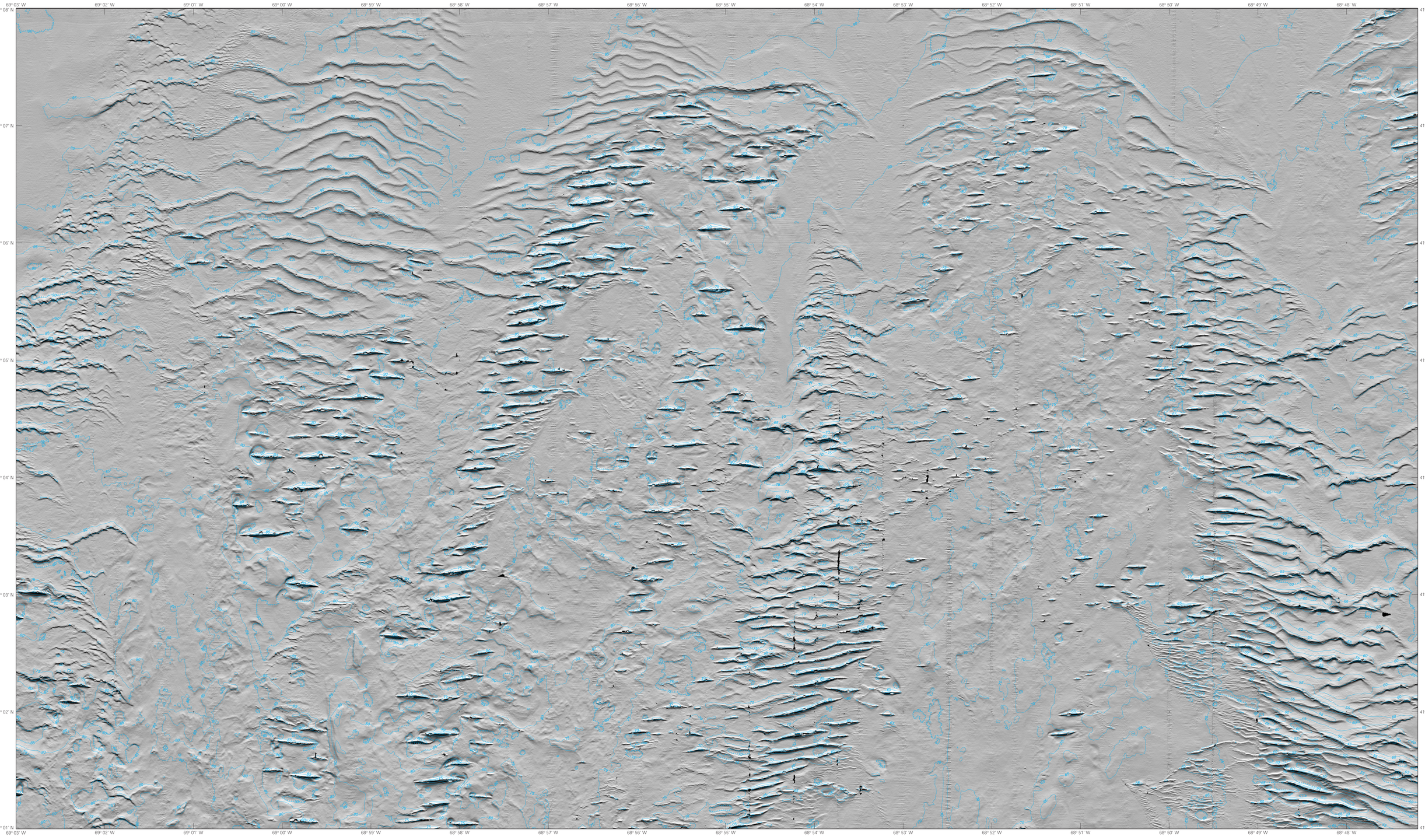
U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

Prepared in cooperation with the
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

GEOLOGIC INVESTIGATIONS SERIES
MAP I-2698-D



Mercator projection

Geodetic Reference System 1980; North American Datum 1983
Longitude of central meridian 68° 55' W.; latitude of true scale 40° 50' N.
False easting 0 m; false northing 0 m

This map is not intended for navigational purposes

SCALE 1:25 000
ONE CENTIMETER REPRESENTS 250 METERS ON THE SEA FLOOR

1 .5 0 1 2 3 4 KILOMETERS
1 .5 0 1 2 NAUTICAL MILES

CONTOUR INTERVAL 5 METERS
DATUM MEAN LOWER LOW WATER

DISCUSSION

Introduction

The Georges Bank Mapping Project is a cooperative effort of the U.S. Geological Survey and the National Oceanic and Atmospheric Administration (NOAA), with support from the University of New Brunswick and the Canadian Hydrographic Service. A multibeam echo sounder survey of the Great South Channel region was conducted in November 1998. This map, one in a series of two mapped quadrangles (see location map), presents the results of this survey, in which sea floor topography is depicted in sun-illuminated (or shaded relief) view at a scale of 1:25,000, with topographic contours overprinted in blue. The image shown here uses a sun elevation angle of 45 degrees above the horizon from an azimuth of 0 degrees and a vertical exaggeration of four times. In effect, topographic relief is enhanced by having the sun illuminate the sea floor from the north, so that shadows are cast on the southern flanks of seabed features. Some features in the image are artifacts of data collection. They are especially noticeable where the seabed is smooth, and they include small highs and lows and unnatural-looking features and patterns that are oriented parallel or perpendicular to survey tracklines, which run north-south. Blank areas (black on the image) represent places where no data exists. Large east-west-trending bedforms (up to 10 m in height) characterize parts of the sea floor in this region. The multibeam echo sounder had difficulty imaging these features because they are oriented at right angles to the ship's tracks and display steep sides and narrow crests. As a result, the crests of some of these bedforms display small gaps or lows that do not exist. For a depiction of the sea floor topography without imagery and for an explanation of survey and topographic data-processing methods, see the companion map by Valentine and others (2002a) on this CD-ROM.

Regional seabed features

The Great South Channel separates the western part of Georges Bank from Nantucket Shoals and is a major conduit for the exchange of water between the Gulf of Maine to the north and the Atlantic Ocean to the south. Water depths range mostly between 55 and 95 m in Quadrangle 2. Minimum depths of 45 to 50 m occur near the southeast corner, and a maximum depth of 100 m occurs in the northwest corner. The major topographic features depicted in the Great South Channel were formed by glacial and postglacial processes. Ice containing rock debris moved from north to south, sculpting the region into a broad shallow depression and depositing sediment to form the irregular depressions and low gravelly mounds and ridges that are visible in parts of the mapped area. Many other smaller glacial features probably have been eroded by waves and currents at work since the time when the region, formerly exposed by lowered sea level or occupied by ice, was invaded by the sea. The low, irregular and somewhat lumpy fabric formed by the glacial deposits is obscured in places by drifting sand and by the linear, sharp fabric formed by modern sand features.

In many respects, the seabed in Quadrangle 2 is similar to that in Quadrangle 1 (Valentine and others (2002b) on this CD-ROM). In both quadrangles the seabed consists of coarse-grained glacial deposits (gravel, sandy gravel, and coarse sand), and, in part, modern sands. In this quadrangle, low ridges and mounds composed of glacial gravel are visible where they have not been obscured by modern sands. An example is the area that extends northward from 41°01' N. to 41°03.5' N. and that is bounded by 68°59' W. and 69°02' W. A similar area lies between 41°01' N. and 41°04' N. and is bounded by 68°55' W. and 68°58' W. Relatively smooth areas of the seabed (that are not dominated by modern sand bedforms) consist of glacial gravel that has been exposed by bottom currents. They are centered at the following locations: 41°02' N., 68°50' W.; 41°01.5' N., 68°52' W.; and 41°02.5' N., 69° 01' W.

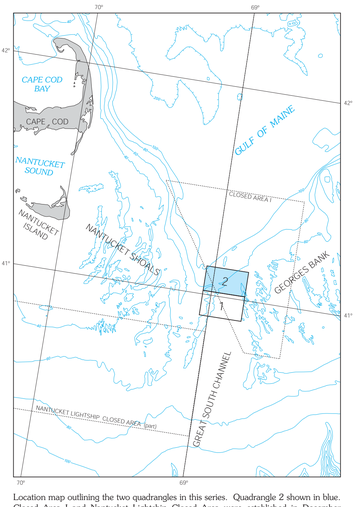
Today, strong tidal and storm currents flow dominantly north and south in the region. Transport of sand by these currents has resulted in the construction of large, east-west-trending sand dunes. These large bedforms contrast strongly with, and partly mask, the subdued topography of the older glacial features. The modern bedforms are represented by two major types. One group of features generally is high and steep-sided, has straight axes, and is composed of coarse-grained sediment (example at 41°06.35' N., 68°56.5' W.). The second group generally is lower, has sinuous axes, and consists of fine-grained sediment (example at 41°06.47' N., 68°57.2' W.). The irregular sinuous shapes and fine-grained nature of the bedforms in the second group suggest that they are more mobile than the more symmetrical and coarse-grained bedforms of the first group. The sinuous bedforms are most common in the northern and southeastern parts of the quadrangle. The high, straight-crested bedforms occur throughout the quadrangle, and many are bounded by linear depressions and are separated from neighboring bedforms by gravel seabed (41°01.7' N., 68°54.1' W.). The linear depressions possibly resulted from the scouring of sand from gravelly glacial deposits around the bedform, a process that caused the formation and settling of the gravel seabed. Several of the large isolated bedforms that are located in gravel areas are eroding. Sand eroded from these bedforms is represented by linear, en-echelon sand waves that trail away downcurrent (southeastward) from the bedforms onto the gravel pavement (41°02.9' N., 68°50.6' W.). As erosion continues (see examples in Valentine and others, 2002b), the bedforms are removed, depressions are left in the sea floor, and thin linear deposits of rippled sand extend downcurrent onto the surrounding gravel seabed. Finally, the thin rippled sand deposits are eroded, and the only evidence of the former large bedforms are elongate depressions in the sea floor.

Four wedge-shaped areas of smooth, sandy seabed extend south from the northern edge of the map area, along 69°03' W., 68°57' W., 68°53' W., and 68°49' W. These smooth areas are separated from one another by somewhat shallower areas of seabed that display large bedforms. The shallower areas display a north-to-south progression (as water depth decreases) of features that grade from sinuous fine-grained bedforms to high, straight-crested, coarse-grained bedforms that are separated from one another by gravelly seabed (for example, the area extending south from 41°08' N. along 68°56' W.). The symmetry and the dominant east-west trend of both groups of large bedforms in this quadrangle suggest that storm and daily tidal currents move sand both north and south in the Great South Channel. Sand grains on the flanks of large and small bedforms probably are moved back and forth during each tidal cycle. Although storm currents are less predictable than tidal currents and can transport sand rapidly over longer distances, the positions of the large bedforms probably are relatively stable. However, the orientation of the sand trails from eroding bedforms suggests that, with time, net sediment movement is to the south and southeast.

REFERENCES CITED

Valentine, P.C., Malczyk, J.T., and Middleton, T.J., 2002a, Sea floor topography of Quadrangle 2, map C *of* Valentine, P.C., ed., Maps showing sea floor topography, sun-illuminated sea floor topography, and backscatter intensity of Quadrangles 1 and 2 in the Great South Channel region, western Georges Bank: U.S. Geological Survey Geologic Investigations Series Map I–2698, scale 1:25,000, on a CD-ROM.

Valentine, P.C., Middleton, T.J., and Malczyk, J.T., 2002b, Sun-illuminated sea floor topography of Quadrangle 1, map B *of* Valentine, P.C., ed., Maps showing sea floor topography, sun-illuminated sea floor topography, and backscatter intensity of Quadrangles 1 and 2 in the Great South Channel region, western Georges Bank: U.S. Geological Survey Geologic Investigations Series Map I–2698, scale 1:25,000, on a CD-ROM.



Location map outlining the two quadrangles in this series. Quadrangle 2 shown in blue. Closed Area 1 and Nantucket Lightship Closed Area were established in December 1994 by the New England Fishery Management Council. Bathymetric contours are in meters.

SUN-ILLUMINATED SEA FLOOR TOPOGRAPHY OF QUADRANGLE 2

By

Page C. Valentine, Jeremy T. Malczyk, and Tammie J. Middleton

Map D of

Maps Showing Sea Floor Topography, Sun-Illuminated Sea Floor Topography, and Backscatter Intensity of Quadrangles 1 and 2 in the Great South Channel Region, Western Georges Bank

Page C. Valentine, editor

2002

CD-ROM of I-2698 for sale by U.S. Geological Survey, Information Services, Box 25286, Federal Center, Denver, CO 80225; telephone: 1-888-ASK-USGS

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