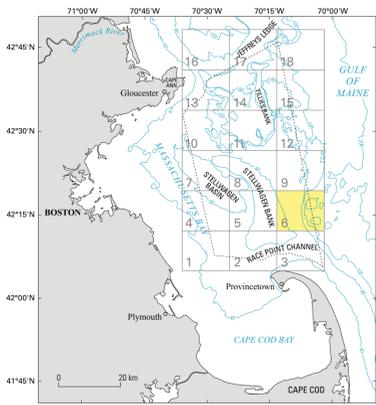
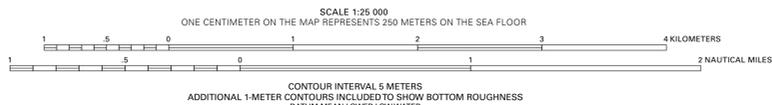


Mercator projection  
Geodetic Reference System 1980; North American Datum of 1983  
Longitude of central meridian 70°13' W; latitude of true scale 41°59' N  
False easting 0 m; false northing 0 m  
This map is not intended for navigational purposes.



Location Map.—Shows quadrangle 6 (highlighted in yellow). Stellwagen Bank National Marine Sanctuary boundary is shown as a dashed line. Bathymetric contours are labeled in meters.

**DESCRIPTION OF MAP UNITS**

[Grain-size composition of each map unit is given as mean weight percent for each grain-size category (table 5). Weight percent values may not add to 100 due to rounding. Texture characteristics for substrates B, D1, D2, and F represent the partial sediment veneer overlying gravel. Substrate unit names (tables 6, 7) describe sediment grain-size composition, surficial morphology, sediment layering, and the mobility or immobility of their surfaces. See Conversion Factors for grain-size classification of sediment grades (Wentworth, 1922) and composite sediment grades of this study. Sand is divided into two composite grades: fine-grained sand (fgs; 0.062 to <math>0.25\text{ mm}</math>) and coarse-grained sand (cgs; 0.25 to <math><2\text{ mm}</math>). Gravel is also divided into two composite grades: Gravel (G; 2 to <math>8\text{ mm}</math>) and Gravel (G<sub>2</sub>; 8 to <math>64\text{ mm}</math>). Abbreviations: r, rippled; i, immobile; m, muddy (>10 weight percent mud); fgs, fine-grained sand; cgs, coarse-grained sand; G, Gravel; G<sub>2</sub>, Gravel; p, pebble; c, cobble; b, boulder. The notation "i\_cgs/pcbG" means "immobile, coarse-grained sand, partial veneer on pebble, cobble, boulder gravel." See Mapping Methods for further explanation.]

- A1\_r\_cgs** Rippled, coarse-grained sand—Substrate A1 is a mobile sand deposit on the upper flank of Stellwagen Bank. Depth range is 30 to 56 m. Mean weight percents per grain-size category: mud, <1; sand, 90 (fgs, 3; cgs, 88); gravel 9 (G, 8; G<sub>2</sub>, 1). Substrate A1 is equivalent to the mobile portion of adjacent substrate B, and is similar to adjacent immobile substrate A2 which lies at deeper depths (53–77 m) on the lower flank of Stellwagen Bank and contains more fine-grained sand (11 weight percent).
- A2\_i\_cgs** Immobile, coarse-grained sand—Substrate A2 is an immobile sand deposit on the lower flank of Stellwagen Bank. Depth range is 53 to 77 m. Mean weight percents per grain-size category: mud, 1; sand, 83 (fgs, 11; cgs, 72); gravel, 16 (G, 11; G<sub>2</sub>, 5). Substrate A2 is similar to adjacent mobile substrate A1 which lies at shallower depths (30–56 m) and contains less fine-grained sand (3 weight percent). It contains less mud and fine-grained sand than substrate E.
- B\_r\_cgs/pcbG** Rippled, coarse-grained sand; partial veneer on immobile, cobble, boulder gravel—Substrate B is a layered substrate of mobile sand overlying immobile gravel on the shallow flank of Stellwagen Bank. Depth range is 36 to 58 m.

Mean weight percents per grain-size category: mud, <1; sand, 92 (fgs, 5; cgs, 86); gravel, 8 (G, 7; G<sub>2</sub>, 1). Cobbles and boulders are identified on the basis of video and photographic imagery. Boulder ridges (substrate C) are present. The mobile sand layer of substrate B is equivalent to adjacent mobile substrate A1.

- C\_i\_cbG** Immobile, cobble, boulder gravel—Substrate C is immobile gravel that forms topographic ridges where cobbles and boulders are piled upon one another and are separated by voids. It is identified on the basis of video and photographic images of mapped topographic ridges. It is present on the flank of Stellwagen Bank where it is associated with substrate B (36–58 m) and substrate D1 (50–83 m), and on the tops of North, East, and Middle Ninety Banks where it is associated with substrate D2 (87–105 m). Equivalent to boulder ridges <math><1\text{ m}</math> and <math>\geq 1\text{ m}</math> on Maps A, E, F, and G.
- D1\_i\_cgs/pcbG** Immobile, coarse-grained sand; partial veneer on pebble, cobble, boulder gravel—Substrate D1 is a layered substrate of immobile sand overlying immobile gravel on the flank of Stellwagen Bank. Depth range is 50 to 83 m. Mean weight percents per grain-size category: mud, 4; sand, 50 (fgs, 16; cgs, 34); gravel, 45 (G, 11; G<sub>2</sub>, 34). Pebbles, cobbles, and boulders are identified on the basis of video and photographic imagery. Boulder ridges (substrate C) are present. Substrate D1 is similar to substrate D2 which lies at deeper depths (87–105 m) on the tops of North, East, and Middle Ninety Banks and has higher mud content (12 weight percent).
- D2\_i\_mcgS/pcbG** Immobile, muddy, coarse-grained sand; partial veneer on pebble, cobble, boulder gravel—Substrate D2 is a layered substrate of immobile muddy sand overlying immobile gravel on the tops of North, East, and Middle Ninety Banks. Depth range is 87 to 105 m. Mean weight percents per grain-size category: mud, 12; sand, 76 (fgs, 22; cgs, 55); gravel, 12 (G, 8; G<sub>2</sub>, 4). Pebbles, cobbles, and boulders are identified on the basis of video and photographic imagery. Boulder ridges (substrate C) are present. Substrate D2 is similar to substrate D1 which lies at shallower depths (50–83 m) on the flank of Stellwagen Bank and has lower mud content (4 weight percent).

- E\_i\_cgs** Immobile, coarse-grained sand—Substrate E is an immobile sand deposit on the lower flank of Stellwagen Bank. Depth range is 66 to 122 m. Mean weight percents per grain-size category: mud, 4; sand, 82 (fgs, 18; cgs, 64); gravel, 14 (G, 9; G<sub>2</sub>, 5). Boulder ridges are absent. Substrate E is similar in mud content to substrate D1 and contains more mud and fine-grained sand than substrate A2.
- F\_i\_cgs/pcbG** Immobile, coarse-grained sand; partial veneer on pebble, cobble, boulder gravel—Substrate F is a layered substrate of immobile sand overlying immobile gravel on the flanks of the Ninety Meter Banks. Depth range is 90 to 148 m. Mean weight percents per grain-size category: mud, 9; sand, 69 (fgs, 25; cgs, 44); gravel, 22 (G, 13; G<sub>2</sub>, 9). Pebbles, cobbles, and boulders are identified on the basis of video and photographic imagery. Boulder ridges are absent. Substrate F is similar to substrates D1 and D2, except that F lies at deeper depths, and the partial veneer of coarse grained sand on the gravel is more extensive.
- G1\_i\_mfgS** Immobile, muddy, fine-grained sand—Substrate G1 is an immobile muddy sand deposit in valleys between Stellwagen Bank and the Ninety Meter Banks. Depth range is 85 to 171 m. Mean weight percents per grain-size category: mud, 10; sand, 88 (fgs, 78; cgs, 10); gravel, 1 (G, 1; G<sub>2</sub>, 1). Substrate G1 is similar to substrate G2 which lies at deeper depths (125–185 m) and has higher 4 phi sand (58 weight percent) and higher mud content (23 weight percent).
- G2\_i\_mfgS** Immobile, muddy, fine-grained sand—Substrate G2 is an immobile muddy sand deposit in deep parts of valleys lying between the Ninety Meter Banks. Depth range is 125 to 185 m. Mean weight percents per grain-size category: mud, 23; sand, 77 (fgs, 77; cgs, 1); gravel, 0. Substrate G2 has the highest mud content of all substrates in quadrangle 6.

**EXPLANATION OF MAP SYMBOLS**  
[Symbols are combined at stations where more than one kind of data were collected. See table 4 for a list of station numbers.]

- × Station with seabed photography
- Station with seabed video imagery
- Station with sediment grain-size analysis
- ▲ Station where sediment sample could not be collected

**Sheet 3.—Seabed geology and station data types**  
**Map D.—Distribution of Geologic Substrates**

Seabed Maps Showing Topography, Ruggedness, Backscatter Intensity, Sediment Mobility, and the Distribution of Geologic Substrates in Quadrangle 6 of the Stellwagen Bank National Marine Sanctuary Region Offshore of Boston, Massachusetts

By  
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2015

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