Paleoceanography of the Arctic -Water masses, Sea ice, and Sediments (PAWS) and LOMROGIII

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Lomonosov Ridge Off Greenland 2012 - LOMROG III

Scientists and technicians from the Earth Science Departments at Stockholm University participated in the third LOMROG expedition, 31 July - 16 September 2012. The expedition was organized by the Geological Survey of Denmark and Greenland (GEUS), with the primary aim to gather geophysical data (multibeam sonar and seismic profiles) from the Lomonosov Ridge, to support the Danish claim for an extended continental shelf to the United Nations Convention on the Law of the Seas (UNCLOS).

We collected multibeam and subbottom profiling data using Oden's hull-mounted Kongsberg EM122/SBP120 system, and retrieved 10 piston cores of about 6 m length each. The cores contain a sediment archive spanning several hundred thousand years, and will be used for reconstructing the Arctic Ocean's paleoclimate and paleoceanography.

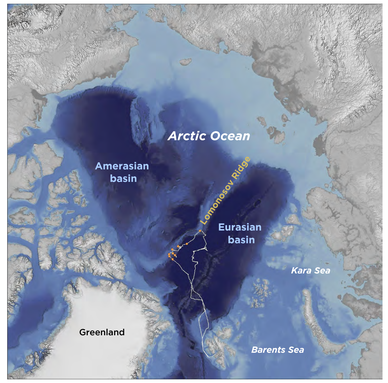

Figure 1. Location map of the Arctic Ocean, and trackline (white) of the LOMROG III expedtition, and location of the retrieved piston cores (orange dots). Bathymetry from IBCAO v 3 (Jakobsson et al., 2012).

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We will study:

Past Arctic sea ice coverage and circulation
IP25, a biomarker from diatoms living only under sea ice, will be used to reconstruct former sea ice extent, together with grain size (indicates ice rafted debris) and planktonic foraminifera (indicates ice free conditions).

Past deep water structure and basin exchange
Hypothesis: Open water conditions are related to changes in the deep/intermediate water exchange with the Atlantic Ocean. This will be tested by down core analysis of Nd-isotopes in ferromanganese coatings on sediment particles. The Arctic Ocean has four major water mass sources with distinct Nd signatures.

Sediment mapping using MBES backscatter
Multibeam echo sounder backscatter data records the strength of the returned echo, which can be used for semi-automated classification of surface sediments and habitats. The sediment cores will give important ground-truthing for the backscatter data.

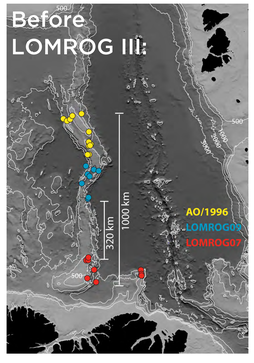

Figure 2. The cores obtained during LOMROG III are from an under-sampled part of the Lomonosov Ridge. We now have core samples from a >1000 km long stretch of the ridge. Bathymetry: IBCAO v. 3 (Jakobsson et al., 2012).

Core correlation over 500 km of the Lomonosov Ridge

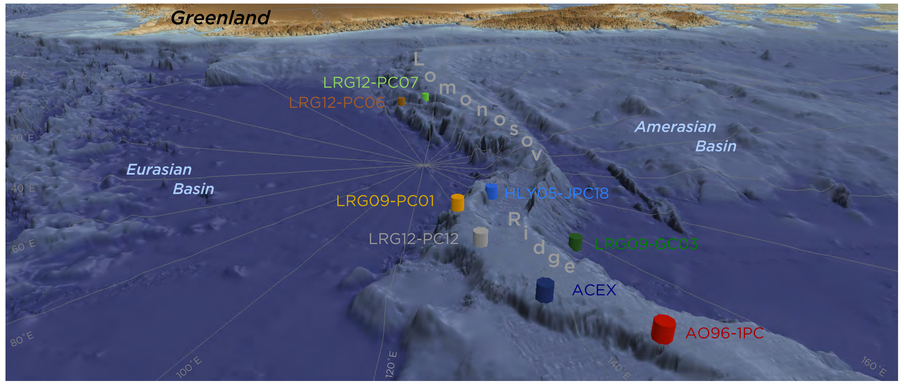

Figure 3. Oblique 3D view of the central Arctic Ocean and the Lomonosov Ridge, showing the coring locations of the 8 selected cores using the same colors as in Figs. 4 (below) and 5 (right). The distance between the most distant cores exceeds 500 km, and the good correlation in density between the cores indicate very homogenous sedimentation in the central Arctic. Preliminary physical property logging of the 8 cores recovered during LOMROGIII reveals that 2 of the cores exhibit a very similar downhole stratigraphy to that encountered closer to the circumpolar regions of the LR. Bathymetry from IBCAO v. 3 (Jakobsson et al., 2012).

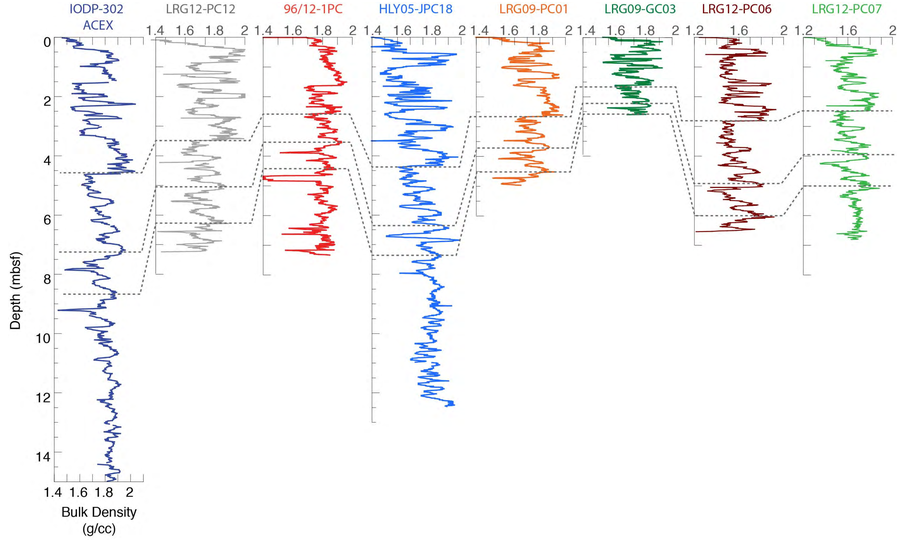

Figure 4. Bulk density records for cores from the Lomonosov ridge that exhibit a coherent downhole stratigraphy. Logs are shown in the true metres below sea floor (mbsf) depth scale with select correlative horizons indicated by dotted lines. Colors are the same as in Figs. 3 and 5.

References

Comiso,, J. C., Parkinson, C. L., Gersten, R., and Stock, L., 2008. Accelerated decline in the Arctic sea ice cover. Geophysical Research Letters 35, L01703, doi:10.1029/2007GL031972,

Jakobsson, M., L. A. Mayer, B. Coakley, J. A. Dowdeswell, S. Forbes, B. Fridman, H. Hodnesdal, R. Noormets, R. Pedersen, M. Rebesco, H.-W. Schenke, Y. Zarayskaya A, D. Accettella, A. Armstrong, R. M. Anderson, P. Bienhoff, A. Camerlenghi, I. Church, M. Edwards, J. V. Gardner, J. K. Hall, B. Hell, O. B. Hestvik, Y. Kristoffersen, C. Marcussen, R. Mohammad, D. Mosher, S. V. Nghiem, M. T. Pedrosa, P. G. Travaglini, and P. Weatherall, 2012. The International Bathymetric Chart of the Arctic Ocean (IBCAO) Version 3.0. Geophysical Research Letters L.12609, doi: 10.1029/2012GL052219.

Preliminary results

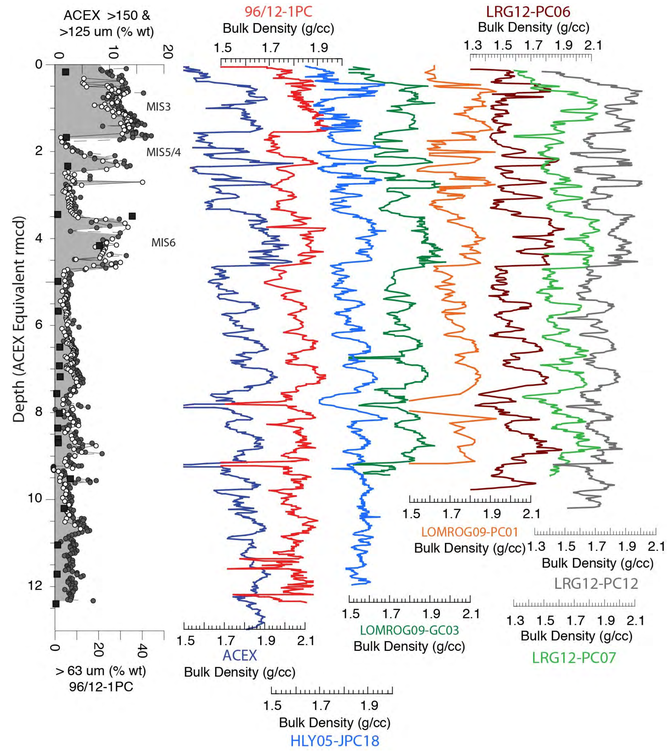

Figure 5. Depth migrated bulk density profiles from Fig 4. All records are here placed on the ACEX depth scale to highlight the stratigraphic similarity between cores. On the left is a composite grain size record for ACEX and 96/12-1PC with MIS stages 3, 4/5 and 6 marked. Colors are the same as in Figs. 3 and 4.

- **The >500 km distance between these stratigraphically aligned cores will allow us to investigate grain size and compositional variability related to the shifting influence of the Beaufort Gyre and Transpolar Drift during the mid- to late Quaternary.**

- **The locations of the cores in different water masses will be used to investigate glacial/interglacial variations in circulation and water mass properties using biogenic and lithogenic isotopes - and explicitly look for isotopic evidence for deep Atlantic waters in the Makarov and Amundsen Basins during glacial periods.**