MAPPING THE SHALLOW SEABED AND SUBMERGED COASTAL FEATURES IN THE CANADIAN ARCTIC

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Abstract

Climate change in the Arctic may already be affecting rates of coastal change, with important implications for northern residents and coastal ecosystems. Rates of relative sea-level change vary across the Arctic from areas of uplift and land emergence to areas of subsidence and coastal submergence. This project aims to improve understanding of changes in relative sea level and associated vertical crustal motion by focusing in areas of rising relative sea level, where the depth and extent of submerged coastal features is poorly known. The project also supports related work on shallow benthic ecology, coastal erosion, seabed hazards, regional impacts assessment, and community adaptation.

A full understanding of coastal processes requires knowledge of both subaerial and submerged components of the coastal system. This study concentrates on the latter, the submerged part of the coast and relict coastal features on the seabed. Multibeam sounding and other supporting marine remote sensing tools can provide detailed shaded-relief images of the seafloor, giving a view of the seabed as if the water were not there. Multibeam sounding also provides data on the acoustic backscatter from the seabed, enabling the interpretation of sediment characteristics. Different sediment textures, such as gravel, sand, or mud, have different reflection properties and can be recognized in the multibeam data.

As part of ArcticNet project 1.6, a multibeam system has been installed and operating on the CCGS *Amundsen* over the past two summer seasons. In 2005, under project 1.2, we planned to carry out shallow-water surveys using the UNB survey launch *Heron*, which was to be carried on and deployed from *Amundsen* at sites in Baffin Bay, Amundsen Gulf, and the Beaufort Sea. A shipboard accident shortly before the start of the summer 2005 northern cruise resulted in sinking of the *Heron* and cancellation of the 2005 shallow seabed surveys.

Methods

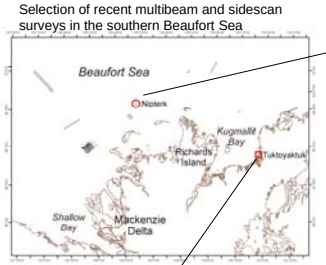
Sidescan sonar uses two sound beams projected either side of the survey track to locate objects on the sea floor. It is usually deployed in a towfish behind the survey vessel.

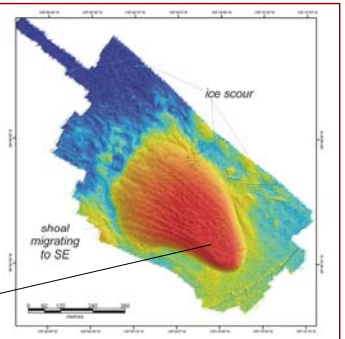
Multibeam technology uses a multi-element transducer to provide many (30-150) individual soundings of water depth and echo strength on each ping. A wide swath of seafloor (4-5 times water depth) can be surveyed in a single pass through an area.

LiDAR (Light Detection and Ranging) uses pulses of laser light to strike the earth. The system measures two-way time travel of the pulse. The system can also penetrate shallow water and is useful in areas where the water is too shallow for a launch.

Results

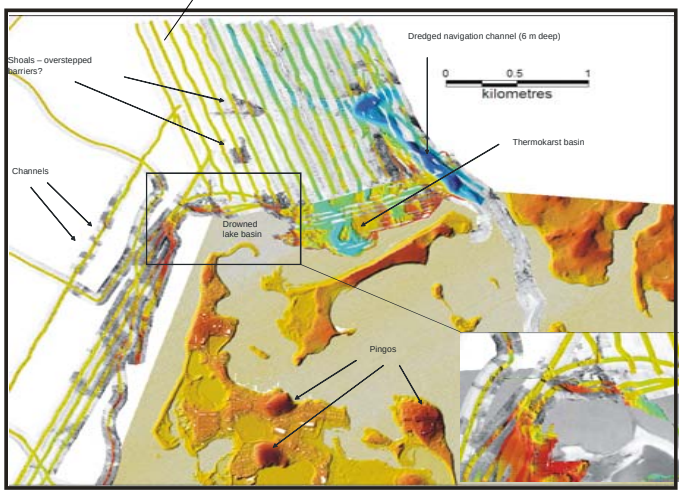
This poster presents examples of multibeam seabed imagery obtained in coastal waters of the Beaufort Sea over the past three years. We present examples of multibeam and related data from other ArcticNet and partner activities in deep and shallow water and demonstrate the relevance of this imagery to the interpretation of environmental change, coastal evolution and sediment supply, seabed hazards and habitat characteristics.





Multibeam surveys at Nipterk

Repetitive surveys of this shoal developed by reworking of the former artificial island at Nipterk show progressive southeastward migration under the influence of dominant northwesterly storm winds and waves. Heavy scouring by sea ice pressure-ridge keels is also evident in the seabed imagery.

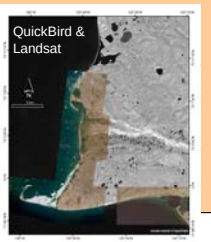


Coastal mapping at Tuktoyaktuk

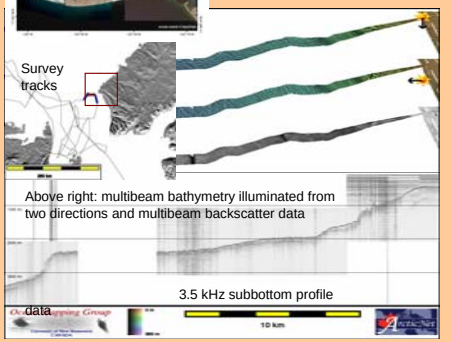
This image combines data from three survey systems (airborne topographic LiDAR, multibeam bathymetry, and interferometric sidescan) to produce a digital elevation model and integrated map of the coast and shallow seabed at Tuktoyaktuk. Detailed bathymetry and topography provide new insights into coastal processes. The highly dissected seabed just offshore from Tuktoyaktuk reflects relict and drowned thermokarst topography. Offshore directed channels may direct storm-surge return currents and eroded sediments away from the coast during storms. Nearshore shoals composed of cobbles suggest overstepped spits and barriers.

Amundsen surveys off Banks Island

The data below show the northern flank of a deep channel, scoured terraces at 240 m and 200 m, and the heavily scoured steep rise to the shoreface in less than 50 m water depth off Sachs Harbour.



Sea level is believed to have risen 20-40 m in this area over several thousand years. This must have played an important role in the evolution of the large spit at Cape Kellett (satellite image at left). Future nearshore mapping will be seeking evidence of submerged shorelines.



Summary and Conclusions

The extent of multibeam imagery collected in northern waters has grown rapidly in recent years through a combination of government initiatives and ArcticNet. Shallow water imagery is still limited in extent for a variety of reasons, including the higher cost attributable to the narrow swath width in shallow depths and the lack of suitable platforms.

Experience gained from *Nahidik* surveys seaward of the Mackenzie Delta and small boat work off Tuktoyaktuk demonstrates that valuable insights can be gained from suitably targeted shallow-water surveys. This work and the ArcticNet 1.6 surveys from *Amundsen* show the value of combining data from multiple sensors. For coastal surveys, a combination of airborne LiDAR and shallow-water sidescan and multibeam data provides the best opportunity to develop a combined view of the entire coastal system.

Acknowledgements

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