Quaternary Geology Offshore Avalon Peninsula Newfoundland and Labrador Seal Cove to Motion Bay
Bear Cove Head to Brigus South

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Assisting compiler: Helen Neilson*, Bathymetric Digital Elevation Model

Scale 1: 40 000

0 0.5 1 2 km

Derived from limited geophysical traverse data with broad extrapolations based on topographic character

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Map Explanation

A marine geophysical and sampling survey conducted from CCGS Hudson in 2009 together with a topographic shaded-relief image constructed from Canadian Hydrographic Service (CHS) spot water depth points, provides control for extrapolation of terrain characteristics used to infer the type and distribution of Quaternary sediments. Considered a mapping-feasability study for areas lacking continuous multibeam sonar coverage, it characterizes geologic conditions of the innermost shelf in eastern Newfoundland.

Topography is governed by Precambrian metasediments with a strong N-S structural trend, manifest as ridges and valleys, locally cropping-out from a thin till mantle, across a 2-4 km wide zone offshore the headlands. East of this, low relief Cambrian(?) and Ordovician age, slightly metamorphosed shales and siltstones are overlain by a till blanket of several metres or more thickness. This has scattered drumlins and small transverse moraines, locally iceberg scoured. Mini-basins between hills and ridges commonly contain glacimarine mud pockets with a sand or gravel lag. Isolated ice-carved or bedrock structure-bounded basins and some outer harbours contain various facies of ponded glacimarine muds, generally with a sand lag cover. Thick sea-level low-stand terraces likely record the reworking of glacigenic material from the paleo-coastline and land-based glaciers. Inside the headlands are local deposits of post-glacial mud.

An accompanying map (Sheet 2) presents an extrapolation of these findings north and south, beyond the survey area, based only on topography. Additional sheets depict the stratigraphic succession (Sheet 3) and sediment thickness (Sheet 4). A separate poster (King 2013, Open File 7360) presents examples and interpretations of the geophysics, photography and sediment core sample data and provides a glacial chronology and potential engineering constraints and opportunities.

Geologic Contact:
Defined
Inferred

Bedrock Contact (sub-crop) see Stratigraphic column; Proterozoic metasediments to west, Lower Paleozoic siliciclastic sediments to east

Seabed Texture from sidescan backscatter signature
Sand dominant
Gravel dominant

Seabed Samples: *CHS fieldsheets contain "bottom quality" annotations from small grab samples summarized here into coarse classes; The CHS "rock" designation represents "hard" bottom with little or no sample recovery, interpreted here as bedrock or large clasts.*
- *mud*
- *sand*
- *gravel*
- *bedrock or cobble*

SURFICIAL FEATURES

Trawl marks: *parallel sets of lineations in the seabed created from the disturbance of sediments by otterboards or scallop dredges during bottom trawling.*

Sandwaves / large sub-aqueous dunes: *Field of composite flow transverse constructive bed feature of medium to fine sand with coarse sand or gravel in the troughs, nearly symmetric in profile and with slightly sinuous, semi-parallel crestlines. Amplitudes up to several decimetres. Indicate periodic sand mobility/disturbance but direction or net flux uncertain.*

Megaripples / small sub-aqueous dunes: *Field of flow- transverse discrete bedforms composed of medium to coarse sand exhibiting a simple ripple-like profile and moderate coherence in crest spacing (generally 5 to 40 m); crestline orientation not shown). Generally asymmetric in profile and with slightly sinuous, semi-parallel crestlines or more rarely 3-D or highly sinuous crestlines. Commonly very thin sand on a gravel lag. Amplitudes unmeasured but may be up to several decimetres. Indicate periodic sand mobility or disturbance.*

Iceberg Scour: *Curvilinear scours and pits. There is a continuum from relict (early post-glacial) scours with partial sand infill from current reworking and low-stand sub-littoral deposition, manifest as a subdued character versus more modern (post-low-stand) "fresh-looking" features with sharp berms. The latter occur preferentially in the shallower areas. Though the till is generally iceberg-scoured, some of the glacimarine units may also have been turbated.*
- *curvilinear scour, distinct*
- *curvilinear scour, indistinct*
- *pit, distinct*
- *pit, indistinct*
- *scours and pits, distinct or undetermined*
- *scours and pits, indistinct*

Boulder Field: *Boulders large enough to cast acoustic shadow on sidescan sonogram (over 70 cm).*

Slide Scar: *Inferred from debris flow deposit in adjacent basin. Failure of glacigenic sediment immediately following glacier retreat.*

Transverse Moraine: *Small, till-cored ridge heavily armoured with gravel, cobbles and scattered boulders. Long axis is transverse to glacier flow, demonstrating a dominant easterly flow off the Avalon Peninsula during deglaciation. Deviations in orientation up to 40º reflect a thin glacier with radiating flow direction governed by the topography. Fifty to 150m crest spacing and 1 to 4 m height. Locally draping the drumlins and occassionally buried beneath Gms and GD.*
- *Surficial; approx. orientation and spacing shown*
- *Buried; orientation not implied*

Drumlin: *Till-cored, streamlined hill heavily armoured with gravel and cobble. Long axis parallels direction of glacier flow, generally eastward and orthagonal to transverse moraines. Orientations and extents are inferred from sidescan sonograms and a bathymetric spot-depth grid too sparse to allow precise definition.*
- *Outline approximate*
- *Orientation approximate*
- *Orientation unmeasured*

Drumlin Field: *Approximate limit of drumlin field as inferred from roughness in digital elevation model*

Bedrock Outcrop: *Isolated outcrop with minor cover of gravel, sand and/or boulders. Depicted only along survey tracks with sidescan sonogram coverage.*

LEGEND

QUATERNARY

POSTGLACIAL SEDIMENTS

Post glacial sediments include the reworked component of glacial deposits derived mainly from wave and current action during the postglacial marine transgression. Locally still active where such processes still persist such as shallow water and along hills and escarpments. It comprises mainly sand and gravel lag deposits overlying all the older map units. These are largely unmapped because they are generally under 0.5 m thick, highly variable spatially, and only properly registered on the sidescan sonograms which cover only a small portion of the map area. The best data control is from old Canadian Hydrographic Service (CHS) field sheet "bottom quality" designations derived from small grab samples or lead lines.

PCsg

Post-glacial to Recent Sand and Gravel: Not shown on map; *Gravelly facies either directly overlies bedrock or capping the till, as a partially modified lag. Locally contains boulders, especially dense across moraines. Sandy facies occurs as partial or full fill in local depressions such as relict iceberg scours, or as a thin, contiguous deposit with a relatively smooth surface overlying the glacimarine units in local basins. Derived mainly from washed/modified glacigenic deposits during sea-level rise. A broad but thin blanket overlying the till in deep water offshore Cape Neddick may be more glacial-outwash-derived.*

LATE GLACIAL TO POSTGLACIAL

Terraced depocentres partly filling Bay Bulls, Cape Broyle Harbour, Calvert Bay and outermost Aquaforte harbours to and beyond the mouths. Little internal seismic character resolved. These remain undated so it is not clear if they are earliest Holocene or latest Late Wisconsinan age.

Gls

Low-stand complex: *Incoherent, homogeneous or possibly prograding internal seismic character. Occurs as terraced deposit in select harbours and harbour mouths with slightly inclined top at 30 to 40m water depth (seaward dipping) and a steep, well-defined seaward slipface/foreset (up to 10°) reaching to over 80 m water depth. Possibly with foreset beds but also as weakly stratified basin fill. Topped with sand and gravel. Locally worked into bedforms. Deposit volume and setting suggests accommodation space was governed by low-stand (wave-base influence) during significant sediment input, either from land-based glacier remnants or coastal erosion of glacigenic materials following marine exposure and transgression.*

GLACIAL SEDIMENTS

Till and pro-glacial marine sediments deposited with retreat of the glacier to land. Till has a strong acoustic scattering affect generally registered as an acoustically incoherent signature on ultra-high and high resolution seismic profiles. This, surficial texture and deposit morphology, including moraines, is the basis for identification of the till. Late-phase glacial processes appear to have continued to deposit in the marine realm when the ice margin was near the present coast or just beyond the headlands. Three pro-glacial stratigraphic units are recognized; a poorly stratified deposit interpreted to be either an iceberg turbate and/or transitional between a till and a water-lain glacimarine mud (Gm), an overlying partly stratified deposit (Gms) and over this but restricted to an isolated basin, a well stratified deposit (Gws). Late Pleistocene age from the Late Wisconsinan glaciation. Pending core analysis from all three glacimarine units.

Gmws

Glacimarine Well Stratified Mud: *Well stratified seismic character. Overlies earlier but less well stratified glacimarine muds. Mapped only in basin outside Cape Broyle Harbour but mud samples in isolated headland-siturated basins may be equivalents. Late stage localized plume deposit from marine-based ice emanating from Cape Broyle Harbour.*

GD

Debrite: *Acoustically homogeneous lense/wedge conformably overlying unit Gms. Debris flow scar is not recognized but the parent material is likely glacigenic originating from the steepest (northwest) bedrock topography-governed basin flank. The debris flow event occurred previous to glacier retreat to land (covered by unit Gmws) so it occurred immediately following ice retreat from the basin. Run-out was sufficient to drape a mid-basin hill.*

Gms

Glacimarine Stratified Mud: *Acoustically well to weakly-stratified. Similar to unit Gm but with stratification. More coherent beds arise either because they have been subject to lesser iceberg turbation as the iceberg draft population diminished or a more proximal point source.*

Gm

Glacimarine Mud: *Acoustically poorly to non-stratified, draped in small bedrock and till-floored basins and valleys and in troughs between moraines. Locally undifferentiated from Gms which generally overlies Gm but occassionally they are interspersed. A silt-rich mud with significant sand and gravel component. An unconformable upper surface is common and generally has a thin (cm to dm) sand lag and less commonly a gravel lag (PGsg). Deposited by proglacial meltwater plumes in quiescent and open marine conditions.*

GTtn

Thin Till and Isolated Bedrock hummocks: *Till, as below but as a thin and patchy sheet overlying bedrock; Isolated bedrock outcrops common. Scoured and pitted by both relict and modern icebergs.*

GTtk

Thick Till: *Diamict, generally with a surficial boulder cobble or sand and gravel lag; Largely in the form of blanket deposits up to 10's of metres thick; Locally with narrow sub-parallel transverse ice retreat moraines and drumlins in the offshore. Poor registration of thin deposits on the seismic profiles precludes precise delineation of its distribution versus the thin till (GTtn).*

PRE-QUATERNARY

BEDROCK

lPbrk

Lower Paleozoic sediments and metasediments: *slightly metamorphosed platformal sediments; grey shales siltstones deposited in open and restricted shallow marine conditions and less commonly terrestrial redbeds (sandstones and siltstones). High acoustic velocity; broadly folded with general NNE-SSW strike trends and dips under 2º. Likely fault-bounded against Late Proterozoic rocks. Likely some Cambrian bounding the Proterozoic sediments but mainly Ordovician with Silurian in the extreme east. Appears in cross-sections only.*

PЄbrk

Late Proterozoic metasediments: *Late Proterozoic (PreCambrian) bedrock. Unsampled offshore; Headland-situated metasedimentary rocks including mainly sandstones and shales and minor conglomerates and tuffs (highest greenshist facies) of the St. John's Group (Renews Head, Fermeuse and Trepassy Formations) south of Mobile Bay and overlying Signal Hill Group (Quidi Vidi and Gibbett Hill Formations) north of Mobile Bay. Folds in the land rocks are much tighter than in the Lower Paleozoic sediments farther offshore and dips are locally very steep, with over-turned beds locally (too extreme to identify acoustically). Locally covered with patchy, unmapped occurrences of most Quaternary map units.*