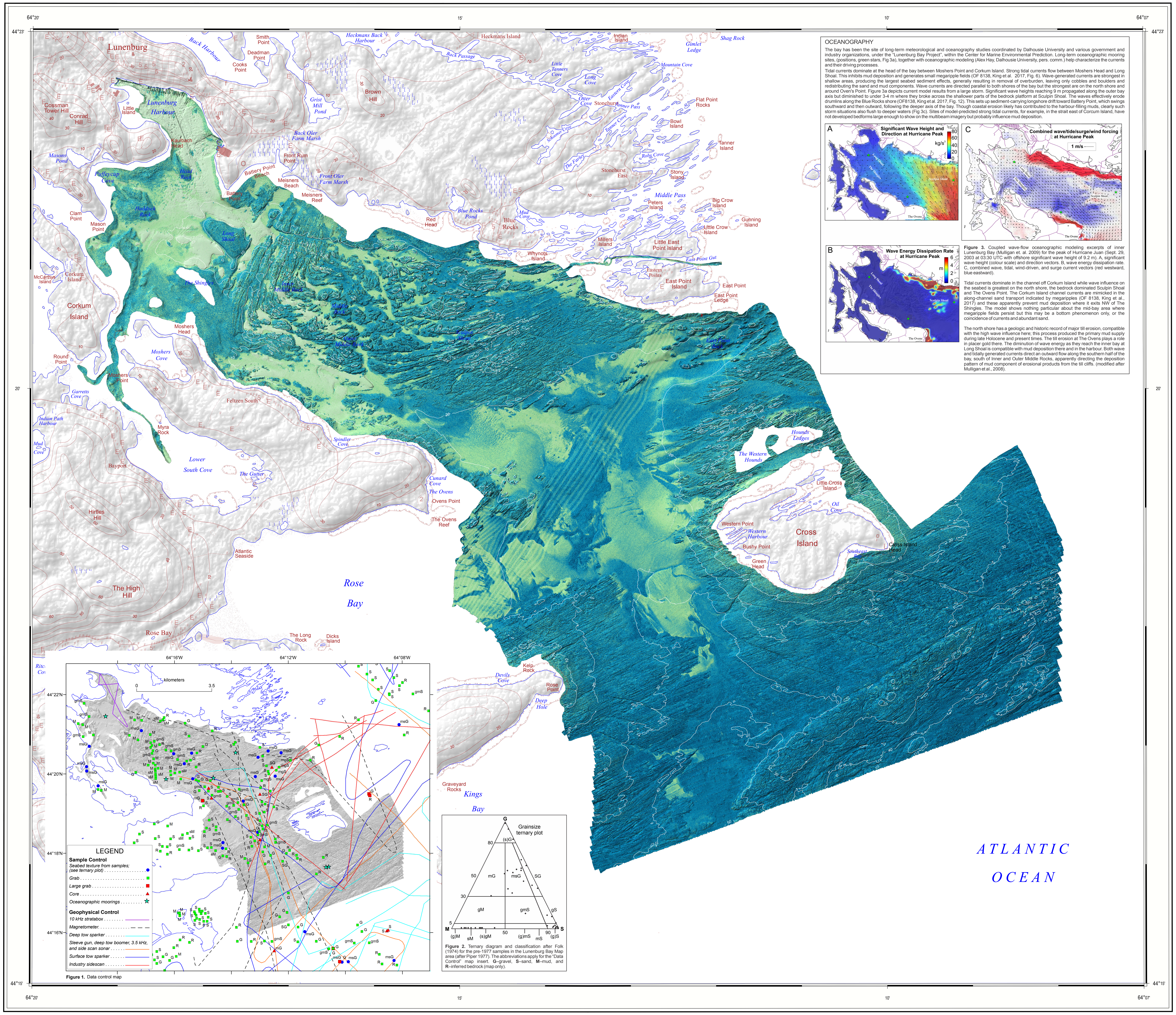
Government of Canada / Gouvernement du Canada



OCEANOGRAPHY

The bay has been the site of long-term meteorological and oceanography studies coordinated by Dalhousie University and various government and industry organizations, under the "Lunenburg Bay Project", within the Center for Marine Environmental Prediction. Long-term oceanographic mooring sites, (positions, green stars, Fig 3a), together with oceanographic modeling (Alex Hay, Dalhousie University, pers. comm.) help characterize the currents and their driving processes.

Tidal currents dominate at the head of the bay between Moshers Point and Corkum Island. Strong tidal currents flow between Moshers Head and Long Shoal. This inhibits mud deposition and generates small megaripple fields (OF 8138, King et al. 2017, Fig. 6). Wave-generated currents are strongest in shallow areas, producing the largest seabed sediment effects, generally resulting in removal of overburden, leaving only cobbles and boulders and redistributing the sand and mud components. Wave currents are directed parallel to both shores of the bay but the strongest are on the north shore and around Oven's Point. Figure 3a depicts current model results from a large storm. Significant wave heights reaching 9 m propagated along the outer bay axis but diminished to under 3-4 m where they broke across the shallower parts of the bedrock platform at Sculpin Shoal. The waves effectively erode drumlins along the Blue Rocks shore (OF8138, King et al. 2017, Fig. 12). This sets up sediment-carrying longshore drift toward Battery Point, which swings southward and then outward, following the deeper axis of the bay. Though coastal erosion likely has contributed to the harbour-filling muds, clearly such storm situations also flush to deeper waters (Fig 3c). Sites of model-predicted strong tidal currents, for example, in the strait east of Corcum Island, have not developed bedforms large enough to show on the multibeam imagery but probably influence mud deposition.

Figure 3. Coupled wave-flow oceanographic modeling excerpts of inner Lunenburg Bay (Mulligan et. al. 2009) for the peak of Hurricane Juan (Sept. 29, 2003 at 03:30 UTC with offshore significant wave height of 9.2 m). A, significant wave height (colour scale) and direction vectors. B, wave energy dissipation rate. C, combined wave, tidal, wind-driven, and surge current vectors (red westward, blue eastward).

Tidal currents dominate in the channel off Corkum Island while wave influence on the seabed is greatest on the north shore, the bedrock dominated Sculpin Shoal and The Ovens Point. The Corkum Island channel currents are mimicked in the along-channel sand transport indicated by megaripples (OF 8138, King et al., 2017) and these apparently prevent mud deposition where it exits NW of The Shingles. The model shows nothing particular about the mid-bay area where megaripple fields persist but this may be a bottom phenomenon only, or the coincidence of currents and abundant sand.

The north shore has a geologic and historic record of major till erosion, compatible with the high wave influence here; this process produced the primary mud supply during late Holocene and present times. The till erosion at The Ovens plays a role in placer gold there. The diminution of wave energy as they reach the inner bay at Long Shoal is compatible with mud deposition there and in the harbour. Both wave and tidally generated currents direct an outward flow along the southern half of the bay, south of Inner and Outer Middle Rocks, apparently directing the deposition pattern of mud component of erosional products from the till cliffs. (modified after Mulligan et al., 2008).

Figure 1. Data control map

Figure 2. Ternary diagram and classification after Folk (1974) for the pre-1977 samples in the Lunenburg Bay Map area (after Piper 1977). The abbreviations apply for the "Data Control" map insert. **G**–gravel, **S**–sand, **M**–mud, and **R**–inferred bedrock (map only).

DESCRIPTIVE NOTES

INTRODUCTION

This map depicting acoustic backscatter strength, in shaded relief view, is part of a three-map series of Lunenburg Bay at a scale of 1:25 000. The series also includes a colour-coded shaded seafloor relief map (OF 8177, King and Beaver, 2017) and a surficial and bedrock geology map, OF 8138, King et al. 2017). The map is derived from multibeam bathymetric echo-sounding surveys. The acoustic backscatter image is presented with an artificial illumination from the NE, an angle of 45° from the horizontal and a vertical exaggeration of 5X.

MULTIBEAM BATHYMETRIC DATA COLLECTION

Surveys were conducted in 2004 and 2006 as a joint program between the Geological Survey of Canada and the Canadian Hydrographic Service (CHS), based at the Bedford Institute of Oceanography in Dartmouth. The CHS launch CSL Plover conducted a three-day survey using the Simrad EM3000 multibeam swath mapping system and the CSL Pelican conducted two surveys, totaling 32 days, with the EM3002 system. The shaded relief image has been gridded at 2 m. The bathymetric image and map were produced in GIS (Geographical Information System) software packages to enhance the seabed relief.

DATA CONTROL

The sample and geophysical control for the area is summarized in the map insert. Most of the sampling and geophysics was conducted by Dalhousie University and GSC in the mid- and late 1970's with follow-up magnetic profiling (Piper et al. 1986). Some industry placer gold-related sidescan surveying in 1987 was followed up with a short aggregate-related survey in 1991 (Fader et al. 1993).

Sample grain sizes (Fig. 2), mostly from Piper (1977), were invaluable control for differentiating mud from sand deposits in the backscatter signal but positioned with Radar or Decca navigation and can be 10s and perhaps 100s of metres in error.

LUNENBURG BAY ACOUSTIC BACKSCATTER

Acoustic backscatter strength is depicted in beige-green to dark blue tones with the blue representing the more reflective (scattering) seabed. There is no simple relationship between backscatter amplitude and surficial sediment type but this signal is a primary guide for mapping seabed texture. The acoustic return from outer-beam transducers (those at low seabed incidence angle, outside about 20°), is sensitive to seabed-roughness (scattering), with stronger signal for rougher seabed. The approximately NNE-SSW-oriented striping between The Ovens and Cross Island is an artifact resulting from incomplete correction for the outer beams. Coarse gravels and cobbles tend to be locally rough and return high-amplitude (blue) while sands and finer grained materials can be locally smooth with a much lower backscatter. Combined with the limited grab sample grain size information (insert and Fig. 1) and acoustic profiler data, an overlay of backscatter data on the multibeam shaded relief image is crucial to recognizing seabed textural relationships with morphology. Integrating this with a model of the surficial geology from stratigraphic and process-oriented understanding (OF 8138, King et al. 2017) enables a conceptual model of the sediment distribution.

The overall blue tone in the area attests to abundant bedrock and bedrock with gravel; there is little sand outside Cross Island except in narrow bedrock crevasses. Most of the sand and mud (lighter tones) lies in the central mid-bay depocenter, the troughs between bedrock ridges and mounds and the more energy-sheltered innermost bay. Drumlins or their remnants are gravel- or cobble-capped. Strong tidal currents in the channel between Corkum Island and Moshers Cove presumably prevent sand or mud deposition on the gravel sea floor. Contrasting yellow and blue tones in the relatively flat-lying portion of the mid bay, between Cross Island and Ovens Point, represent sand versus gravel with the gravel generally confined to channels, the troughs of sand waves (off Ovens Point), or flanking the topographically higher bedrock. Here, present or past currents removed the sand, leaving only a gravel lag. Though not emphasized on the geology map (OF 8138, King et. al, 2017), a more yellow "halo" across the entire shallow shoreface of Cross Island and Rose Point represents thin and patchy sand lying directly on bedrock. This reflects a local source derived from erosion of mainly glacial sediments at the coastline and trapped in bedrock crevasses.

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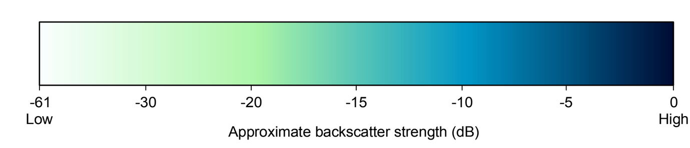

doi:10.4095/299687

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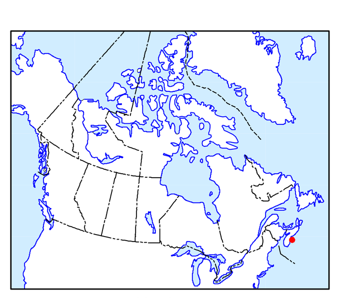


LOCATION MAP

Authors: E. L. King and D. Beaver

This map was produced by Natural Resources Canada in co-operation with Canadian Hydrographic Service

Multibeam bathymetric data collected by Canadian Hydrographic Service, 2004, 2006

Multibeam backscatter data compiled by Geological Survey of Canada

Cartography by P. O'Regan, Natural Resources Canada

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

OPEN FILE 8176

BACKSCATTER STRENGTH AND SHADED SEAFLOOR RELIEF

LUNENBURG BAY

SCOTIAN SHELF

OFFSHORE NOVA SCOTIA

Scale 1:25 000/Échelle 1/25 000

kilometres 0.5 0 0.5 1.0 1.5 2.0 kilomètres

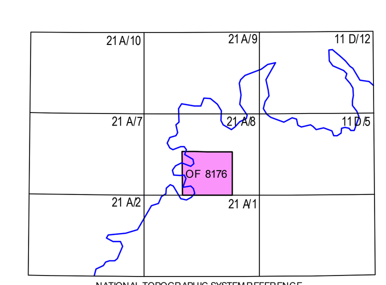
Universal Transverse Mercator Projection
North American Datum 1983
This map is not to be used for navigational purposes

Projection transverse universelle de Mercator
Système de référence géodésique nord-américain, 1983
Cette carte ne doit pas être utilisée aux fins de navigation

Digital topographic data from Natural Resources Canada, modified by GSC (Atlantic)

Digital bathymetric contours in metres supplied by the Canadian Hydrographic Service and Geological Survey of Canada (Atlantic)

Magnetic declination 2017, 17°14.7'W, decreasing 6.9' annually



NATIONAL TOPOGRAPHIC SYSTEM REFERENCE

Recommended citation

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