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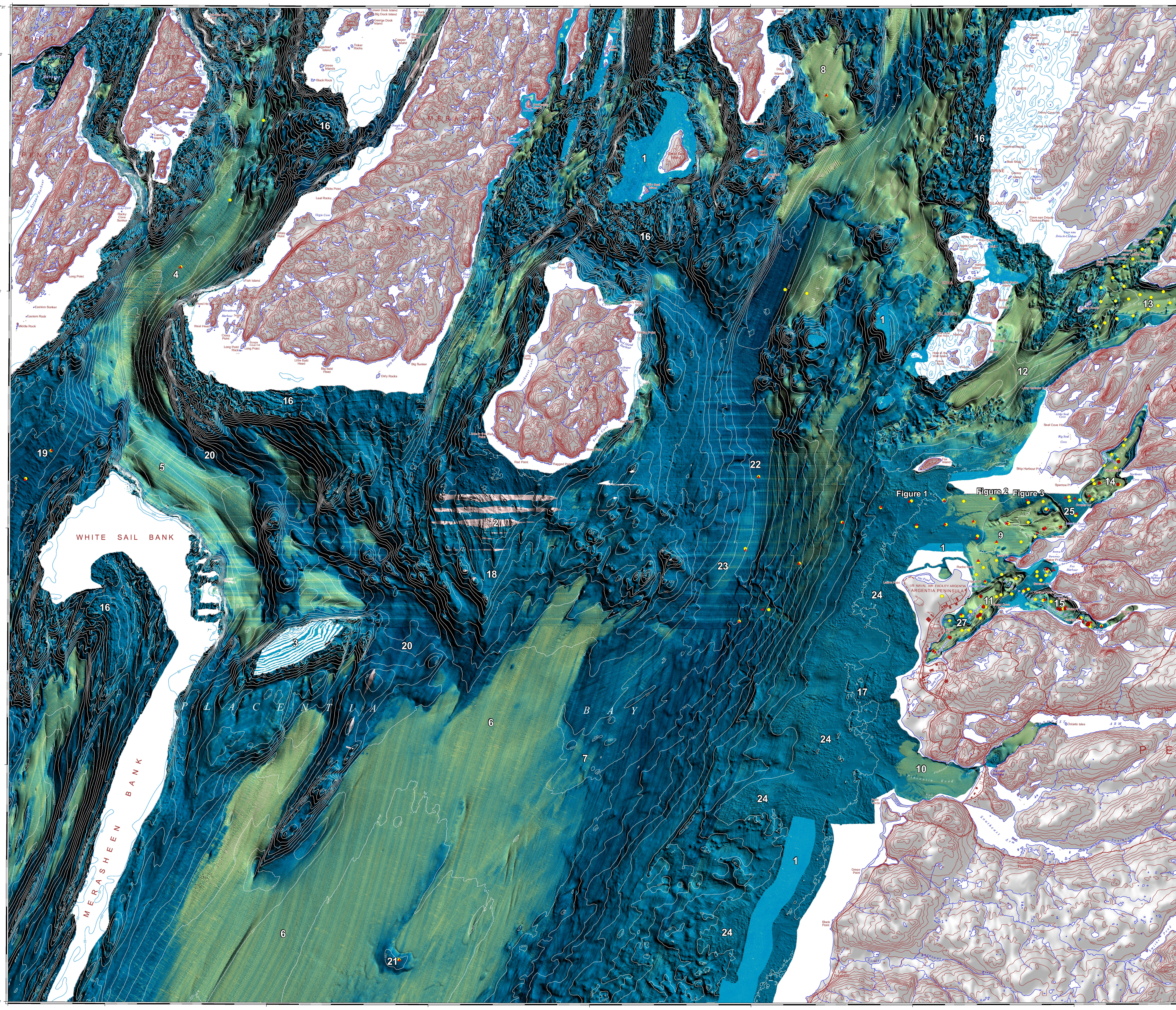

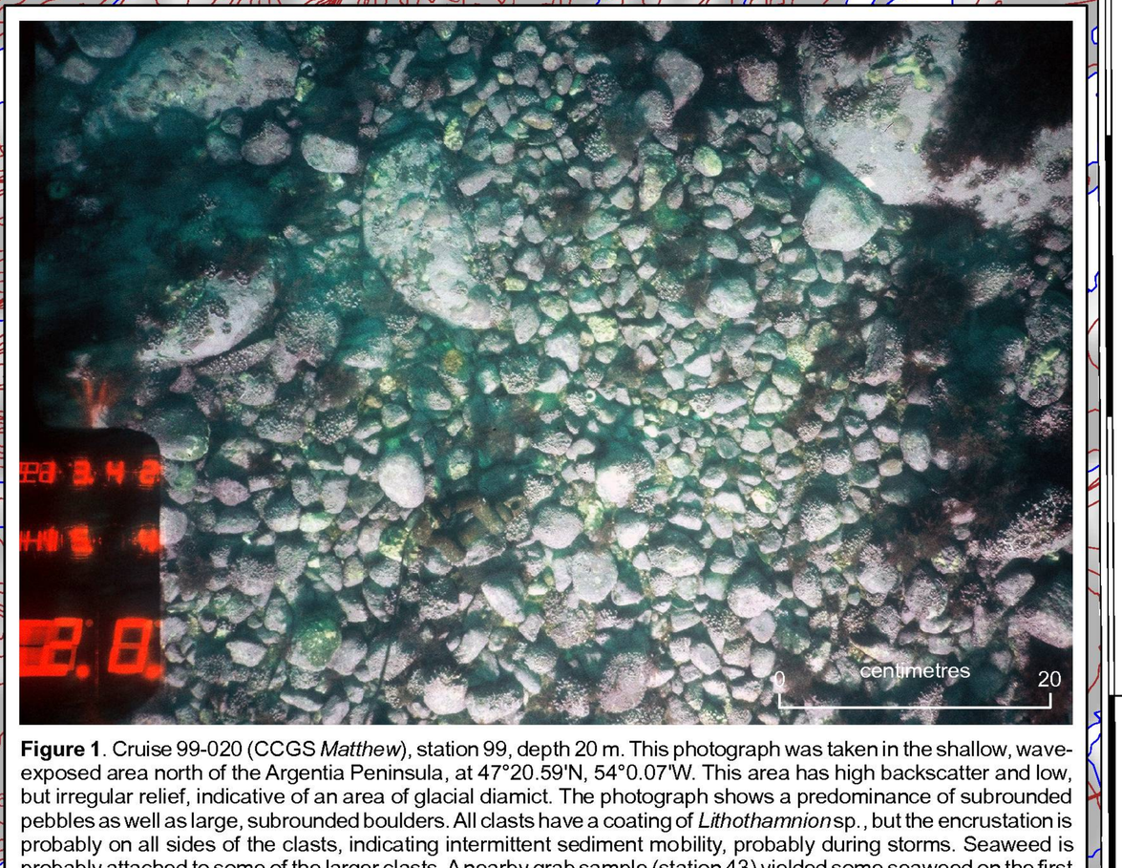

Figure 1. Cruise 99-020 (CCGS *Matthew*), station 99, depth 20 m. This photograph was taken in the shallow, wave-exposed area north of the Argentia Peninsula, at 47°20.59'N, 54°0.07'W. This area has high backscatter and low, but irregular relief, indicative of an area of glacial diamict. The photograph shows a predominance of subrounded pebbles as well as large, subrounded boulders. All clasts have a coating of *Lithothamnion* sp., but the encrustation is probably on all sides of the clasts, indicating intermittent sediment mobility, probably during storms. Seaweed is probably attached to some of the larger clasts. A nearby grab sample (station 43) yielded some seaweed on the first attempt, and a few pebbles encrusted all over with *Lithothamnion* on the second. Photograph by R. Murphy, 5 July 1999. 2009-397

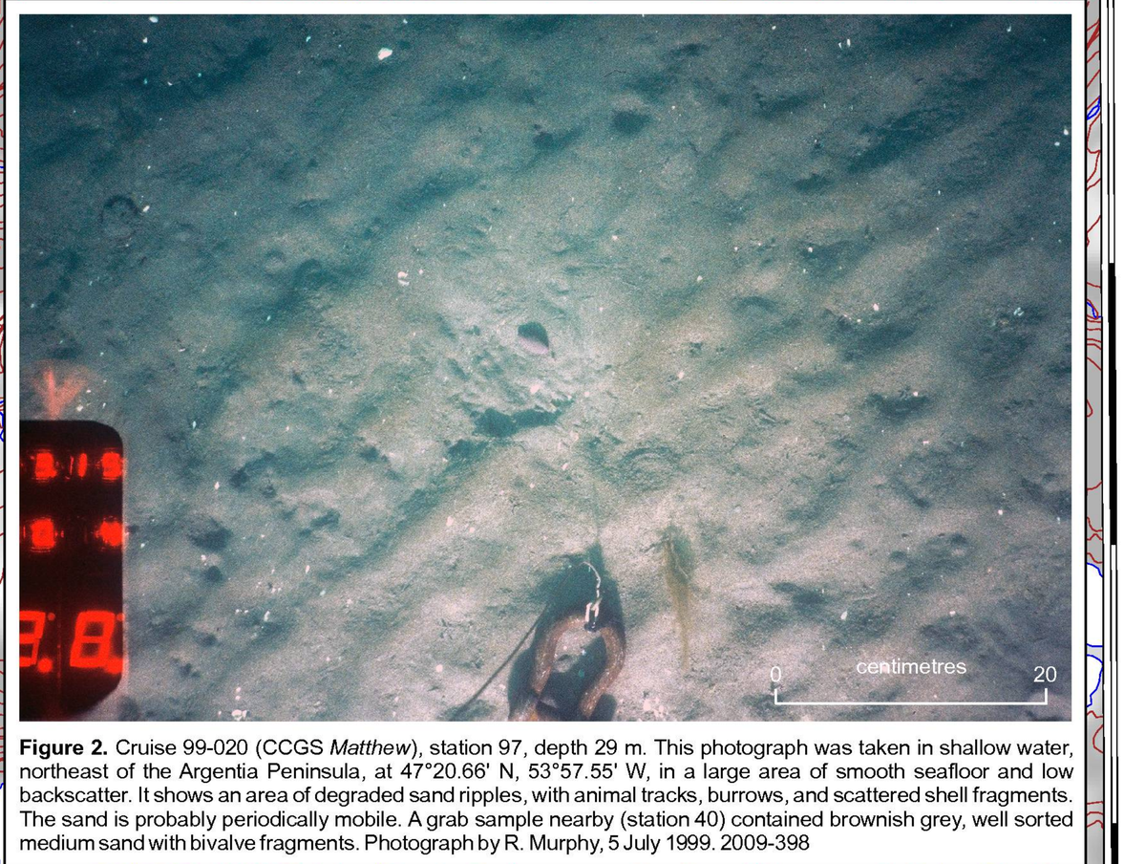

Figure 2. Cruise 99-020 (CCGS *Matthew*), station 97, depth 29 m. This photograph was taken in shallow water, northeast of the Argentia Peninsula, at 47°20.66' N, 53°57.55' W, in a large area of smooth seafloor and low backscatter. It shows an area of degraded sand ripples, with animal tracks, burrows, and scattered shell fragments. The sand is probably periodically mobile. A grab sample nearby (station 40) contained brownish grey, well sorted medium sand with bivalve fragments. Photograph by R. Murphy, 5 July 1999. 2009-398

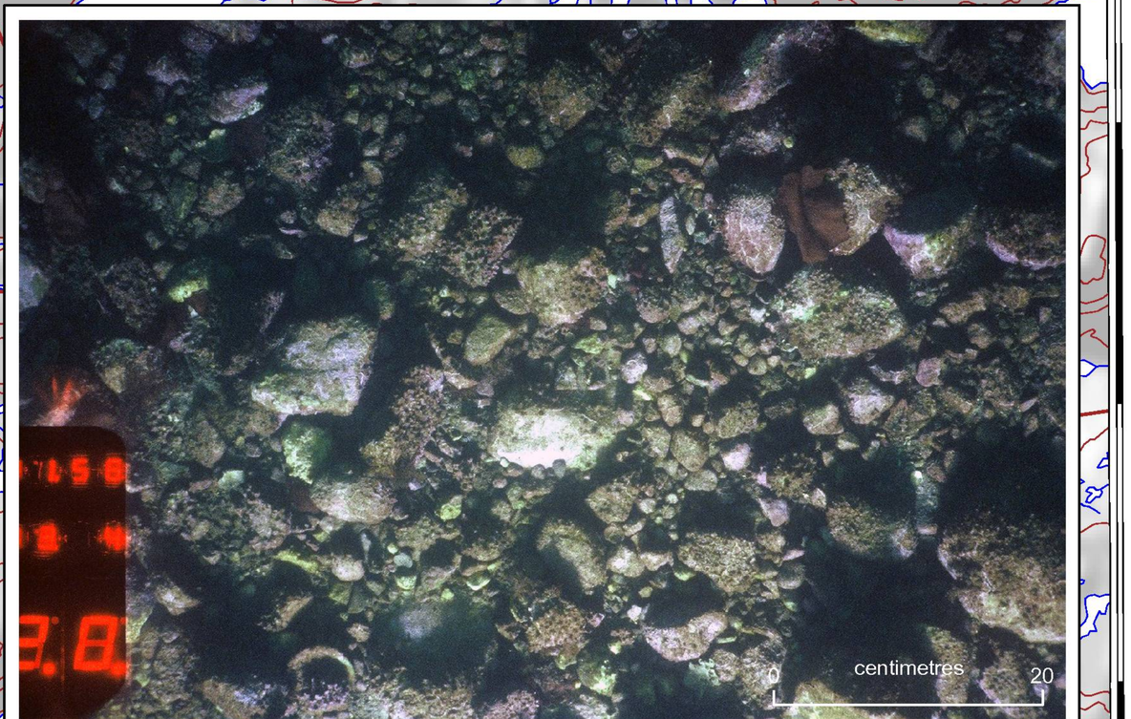

Figure 3. Cruise 99-020 (CCGS *Matthew*), station 94, depth 26 m, at 47°20.62'N, 53°56.41'W. This photograph was taken south of Ship Harbour Point, on a ridge of high backscatter that is interpreted as being composed of glacial diamict. Grab sampling (station 37) returned a single cobble, encrusted all over with *Lithothamnion* sp., indicative of periodic sediment mobility. Photograph by R. Murphy, 5 July 1999. 2009-399

DESCRIPTIVE NOTES

INTRODUCTION

Multibeam systems record mean energy and time series of amplitudes returned in each beam. This mean energy is commonly called the backscatter amplitude. It is tempting to use this as a direct proxy for surficial sediment type, but consideration of the physics of the problem presents a more convoluted picture (Courtney and Shaw, 2000), and there exists no direct relationship between backscatter amplitude and surficial sediment type; however, for angles of incidence greater than roughly 20° there is a general correspondence between backscatter amplitudes and surficial sediment roughness that can be used for cursory mapping and sediment identification. Coarse gravel and cobbles tend to be locally rough and return high-amplitude, wide-angle backscatter signals, whereas sand and fine-grained materials can be locally smooth with a much lower backscatter. This map sheet is one of five maps of the Placentia Bay area (*see also* Potter and Shaw, 2010a, b, c, d).

EXTRACTION, GRIDDING, AND LEVELLING OF BACKSCATTER

Backscatter was extracted using tools developed in-house at GSC Atlantic. Raw Kongsberg datagrams from the various sounder systems used in Placentia Bay were first converted to Generic Sensor Format (GSF; http://www.saic.com/maritime/gsf/; accessed January 4, 2010), an open source standard file format for bathymetry. The backscatter extraction software reads in gsf files and creates raster files of backscatter amplitude corrected for beam dependence, thus reducing or eliminating the typical track-parallel corrugation in the backscatter signal.

Each contiguous survey block corresponding to a unique multibeam system and year was 'gridded' separately then later merged while applying a static shift in order to level the synthetic surface to a common datum. Initially, histograms were generated for each survey block to assess backscatter data range. Some of the more recent multibeam systems displayed anomalously high backscatter ranges (e.g. -35 dB to +5 dB) so the merged data sets were levelled to the older EM1000 surveys that were reporting more sensible ranges of -50 dB to -10 dB. The amount of shift to apply to each survey block was determined by analysis of backscatter values in areas of overlap between surveys of differing ages and sounder systems. By generating histograms of the difference between values reported within each grid cell in the overlap, the backscatter grid for the entire Placentia Bay area was 'stitched together'.

DISTRIBUTION OF BACKSCATTER VALUES

Backscatter is depicted using a colour scale ranging from almost white (low backscatter) to indigo (high backscatter). The coloured backscatter is draped over a grey digital elevation model of the bathymetry. In several areas (e.g. area 1) the authors were able to extract backscatter, but not relief, so the backscatter is not draped over underlying relief as it is throughout the remainder of the map. By contrast, on several strips (area 2) just south of Red Island, and a few smaller patches elsewhere, the authors could not extract backscatter, so the underlying grey-scale shaded-relief values show through. In area 3 the authors could not extract bathymetry, and could not extract backscatter for the wider beam angles, hence the strange striped pattern.

The distribution of backscatter values in the map area is strongly bimodal, with a primary peak at -38 dB (low backscatter) and secondary peak at -25 dB (high backscatter). Throughout Newfoundland coastal waters, areas of low backscatter (mud) generally occur in the deepest areas and in depressions, whereas areas of high backscatter (gravel and sand) occur in shallow areas and near coasts. This is a generalization, for example, extensive areas of deep water in Eastern Channel have high backscatter and the fairly shallow embayments of the east coast — Long Harbour, Ship Harbour, Placentia Sound, Argentia Harbour, and Placentia Road — contain extensive areas of low backscatter, which indicate mud in all cases except Placentia Road (sand).

INTERPRETATION OF BACKSCATTER

The interpretations of backscatter in this area are based on the following GSC marine seismic and sampling surveys: *Navicula* 89-026 (Shaw et al., 1990), *Matthew* 99-020 (J. Shaw, R. Cranston, P. Girouard, K. Asprey, R. Murphy, and B. Wile, unpub. report, 1999), *Matthew* 2005-051 (Shaw et al., 2006), and *Hudson* 2006-039 (Shaw et al., 2007).

In Western Channel (area 4) and north of White Sail Bank (area 5) a large area of low backscatter correlates with thick deposits of postglacial mud. The largest area of mud in the map area (area 6) occupies the deep water of outer Placentia Bay. In many areas the boundary between the low-backscatter mud and surrounding high-backscatter terrain is sharp, but at area 7 the boundary is gradational, indicative of an increasing current stress at the seafloor, and thinning and coarsening of the postglacial mud unit toward the northeast. Eastern Channel also contains extensive areas of thick, gas-charged postglacial mud that displays sharp boundaries with the irregular, high-backscatter terrain (area 8).

Off the east coast, low backscatter may indicate either sand or mud. Northeast of the Argentia Peninsula the seafloor is relatively exposed to reworking by waves, and the low backscatter is indicative of sand (area 9). Similarly, the low backscatter values in Placentia Road (area 10) correspond to a wedge of sand that thickens toward the coast. Elsewhere, low backscatter equates with the silty mud found in the harbours and inlets (areas 11, 12, 13, and 14). The less bright backscatter signal in Placentia Sound (area 15) corresponds with a muddy seafloor upon which gravelly dredge spoil was dumped during and after World War II.

High backscatter corresponds with a range of seafloor textures and terrains. Outcrops of various types of bedrock have high backscatter (area 16). The bedrock outcrops at area 17 are small and protrude above a cover of Quaternary sediments. Ice-contact sediment, or till, occurs in many areas (area 18), and consists of muddy bouldery gravel at the seafloor. The till at area 19 occurs in the form of multiple, closely spaced ridges (De Geer moraines) up to 8 m high and formed as glaciers retreated from the region. Glaciomarine mud (area 20) blankets older Quaternary sediments and is commonly winnowed at the seafloor, forming a veneer of muddy angular gravel. The glaciomarine mud at area 21 drapes a ridge that protrudes from beneath a thick cover of postglacial mud; on the shaded seafloor relief map (Potter and Shaw, 2009) the surface of the ridge is heavily marked by iceberg pits.

Some of the high backscatter values occur in deep water in Eastern Channel, where, because of strong currents at the seafloor, there has been very limited postglacial mud deposition compared to areas farther south. At area 22 the grab sample consisted of gravelly mud, whereas at area 23, one of the few areas with intermediate backscatter intensity, the grab sample contained sandy mud with some gravel.

A 5 km wide swath of seafloor off the coast of the Avalon Peninsula has high backscatter due to the presence of gravelly substrates (area 24). This is an area that was subaerially exposed during the postglacial relative sea-level lowstand (Shaw and Forbes, 1995), and has subsequently been transgressed. Much of the coarser gravel is immobile, and is coated with *Lithothamnion* sp. Similarly, the platform at area 25 is a moraine, reworked during the lowstand; it is covered with mobile, poorly sorted gravel. In Long Harbour a former delta (area 26) submerged by the transgression is covered by muddy, sandy gravel, and scattered heaps of dredge spoil. The Argentia area was extensively dredged during World War II. A former shoal at area 27 was dredged, leaving behind a gravelly surface with a scalloped appearence on high-resolution, shaded-relief imagery.

ACKNOWLEDGMENTS

Most surveys were carried out with the collaboration of the Canadian Hydrographic Service (CHS). In particular the authors acknowledge the roles played by A. Roy and C. Stirling, St. John's, Newfoundland, and M. Lamplugh, Dartmouth, Nova Scotia. The authors also acknowledge the masters and crews of the CCGS Frederick G. Creed and CCGS Matthew, and the coxwains of the CHS hydrographic launch Plover. D. Beaver of the GSC operated the multibeam system on some launch surveys. Cartography was by P.A. Melbourne and G. Grant of Natural Resources Canada. The authors relied heavily on contributions by GIS specialists S. Hayward and S. Hynes. The map was reviewed by R. Taylor and D. Whalen. The work was part of GSC project X-38 (J. Shaw, leader) in the Geoscience for Ocean Management Program.

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2010a: Backscatter strength and shaded seafloor relief, Placentia Bay north, offshore Newfoundland and Labrador; Geological Survey of Canada, Map 2151A, scale 1:50 000.

2010b: Backscatter strength and shaded seafloor relief, Placentia Bay southeast, offshore Newfoundland and Labrador; Geological Survey of Canada, Map 2155A, scale 1:50 000.

2010c: Backscatter strength and shaded seafloor relief, Placentia Bay southwest, offshore Newfoundland and Labrador; Geological Survey of Canada, Map 2154A, scale 1:50 000.

2010d: Backscatter strength and shaded seafloor relief, Placentia Bay west, offshore Newfoundland and Labrador; Geological Survey of Canada, Map 2152A, scale 1:50 000

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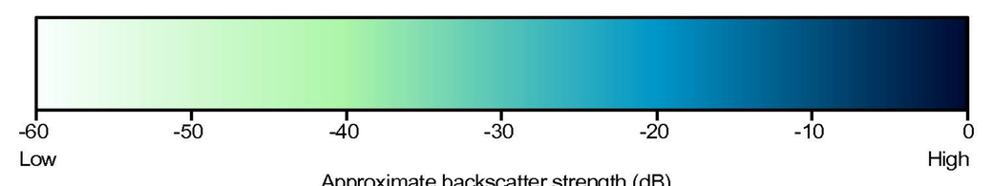
SYMBOLS

Grab sample . . . .
Gravity core . . . .
Seafloor photograph . . . .



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625 Robson Street, Vancouver, British Columbia V6B 5J3
490, rue de la Couronne, Québec, Quebec G1K 9A9
1 Challenger Drive, P.O. Box 1006, Dartmouth, Nova Scotia B2Y 4A2

LOCATION MAP

Authors: D.P. Potter and J. Shaw

This map was produced by Natural Resources Canada in co-operation with Fisheries and Oceans Canada

Multibeam bathymetric data collected by Canadian Hydrographic Service and Natural Resources Canada, 1995, 2004–2006

Multibeam backscatter data compiled by D.P. Potter, 2007 and 2008

Digital cartography by P.A. Melbourne, Data Dissemination Division (DDD)

Any revisions or additional geographic information known to the user would be welcomed by the Geological Survey of Canada

MAP 2153A

BACKSCATTER STRENGTH AND SHADED SEAFLOOR RELIEF

PLACENTIA BAY EAST

OFFSHORE NEWFOUNDLAND AND LABRADOR

Scale 1:50 000/Échelle 1/50 000

kilometres 1 0 1 2 3 4 kilomètres

Universal Transverse Mercator Projection	Projection transverse universelle de Mercator
North American Datum 1983	Système de référence géodésique nord-américain, 1983
© Her Majesty the Queen in Right of Canada 2010	© Sa Majesté la Reine du chef du Canada 2010
This map is not to be used for navigational purposes	Cette carte ne doit pas être utilisée aux fins de navigation

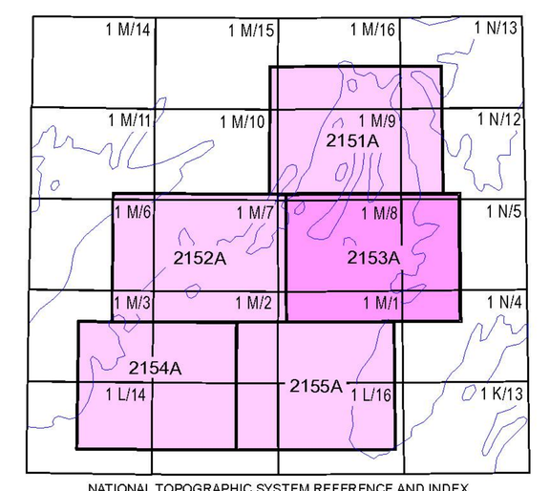
Digital base map (land area) from data compiled by Geomatics Canada, modified by GSC (Atlantic)

Digital bathmetric contours in metres supplied by Canadian Hydrographic Service and GSC (Atlantic)

Magnetic declination 2010, 19°42'W, decreasing 11.6' annually

Elevations in feet above mean sea level

Depth in metres below mean sea level



NATIONAL TOPOGRAPHIC SYSTEM REFERENCE AND INDEX TO ADJOINING GEOLOGICAL SURVEY OF CANADA MAPS

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2010: Backscatter strength and shaded seafloor relief, Placentia Bay east, offshore Newfoundland and Labrador; Geological Survey of Canada, Map2153A, scale 1:50 000.

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