

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 Commonwealth of Massachusetts and the Canadian Hydrographic Service. The mapping effort began with a series of 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 perspective relief) view at a scale of 1:250,000. The perspective view is a three-dimensional view of the sea floor using 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 exaggerated four times to illustrate the three-dimensional character of the sea floor, 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 they are oriented parallel to the perspective view. They are also the most prominent looking features and patterns that are oriented parallel or perpendicular to survey transects. For a depiction of the topographic contours alone, and an explanation of surveying methods and data collection, see Valentine and others (1997). Topographic contour maps of all 18 quadrangles in the map series are available on a CD-ROM in EPS, PGS, Arc export, and PDF file formats (Valentine and others, 1998).

Regional seabed features

The major topographic features depicted in the map series were formed by glacial processes. In broad terms, these features are categorized into glaciogenic features, non-glaciogenic features, and features that are continental rock debris mantled in the region, scabbling its surface and depositing sediment to form the large banks, banks, ridges, and valleys. Many other features observed here represent the latter stages of deglaciation. They are the result of post-glacial wave action and erosion. The area was covered by stationary ice, whether at the time or since, small valley glacial ice fields were active in and near areas of high topographic relief. The sea invaded the region formerly occupied by ice. The sea floor was partially modified and some new sedimentary deposits formed. Today the sea floor is modified mainly 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 eroded in 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 12 features

This quadrangle covers the deep part of the northeastern flank of Stellwagen Bank. The bank surface is uneven and displays a variety of sediment types and features, but the seabed features extend into this quadrangle from Quadrangle 9 to the south (Valentine and others, 2000a). Much of the quadrangle is characterized by subrecently scabbed and ridged land. Some shallow depressions in the sea floor, for example, at 42°31'N, 70°11'W, 12.7 m deep, may contain the former meltwater of large masses of melting glacial ice. The seabed in the quadrangle is gravelly, including boulder ridges and ridges of sand. Some of the sand is partially sorted and contains a discontinuous number of ovals. The sea floor in the northwest corner of the quadrangle exhibits a highly grooved surface. The grooves are approximately 5 m deep and 10 m apart and are oriented roughly east-northeast. They may be interpreted to have been formed by the peogressing action of glaciogenic currents during the late stages of the last glaciation in the north-central part of the quadrangle, the low, rounded, elongate banks resemble drumlinized ridges characteristic of glaciogenic currents. They are oriented roughly east-northeast. The sea floor in the northwest corner of the quadrangle is characterized by the presence of many of the hills prominently display elongate, sinuous boulder ridges that resemble eskers (sand and gravel deposited by meltwater within a stationary glacial ice). Numerous small depressions are present in the northwest corner of the quadrangle (42°31'N, 70°11'W). They appear to be lateral moraines (deposits of rock debris piled up at the edges of moving ice) caused by valley glaciers. The depressions are roughly circular and are bounded by low ridges. The depressions are separated by voids from which sand and small gravel presumably were eroded during advance of the sea after the glacial ice melted.

There are two deep depressions in the center of the quadrangle (42°31'N, 70°09'W). They are 20 to 35 m deep and are flooded with slightly muddy sand.

Mounds of glacial debris are present at the intersection of the valleys. The north-trending valley displays a low terrace edge (42°29'N, 70°10'W) that may represent a marine deposit at the northern terminus of a small valley glacier that

occupied the southern part of the valley. Two glaciated valleys dominate the northwest corner of the quadrangle. They have a depth of 31 to 35 m and are flooded with slightly muddy sand. The larger valley trends northwest, then bends to the southwest and constricts into a deep basin in Quadrangle 11 (Valentine and others, 2000a). The smaller valley trends northwest and is bounded to the west by the other, smaller valley from the north. The smaller valley is a hanging valley whose floor is shallow by approximately 5 m (42°32'N, 70°13.1'W). The floor of a shallow basin is flooded with slightly muddy sand. The sea floor in the northwest (42°32'N, 70°13.1'W) displays low gravel ridges whose distinctive meander-like pattern resembles that of glaciogenic drift (sediment deposited in large cracks in glacial ice). A somewhat similar pattern is present in the northwest corner of Quadrangle 11 (Valentine and others, 2000a) and in the adjacent Quadrangle 9 to the south (Valentine and others, 2000a). Two large sand features are present in Quadrangle 12. A large northeast trending sand bank is bounded to the west by a deep basin in Quadrangle 11 (Valentine and others, 2000a). The bank is bounded to the north by a northeast trending sand bank. The south. The bank is bounded to the northwest by northeast trending gullies and bedforms. A long, low sand bank, also trending northeast, lies along the western margin of a shallow valley. The sand bank is bounded to the west by a deep basin (42°31'N, 70°13.1'W). The valley separates elevated areas topped by boulder ridges (eskers), and its floor within the 11.5-meter depression low ridges that possibly are crevase fills.

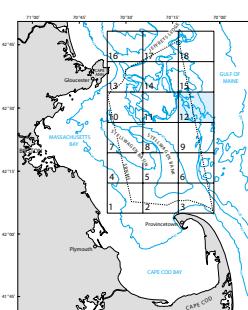
REFERENCES CITED

Valentine, P.C., Unger, T.S., Baker, J.L., and Roworth, A., 1997, Sea floor topography and perspective-view imagery of Quadrangle 1-18, Stellwagen Bank National Marine Sanctuary off Boston, Massachusetts, U.S. Geological Survey Open-File Report 97-485, scale 1:25,000.

Valentine, P.C., Baker, J.L., Unger, T.S., and Polson, C., 1998, Sea floor topographic map and perspective-view imagery of Quadrangle 1-18, Stellwagen Bank National Marine Sanctuary off Boston, Massachusetts, U.S. Geological Survey Open-File Report 98-485, scale 1:25,000.

Valentine, P.C., Baker, J.L., and Unger, T.S., 2000a, Sun-illuminated sea floor topography of Quadrangle 9 in the Stellwagen Bank National Marine Sanctuary off Boston, Massachusetts, U.S. Geological Survey Geologic Investigations Series Map I-2710, scale 1:25,000.

2000b, Sun-illuminated sea floor topography of Quadrangle 11 in the Stellwagen Bank National Marine Sanctuary off Boston, Massachusetts, U.S. Geological Survey Geologic Investigations Series Map I-2711, scale 1:25,000.



Location map outlining the 18 quadrangles in this series. Quadrangle 12 is 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 12 IN THE STELLWAGEN BANK NATIONAL MARINE SANCTUARY OFF BOSTON, MASSACHUSETTS

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