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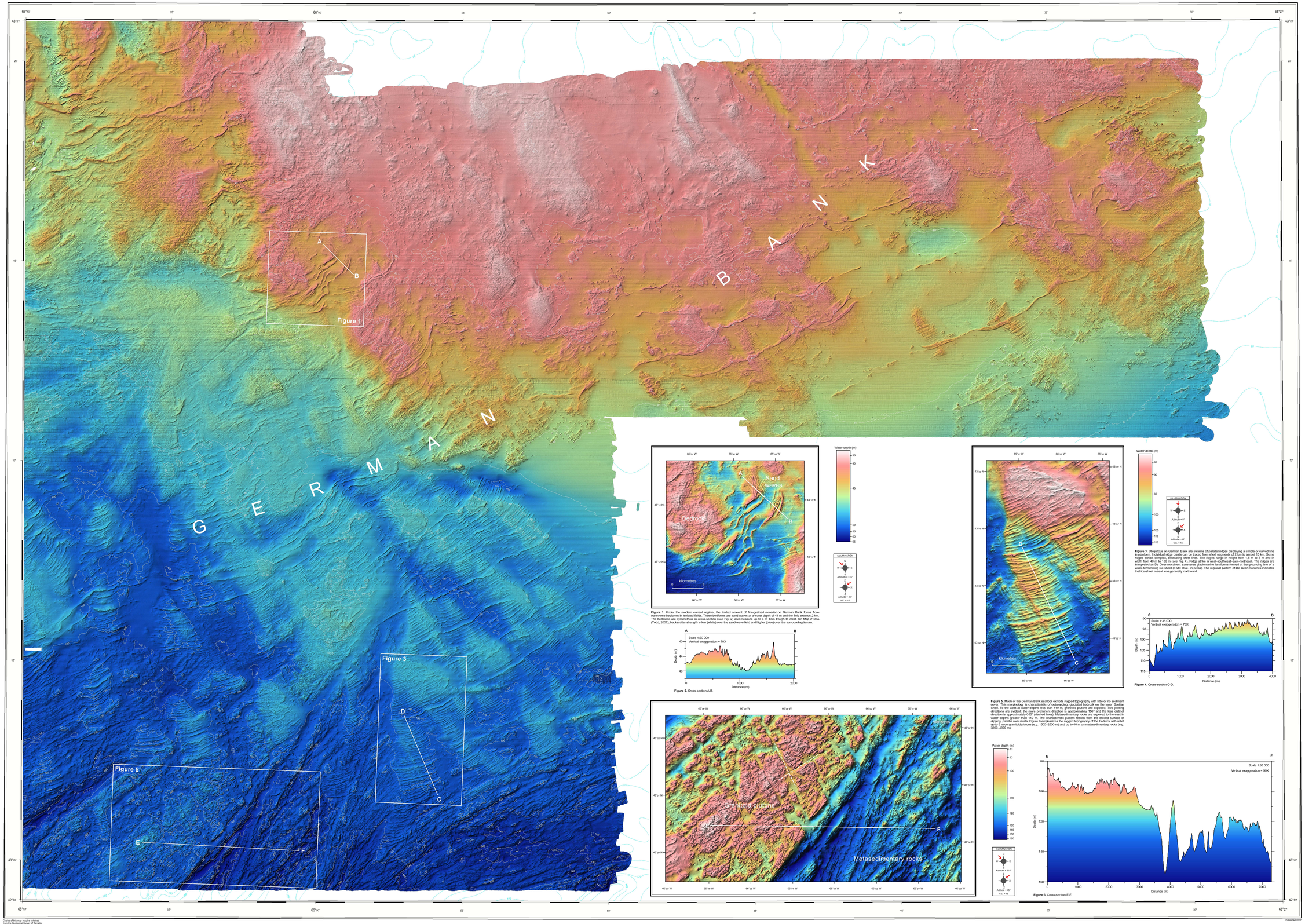

Figure 1. Under the modern current regime, the limited amount of fine-grained material on German Bank forms flow-transverse bedforms in isolated fields. These bedforms are sand waves at a water depth of 44 m and the field extends 2 km. The bedforms are symmetrical in cross-section (see Fig. 2) and measure up to 4 m from trough to crest. On Map 2106A (Todd, 2007), backscatter strength is low (white) over the sand-wave field and higher (blue) over the surrounding terrain.

Figure 2. Cross-section A-B.

Figure 5. Much of the German Bank seafloor exhibits rugged topography with little or no sediment cover. This is especially true in the northeast where bedrock is exposed on the floor of the Gilbert Shelf. To the west at water depths less than 110 m, gradted plutons are exposed. Two jointing directions are evident: the more prominent direction is approximately 150° and the less distinct direction is approximately 055° (dashed lines). Metasedimentary rocks are exposed to the east in water depths greater than 110 m. The characteristic pattern results from the eroded surface of dipping, parallel rock strata. Figure 6 emphasizes the rugged topography of the bedrock with relief up to 5 m on granitoid plutons (e.g. 1500–2500 m) and up to 40 m on metasedimentary rocks (e.g. 3600–4300 m).

Figure 6. Cross-section E-F.

Figure 3. 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 exhibit complex, bifurcating crest lines. The ridges range in height from 1.5 m to 8 m and in width from 40 m to 130 m (see 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 (Todd et al., in press). The regional pattern of De Geer moraines indicates that ice-sheet retreat was generally northward.

Figure 4. Cross-section C-D.

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 1521 km² of the seafloor. Other surveys collected geological and biological data for scientific interpretation. This map sheet shows the seafloor topography of German Bank (southeast area) in sun-illuminated, shaded-relief view. Multibeam bathymetric data (Todd, 2007) and topographic data generated from the multibeam data are shown (in white) on the colour-coded multibeam topography at a depth interval of 20 m. Bathymetric contours (in blue) outside the multibeam survey area, presented at a depth interval of 10 m, are from the Natural Resource Map series (Canadian Hydrographic Service, 1967, 1971a, b, 1972). Map 2106A (Todd, 2007) shows coloured backscatter strength in shaded-relief view. Map 2107A (Todd, 2007) shows sun-illuminated topography in shaded-relief view with colour-coded surficial geological units. Map 2108A (Todd and Kostylev, in press) shows seafloor topography in shaded-relief view with colour-coded benthic habitat zonation.

The complete German Bank map includes two adjoining map areas at a scale of 1:50 000: sheet 1 and sheet 2. 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 map 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 transducer mounted in the starboard pontoon. This system produces 60 beams arrayed over an arc of 150°. Each beam measures 2° across and 4° along and thus ensonifies a 7% area of the seafloor at nadir. 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. Survey speeds averaged 14 knots, resulting in an average data collection rate of about 5.0 km² /h in water 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 a revised horizontal resolution. The shaded-relief image was generated from a gridded bathymetric model having 10 m cells and then artificially illuminated by 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 cast on the southeast-facing slopes. Small topographic features are accentuated that could not be effectively shown by contours at this scale. (On maps 2106A and 2108A (Todd, 2007, in press) and 2109A (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. The colour ramp was designed to highlight the shallow areas of the bank, which are the areas most frequently occurring water depths. Hypsometric analysis was used to calculate the cumulative frequency of water depth. The resulting colour ramp highlights subtle variations in water depth that would otherwise be obscured.

Some 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° 12' N, 65° 40' W). Because these artifacts are faint, they do not detract from the overall appearance on the map, the human eye can disregard them and distinguish real topographic features.

To enhance geomorphological features illustrated in Figures 1, 3, and 5, 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 area (King and MacLean, 1976). The geomorphology of the inner shelf area constituting German Bank is dominated by outcropping bedrock (Fig. 5) consisting of Cambro-Ordovician metasedimentary rocks and granitoid plutons (Pe-Piper and Loncarevic, 1989; Pe-Piper and Jansa, 1995). Bedrock has been modified by glacial erosion and is separated from the discontinuous and thin, overlying unconsolidated Quaternary sediments by a rugged erosional surface (Fig. 6, cross-section E-F).

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 that terminated to the south on the Scotian Slope (Schnitker et al., 2001; Hundert, 2003). The glacial limit marks the seaward limit of subaerial exposure of the Scotian Shelf during the last glaciation. Ice-sheet 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 geomorphological features formed during the Quaternary glaciation of the bank; these features are discussed on Map 2106A (Todd, 2007). Moraines are topographically prominent (Fig. 4, cross-section C-D). Sediment beforms of limited aerial extent are rare (Fig. 2, cross-section A-B).

ACKNOWLEDGMENTS

G. Costello of the Canadian Hydrographic Service (CHS) organized the multibeam bathymetric survey of German Bank and oversaw data processing. Canadian Hydrographic Service provided the data to the Geological Survey of Canada (GSC) for further processing and interpretation. K. DesRoches 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 at sea. R.A. Pickrill (GSC), G. Costello (CHS), and D.C. Mosher (GSC) reviewed the manuscript. Geographic Information Systems and Information Systems and cartographic support was provided by S. Hayward, W.A. Rainey, S. Pereira, and P. O'Regan. The authors thank V. Barrie and A. Bolduc for scientific review of the map.

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in press: Surficial geology and sun-illuminated seafloor topography, German Bank, Scotian Shelf, offshore Nova Scotia; Geological Survey of Canada, Map 2108A, scale 1:50 000.

Todd, B.J. and Kostylev, V.E.
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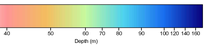
Todd, B.J., Valentine, P.C., Longva, O., and Shaw, J.
in press: Glacial landforms on German Bank, Scotian Shelf: evidence for Late Wisconsinan ice sheet dynamics and implications for the formation of De Geer moraines; Boreas.



Location map shows extent of map sheet in red. The pink shadowing shows the extent of the multibeam sonar coverage. Five-digit numbers refer to Marsden Square System used for Natural Resource Map series at 1:250 000 scale. Blue line shows 200-m isobath.

Copies of this map may be obtained:
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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
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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°40'W, decreasing 6.2' annually.

Depth in metres below mean sea level

Published 2007

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

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