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GEOLOGICAL SURVEY OF CANADA | COMMISSION GÉOLOGIQUE DU CANADA

DESCRIPTIVE NOTES

INTRODUCTION

This map is part of a four-map series of German Bank, located on the Scotian Shelf off southern Nova Scotia. This map is the product of a 1997–2003 survey that used a multibeam sonar system to map 1929 km² of the seafloor. Other surveys collected geological and biological data for scientific investigations. Map 2106A (Todd, 2007) shows coloured shaded-relief view of multibeam bathymetry, a shaded-relief view and seafloor depth (coded by colour) at a scale of 1:50 000. Topographic contours generated from the multibeam data are shown (in white) on the colour-coded multibeam topography at a contour interval of 10 m. Bathymetric contours (in black) are derived from Canadian hydrographic charts at a depth interval of 10 m, put from the National Resource Map series (Canadian Hydrographic Service, 1967–1972). Map 2106A (Todd, 2007) shows coloured backscatter strength in shaded-relief view. Map 2106A (Todd, in press) shows seafloor topography in shaded-relief view with colour-coded surficial geological units. Map 2106A (Todd and Kostylev, in press) shows seafloor topography in shaded-relief view with colour-coded benthic habitats.

The complete German Bank map includes two adjoining maps area at a scale of 1:50 000 sheet 1 and sheet 3. The three map areas comprise 5321 km² of seafloor surveyed with a multibeam sonar system. In total, twelve map sheets constitute the German Bank map suite (three maps sheets on four themes: topography, backscatter strength, surficial geology, and benthic habitat).

MULTIBEAM BATHYMETRY DATA COLLECTION

Multibeam bathymetric data were collected by the Canadian Hydrographic Service using the Canadian Coast Guard Ship Frederick G. Creed, a SWATH (small waterplane area twin hull) vessel. The ship was equipped with a Simrad Subsea EM1000 multibeam bathymetric survey system (95 kHz) with the transducers mounted in the ship's two hulls. Survey lines were oriented perpendicular to the trend of the 150° and operated by surveying a narrow strip of seafloor across track and detecting the seafloor echo. The width of seafloor imaged on each survey line was five to six times the water depth. Line spacing was about three to four times water depth to provide ensonification overlap between adjacent lines. The Differential Global Positioning System was used for navigation, providing positional accuracy of ±3 m. Water depths were corrected for tides and sound velocity variations in the water column. The survey had depths of 20–70 m. The sound velocity in the ocean was measured during multibeam data collection and used to correct the effect of sonar beam refraction. The data were adjusted for tidal variation using tidal predictions from the Canadian Hydrographic Service.

MULTIBEAM BATHYMETRIC DATA DISPLAY

The multibeam bathymetric data are presented at 5 m/pixel horizontal resolution. The shaded-relief bathymetric image was produced using software developed by R.C. Courtney (GSC). The shaded-relief is relief by a virtual light source positioned 45° above the horizon at an azimuth of 315°. In the resulting image, topographic features are enhanced by strong illumination on the northwest-facing slopes and by shadows on the southeast-facing slopes. Small-scale features (<100 m) and large-scale features (>1 km) can be effectively shown by contours at this scale. (On maps 2106A and 2106A (Todd, 2007, in press) and 2106A (Todd and Kostylev, in press), the shaded-relief image also serves as the map background with colours superimposed.) Superimposed on the shaded-relief image are colours assigned to water depth, ranging from white (shallow) to blue (deep). In order to apply the widest colour range to the most significant depths, the colour ramp was nonlinear, with greater colour change for shallower increments of water depth. The resulting colour ramp highlights subtle variations in water depth that would otherwise be obscured.

Linear features in the multibeam data are artifacts of data collection and environmental conditions during the survey periods. The orientation of the survey track-lines can, in some instances, be identified by faint parallel stripes in the image (for example near 43°19'N, 66°44'W). Because these artifacts are usually regular and geometric in appearance on the map, the human eye can disregard them and distinguish real topographic features.

To enhance the topographic features illustrated in Figures 1 and 3, hypsometric analysis was applied to these large-scale maps. Enhancement also included adjustment of the illumination elevation and azimuth and vertical exaggeration.

GEOMORPHOLOGY

The Scotian Shelf is a formerly glaciated continental margin characterized by a topographically rugged inner shelf which is an offshore continuation of the prominent Maritime peneplain on the adjacent land (Fig. 1; Grant, 1975; Piper et al., 1990). Seafloor relief is 10–20 m, with local relief to 50 m. German Bank is domeated by outcropping bedrock (Fig. 1) consisting of Cambro-Ordovician metasedimentary rocks (Meguma Group) intruded by Late Devonian–Carboniferous granitoid plutons (Dzapasu and King, 1972; Clarke and Chatterjee, 1988; Pe-Piper and Jamieson, 1989). The bedrock is truncated by a marine erosion and is separated from the discontinuous and thin, overlying, unconsolidated Quaternary sediments by a rugged erosional surface (Fig. 2, cross-section A-B).

During the late Quaternary period glacial maximum, culminating in the Gulf of Maine region at approximately 20 000 BP (20 ka), German Bank was below sea level and covered by a regional ice sheet (Shaw and Forbes, 1990; Shaw et al., 2002; Todd et al., 2007; Todd et al., 2007). The glacial maximum was followed by a multiphased retreat of the ice front and emergence of the bank. Ice-front retreat and glaciomarine deposition began as early as 18 ka with grounded ice absent from the Gulf of Maine by approximately 14 ka (King and Fader, 1986; Schnitker et al., 2001). German Bank exhibits glacimorphological features formed during the Quaternary glaciation of the bank; three features are discussed on Map 2106A (Todd, in press). Moraines are topographically prominent (Fig. 4, cross-section C-D).

ACKNOWLEDGMENTS

G. Costello of the Canadian Hydrographic Service (CHS) organized the multibeam bathymetric survey of German Bank. Multibeam bathymetric data were processed by the Canadian Hydrographic Service and the Geological Survey of Canada (GSC) for further processing and interpretation. K. Dashfordes processed the backscatter strength using software developed by R.C. Courtney (GSC). The authors thank the master and crew of the CCGS Frederick G. Creed for their efforts. C. Fewings, D. Scott (GSC), G. Costello, and M. Lamplugh (CHS) supported the development of the German Bank maps. Geographical information system support was provided by S. Blasetti and D. Forbes (GSC). D. Mosher, S. Hynes, and P. O'Regan. The authors thank V. Barrie and A. Bobbs for scientific review of the map.

REFERENCES

Canadian Hydrographic Service
1967: National Resource Chart 15136-4, bathymetry; Department of the Environment, Ottawa, Ontario, scale 1:200 000.
1972: National Resource Chart 15136-5, bathymetry; Department of the Environment, Ottawa, Ontario, scale 1:200 000.

Dzapasu, G. and King, L.H.
1972: Surficial geology of the Yarmouth-German Bank map area; Canadian Hydrographic Service, Marine Sciences Paper 2, Geological Survey of Canada, Paper 72-24, 6 p.

Hundert, T.
2003: Western Scotian Slope stratigraphy: insights into late Quaternary deglaciation of the western Scotian Shelf, eastern Canada; M.Sc. thesis, Dalhousie University, Halifax, Nova Scotia, 154 p.

King, L.H. and Fader, G.B.J.
1986: Wisconsinan glaciation of the continental shelf southeast Atlantic Canada; Geological Survey of Canada, Bulletin 363, 72 p.

King, L.H. and MacLean, B.
1976: Geology of the Scotian Shelf; Canadian Hydrographic Service, Marine Sciences Paper 7, Geological Survey of Canada, Paper 74-31, 31 p.

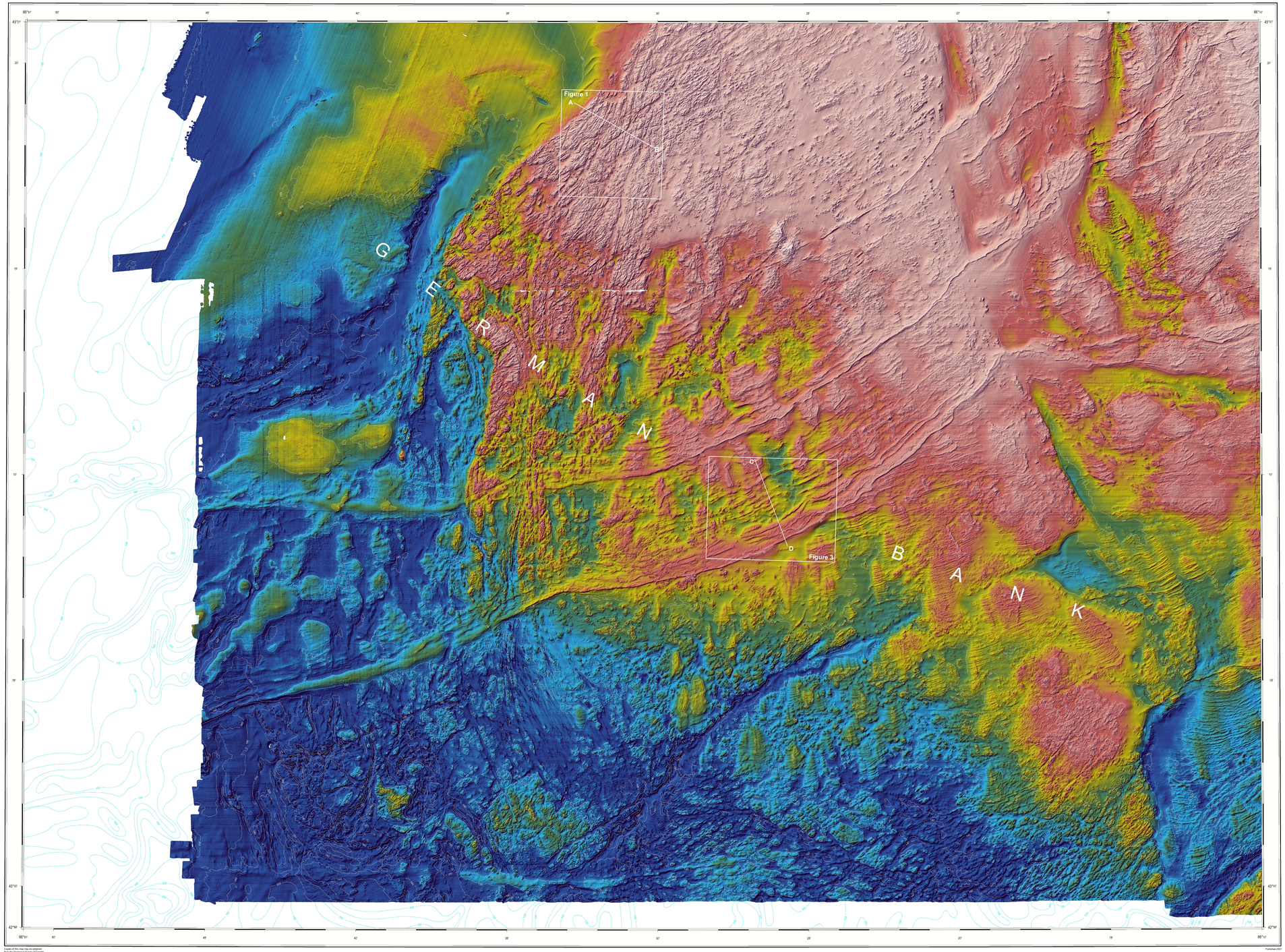
Pe-Piper, G. and Jamieson, R.A.
1989: Pre-Breconian basement rocks offshore Nova Scotia, Canada: new constraints on the origin and Paleozoic accretionary history of the Meguma Terrane; Geological Society of America Bulletin, v.101, p. 1773–1791.

Pe-Piper, G. and Loncarevic, B.D.
1989: Offshore continuation of Meguma terrane, southwestern Nova Scotia; Canadian Journal of Earth Sciences, v. 26, p. 976–191.

Schnitker, D., Belknap, D.F., Bacchus, T.S., Friez, J.K., Lunardi, B.A., and Popek, D.M.
2001: Deglaciation of the Gulf of Maine; in Deglacial History and Relative Sea-level Changes, Northern New England and Adjacent Canada; ed. J.T. Weddle and M.J. Retelle; Boulder, Colorado, Geological Society of America, Special Paper 351, p. 9–34.

Todd, B.J.
2007: Backscatter strength and sun-illuminated seafloor topography, German Bank, Scotian Shelf, offshore Nova Scotia; Geological Survey of Canada, Map 2106A, scale 1:50 000.
in press: Surficial geology and sun-illuminated seafloor topography, German Bank, Scotian Shelf, offshore Nova Scotia; Geological Survey of Canada, Map 2106A, scale 1:50 000.

Todd, B.J. and Kostylev, V.E.
in press: Benthic habitat and sun-illuminated seafloor topography, German Bank, Scotian Shelf, offshore Nova Scotia; Geological Survey of Canada, Map 2106A, scale 1:50 000.



Copies of this map may be obtained
from the Geological Survey of Canada
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(604)-666-0271 Fax: (604)-666-1337
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Multibeam bathymetric data collected by Canadian Hydrographic Service, 1997, 1998, 2000, 2002, and 2003

Multibeam bathymetric data compiled by Canadian Hydrographic Service and Geological Survey of Canada, 1997, 1998, 2000, and 2002–2004

Digital cartography by P. O'Regan, Data Dissemination Division (DDD) and S. Hayward, GSC (Atlantic)

MAP 2107A

SUN-ILLUMINATED SEAFLOOR TOPOGRAPHY

GERMAN BANK

SCOTIAN SHELF

OFFSHORE NOVA SCOTIA

Scale 1:50 000/Échelle 1/50 000

kilometres 1 0 1 2 3 4 kilometres

Universal Transverse Mercator Projection
North American Datum 1983
© Her Majesty the Queen in Right of Canada 2007
This map is not to be used for navigational purposes

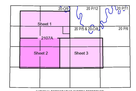
Projection transverse universelle de Mercator
Système de référence géodésique nord-américain, 1983
© Sa Majesté la Reine du chef du Canada 2007
Cette carte ne doit pas être utilisée aux fins de navigation

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

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

Magnetic declination 2007, 17°23'W, decreasing 5.9' annually

Depth in metres below mean sea level



Published 2007

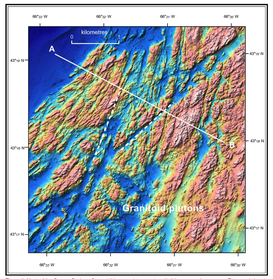


Figure 1. Much of the German Bank seafloor exhibits rugged topography with little or no sediment cover. This morphology is characteristic of outcropping, glaciated bedrock on the inner Scotian Shelf. Exposed granitoid plutons dominate much of the map area. Two jointing directions are evident at 025° and 090°(dashed lines).

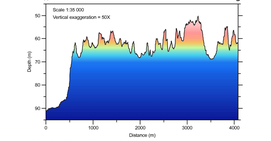


Figure 2. Cross-section A-B emphasizes the rugged topography of the bedrock with relief up to 18 m.

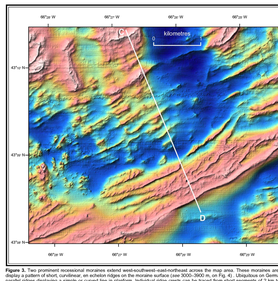


Figure 3. Two prominent moraines extend west-southwest–east-northeast across the map area. Three moraines are up to 1 km wide and display a pattern of short, curvilinear, en echelon ridges on the moraine surface (see 3000–3900 m, on Fig. 4). Ubiquitous on German Bank are swarms of parallel ridges displaying a simple or curved line in planform. Individual ridge crests can be traced from short segments of 2 km to almost 10 km. Some ridges are superimposed on the moraines and are oriented at a high angle to the moraine crests (see 3000–3900 m, on Fig. 4). Ridge strike is west-southwest–east-northeast. The ridges are interpreted as De Geer moraines, transverse glaciomarine landforms formed at the grounding line of a water-terminating ice sheet. The regional pattern of De Geer moraines indicates that ice-sheet retreat was generally northward.

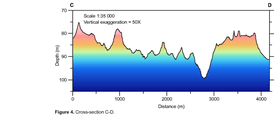
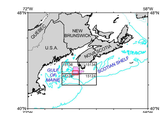


Figure 4. Cross-section C-D.



Location map shows extent of map sheet in red. The pink shadowing shows the extent of the multibeam sonar coverage. Five-digit bathymetric contours are in metres below mean sea level. Coordinate reference: Map centre at 1:250 000 scale. Blue line shows 200 m isobath.

Sheet 2 of 3, sun-illuminated seafloor topography (southwest area)

Recommended citation:

Todd, B.J.
2007: Sun-illuminated seafloor topography, German Bank, Scotian Shelf, offshore Nova Scotia; Geological Survey of Canada, Map 2107A, scale 1:50 000.

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