

Map uses projection
Geoidetic Reference System 1983, North American Datum 1983
Longitude of central meridian 70°19' W, latitude of true scale 41°59' 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
4 KILOMETERS
NAUTICAL MILES
CONTOUR INTERVAL 5 METERS
DATUM MEAN LOWER LOW WATER

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 Service. 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 (shaded relief) view at a scale of 1:25,000, with topographic contours superimposed in blue. The image shows how sea floor features are distorted by the geometry of the bathymetric data. The map uses a sun illumination 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 seafloor features. Some features in the image are artifacts of data collection. They are especially noticeable where the seafloor is smooth, and they include small high and low and unrelated-looking features and patterns that are oriented parallel or perpendicular to survey tracklines. For a depiction of the topographic contour 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 in the map series are available on a CD-ROM in EPS, PDF, Arc export, and POF file formats (Valentine and others, 1998). Blank areas represent places where no data exist.

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 banks, ridges, and valleys. Many other features observed here represent the later stages of deglaciation. They are the result of processes at work when much of the area was covered by stationary retreating 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 formed. Today, the sea floor is modified mainly by strong southward-flowing bottom currents caused by storm winds from the northeast. These currents erode sediments from the shallow banks and transport them into the

banks. With time, the banks affected by these currents become coarser, as sand and mud are removed and gravel remains; and the western flanks of the banks, as well as adjacent basins, are built up by deposits of mud and sand.

Quadrangle 5 features

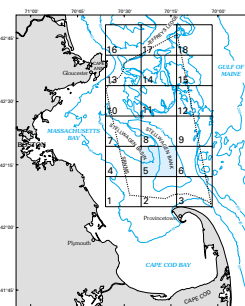
This quadrangle covers the western central part of Stellwagen Bank and an embayment of Stellwagen Basin into the western flank of the bank. The bank surface slopes eastward and westward from a broad central crest delineated by the 20- and 30-meter contours. Eastward of the crest, extending to a depth of 80 m, the gently sloping sea floor is sand and gravel, including boulder piles and ridges. The central bank crest and the western flank (to a water depth of 70 m) are composed of coarse- to fine-grained sand and gravelly sand. Both the eastern and western flanks exhibit a variety of sand deposits and bedforms that indicate movement of sand from northeast to southwest by storm-wave currents. These deposits typically are a series of coarse- and fine-grained sand bodies that have stepped along transport. In the northeastern part of the quadrangle, the deposits are long, linear, and north-northeast trending; they surround these large parallel boulder ridges that have relief of several meters (42°18' N, 70°17' W) and that trend northeast. On the bank crest, in the southeastern part of the quadrangle, migrating sediment has been formed into rounded deposits of varying features, extending north-northeast from 42°13.2' N, 70°15.0' W to 42°15.8' N, 70°16.2' W. On the western flank of the bank, sand gradually becomes fine grained with increasing water depth. From the southern edge of the quadrangle northward, between 70°18' and 70°20' W, the seabed is composed of large sheets of fine-grained sand waves to the west intertonguing with and overlying coarse sand to the east. The western flank gives way at 70 to 75 m water depth to the smooth muddy floor of Stellwagen Basin. In several areas of the basin, the almost flat sea floor is interrupted by shallow irregular depressions that contain low mounds and that are similar to features observed in Quadrangles 7 and 8 (Valentine and others, 1999a). These features range up to several hundred meters in length (42°15.0' N, 70°22.0' W; 42°17.6' N, 70°20.9' W). Observations have shown the mounds, in some places, to be patches of gravel, including boulders, that are frequently by greenfish. Boulders and smaller gravel have been observed in the bottom of pits in the mud in which fish are present. The depressions are interpreted to have been formed by the scavenging actions of greenfish that have exposed the gravel habitat and prevented its burial by basin mud.

Two spurs extend northward from Stellwagen Bank into Stellwagen Basin. The southern spur is a rough-surfaced low boulder ridge, partly buried by muddy sand, and

a connected bank of low relief that extends into Quadrangle 4 Valentine and others, 2000). The northern spur and an adjacent small bank lie in water depths of 65 m and 70 m, respectively, and have a relief of 25 to 20 m. Their surfaces are dominantly sand and gravel, including boulders. The surface of this spur exhibits several irregular depressions that probably outline the former locations of large masses of melting glacial ice. Together, the spur and small bank extend northward into Stellwagen Basin and are aligned with three elongate banks located in Quadrangles 4 and 7 (Valentine and others, 2000, 1999a). The surfaces of the banks are sand and gravel, including boulder piles and ridges, with a thin veneer of mud. The internal composition of the banks and spur is unknown. Their elongate shape suggests formation by glacial processes, chiefly by erosion of surrounding low-resistant sediment and rock. The northern spur in this quadrangle resembles a bank that has partly emerged from Stellwagen Bank proper through erosion of the surrounding rock materials by glacial ice.

REFERENCES CITED

Valentine, P.C., Baker, J.L., Unger, T.S., and Roworth, E.T., 1997, Sea floor topography of Quadrangle 5 in the Stellwagen Bank National Marine Sanctuary of Boston, Massachusetts: U.S. Geological Survey Open-File Report 97-506, scale 1:25,000.
Valentine, P.C., Baker, J.L., Unger, T.S., and Palocz, C., 1998, Sea floor topographic map and perspective-view imagery of Quadrangles 1-18, Stellwagen Bank National Marine Sanctuary off Boston, Massachusetts: U.S. Geological Survey Open-File Report 98-138, 1 CD-ROM.
Valentine, P.C., Baker, J.L., and Unger, T.S., 1999a, Sun-illuminated sea floor topography of Quadrangle 7 in the Stellwagen Bank National Marine Sanctuary of Boston, Massachusetts: U.S. Geological Survey Geologic Investigations Series Map I-2707, scale 1:25,000.
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—, 2000, Sun-illuminated sea floor topography of Quadrangle 4 in the Stellwagen Bank National Marine Sanctuary of Boston, Massachusetts: U.S. Geological Survey Geologic Investigations Series Map I-2704, scale 1:25,000.



Location map showing the 18 quadrangles in this series. Quadrangle 5 shown in blue. Stellwagen Bank National Marine Sanctuary (SBNMS) boundary indicated by dashed line. Bathymetric contours in meters.

SUN-ILLUMINATED SEA FLOOR TOPOGRAPHY OF QUADRANGLE 5 IN THE STELLWAGEN BANK NATIONAL MARINE SANCTUARY OFF BOSTON, MASSACHUSETTS

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