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

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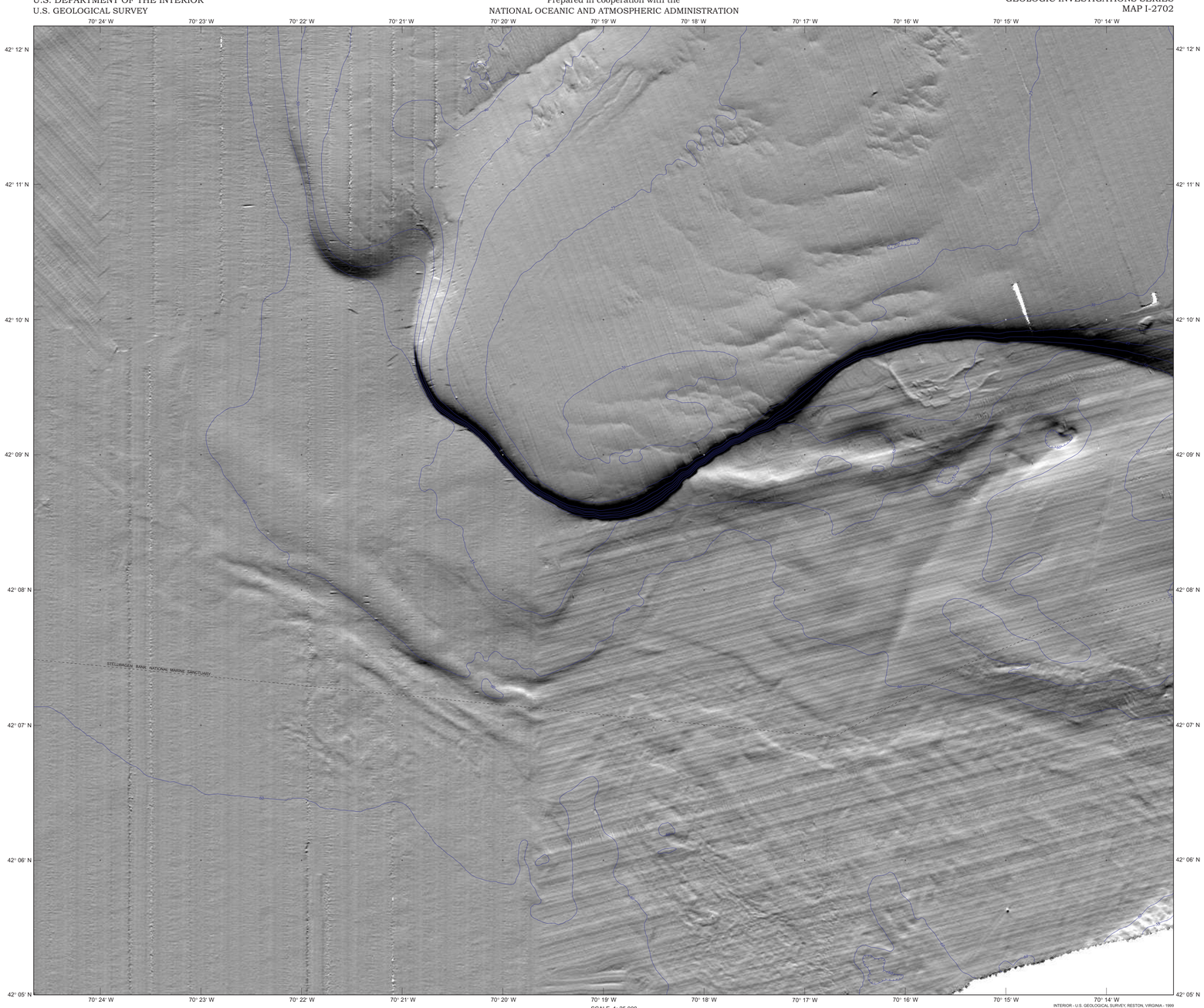
GEOLOGIC INVESTIGATIONS SERIES
MAP I-2702



Mercator projection
Geodetic Reference System 1980; North American Datum 1983
Longitude of central meridian 70° 19' W; latitude of true scale 41° 39' N
False easting 0 m; false northing 0 m
This map is not intended for navigational purposes.

SCALE 1: 25 000

ONE CENTIMETER ON THE MAP REPRESENTS 250 METERS ON THE SEA FLOOR

1 0 1 2 3 4 5 KILOMETERS

CONTOUR INTERVAL 5 METERS
DATUM MEAN LOWER LOW WATER

INTERIOR - U.S. GEOLOGICAL SURVEY, RESTON, VIRGINIA - 1999

SUN-ILLUMINATED SEA FLOOR TOPOGRAPHY OF QUADRANGLE 2 IN THE STELLWAGEN BANK NATIONAL MARINE SANCTUARY OFF BOSTON, MASSACHUSETTS

By

Page C. Valentine, Tanya S. Unger, and Jessica L. Baker

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AUTHOR AFFILIATIONS
U.S. Geological Survey, Woods Hole Field Center
384 Woods Hole Road, Woods Hole, MA 02543

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DISCUSSION

Introduction - The Stellwagen Bank National Marine Sanctuary Mapping Project is a cooperative effort of the U.S. Geological Survey and the National Oceanic and Atmospheric Administration, with support from the University of New Brunswick and the Canadian Hydrographic Survey. The multibeam echo sounder survey was conducted on four cruises over a two-year period from the fall of 1994 to the fall of 1996. This map shows one of a series of 18 quadrangles (see location map) in which sea floor depth information 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 350 degrees and a vertical exaggeration of four times. In effect, topographic relief is enhanced by having the sun illuminate the sea floor from a position 10 degrees west of north so that shadows are cast on the southern flanks of seabed features. Some features in the images are artifacts of data collection. They are especially noticeable where the seabed is smooth and include small highs and lows and unnatural-looking features and patterns that are oriented parallel or perpendicular to survey tracklines. For a depiction of the topographic contours alone, and for an explanation of survey and topographic data processing methods, see the companion map by Valentine and others (1997). Topographic contour maps of all 18 quadrangles of the map series are available on a CD-ROM in EPS, PS, Arc export, and PDF file formats (Valentine and others, 1998). Blank areas represent places where no data exists.

Regional seabed features - The major topographic features depicted in the map series were formed by glacial processes. In broad terms, these features are interpreted here to represent a geologic history that developed in several stages. Ice containing rock debris moved across the region, sculpting its surface and depositing sediment to form the large basins, banks, ridges, and valleys. Many other features observed here represent the latter stages of deglaciation. They are the result of processes at work when much of the area was covered by stationary rotting ice, and when at the same time small valley glaciers and ice falls were active in and near areas of high topographic relief. The sea invaded the region formerly occupied by ice, and seabed features were partly eroded and some new sedimentary deposits were formed. Today, the sea floor mainly is modified by strong southwestward-flowing bottom currents caused by storm winds from the northeast. These currents erode sediments from the shallow banks and transport them into the basins. With time, the banks affected by these currents become coarser, as sand and mud are removed but gravel remains; and the western flanks of the banks, and adjacent basins, are built up by deposits of mud and sand.

Quadrangle 2 features - This quadrangle covers the southwestern corner of Stellwagen Bank, the southeastern part of Stellwagen Basin, and the western part of the channel that separates the bank from Cape Cod. The southernmost extremity of the bank, the shallowest part of the bank overall, lies at a water depth of 20 m in the center of the quadrangle and is bounded on the south and southwest by a 25-meter escarpment. The southwestern face of the escarpment bears a prominent notch that incises the bank for approximately one kilometer. The bank crest is relatively flat in water depths of 20 to 30 m. The western flank of the bank slopes from a water depth of 30 m to meet the floor of Stellwagen Basin at 55 m. The seabed between 20 and 40 m is covered by sand and gravelly sand. In this interval, the smooth seabed is relatively uniform in texture, and curved features of low relief represent the intermingling of storm deposits of fine and coarse sand. A wedge-shaped feature in the northern part of the quadrangle (70° 20'W) is part of a storm deposit of fine-grained sand dunes that extends southward from Quadrangle 5 (Valentine and others, 1999a). The western flank of the bank extends westward into Stellwagen Basin as a terrace of low relief in the 40- to 50-m depth interval. Its surface is slightly hummocky sand and muddy sand that is interpreted to represent storm deposits. To the west, the basin floor is sandy mud and mud. Several sets of low curved ridges intersect the southern escarpment of the bank. The best-defined ridges are at 45 m water depth and resemble rock debris deposited from the lobe of a former ice fall that flowed from the bank. A better preserved feature of similar origin is present at the base of a small bank located in Quadrangle 6 to the east (Valentine and others, 1999b). In the southern part of the quadrangle, in water depths of 50 to less than 65 m, the channel between the bank and Cape Cod opens westward into Stellwagen Basin. The channel floor is sandy and gradually becomes finer-grained and muddy as it merges with the basin to the west. The seabed in this region displays low ridges, grooves, and hummocks that are interpreted to have formed by glacial processes during a time of ice movement and a later time of ice melting. These features are now covered to varying degrees by sediment. They are clearly observed in the deep parts of the channel and in the basin to the west, but they are less visible near the bank margins where they have been more deeply buried by sediment from the bank.

REFERENCES CITED

Valentine, P.C., Unger, T.S., Baker, J.L., and Roworth, E.T., 1997, Sea floor topography of Quadrangle 2 in the Stellwagen Bank National Marine Sanctuary off Boston, Massachusetts: U.S. Geological Survey Open-File Report 97-503, scale 1:25,000.

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Location map - Shows mapped quadrangle outlined. Stellwagen Bank National Marine Sanctuary (SBNMS) boundary shown as dashed line. Bathymetric contours in meters.