasoning suggest that an ice cap persisted on Spitsbergen Bank for some thousand years and lasted much longer than those that fed the adjacent glacial troughs: 1) the freshness of the morphology in Kveithola Trough compared to that of adjacent Storfjorden and Bear Island troughs; 2) the volume of sediment in the GZW ridges compared to the small catchment area; 3) preliminary assessment of the stratigraphic position of debris flow deposits on the continental slope. The 15 m of sedimentary drape deposited on top of GZW ridges contains a high-resolution palaeoclimatic record of the last thousand years, which accumulated at a very high average sedimentation rate. Sampling (through drilling) of the thin glaciomarine sediments between the till lenses of the successive GZW ridges may allow the dating of deglaciation phases in the Barents Sea.