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Habitat Mapping of the Gulf of Maine

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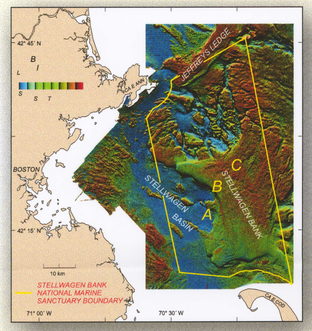
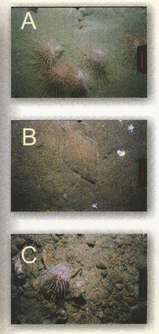
INTRODUCTION

Off the Atlantic coast of North America, Canada and the United States share jurisdiction of the Gulf of Maine. This "sea within a sea" measures almost 91,000 square kilometres in size and has an average depth of 150 metres. The gulf exhibits a complex bathymetry of banks, basins, channels and ridges which reflect its geological history. The Geological Survey of Canada and the US Geological Survey have a long-standing legacy of marine geological studies in the gulf. Over the past five years, an integration of geoscience and marine biological information has lead to a greater understanding of the diversity of benthic and pelagic habitats. This poster highlights aspects of the habitat mapping research of the two national geoscience agencies.

STELLWAGEN BANK



Photographs of typical sea floor habitats



A. Muddy sea floor on the eastern edge of Stellwagen Basin at 79 m water depth showing ceriantheid burrowing anemones, shrimp, and fish or crab burrows. Low energy environment and low deposition as there are no sources of mud on the adjacent bank or on the land. Only deposition is from settlement of mud

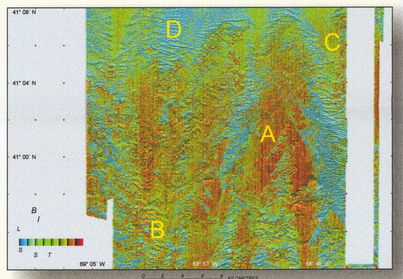
B. Coarse sand on the western edge of Stellwagen Bank at 37 metres showing flounder. High energy environment affected by storm wave currents. Sand is transported from the east and onto the

C. Pebbles and cobbles in sand on the northeastern margin of Stellwagen Bank at 58 m showing a ceriantheid burrowing anemone. High energy environment; storm wave currents expose gravel by transporting sand to the west.

Source: U.S. Geological Survey Fact Sheet 078-98

Stellwagen Bank is a nearshore fishing ground that exhibits a variety of sedimentary environments and biologic habitats. Transitions between sediment types and energy levels often are very sharp. Topographic features were formed, for the most part, by glacial processes. Ice, containing rock debris, moved across the region, sculpting the surface and depositing sediment to form basins, banks and other features. Many of the smaller features formed during a final period of ice stagnation and melting. Today, the sea floor on the banks is modified by strong storm-generated currents and waves from the northeast that erode sand and transport it into basins.

GREAT SOUTH CHANNEL



Sedimentary environments

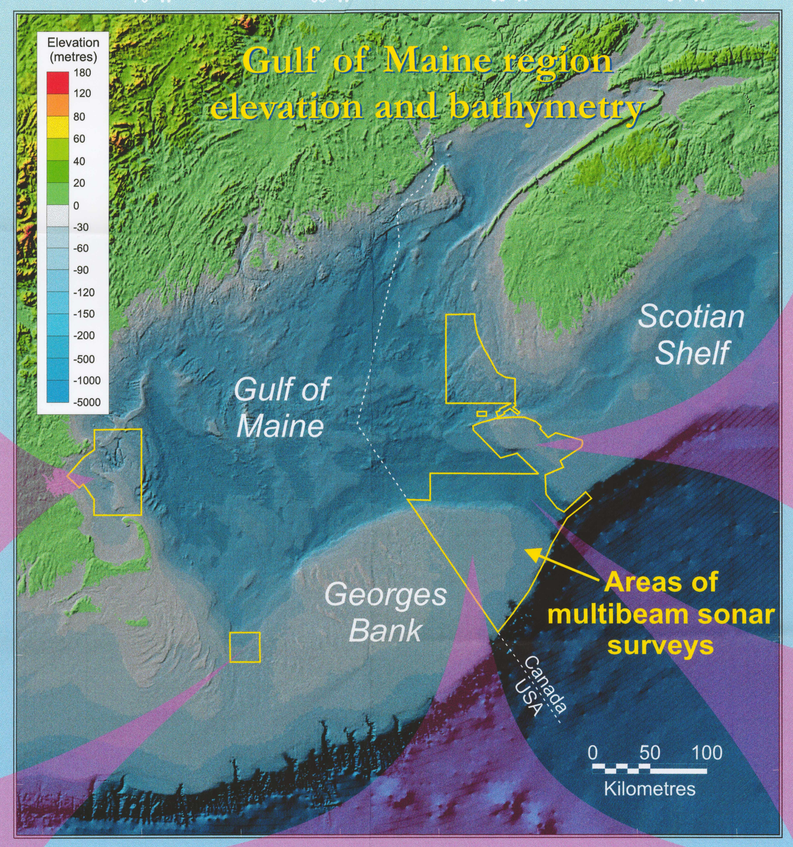
Unit A Hard bottom, high backscatter. Seabed smooth to hummocky. Bottom types are:
a. Gravel pavement; pebbles, some sand visible.

Unit B Hard bottom, moderate-high backscatter. Hummocky gravel, sand dunes. Bottom types are:
a. Gravel pavement, sand veneer; in dune troughs.

Unit C Moderately hard bottom and moderate backscatter. Relatively smooth. Bottom types are:
a. Fine to medium sand; burrows; no ripples.

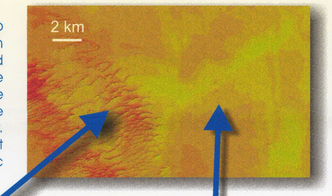
Unit D Soft bottom, low backscatter. Small ripples to large sand dunes (10 m), oriented E-W.

Great South Channel separates Georges Bank from Nantucket Shoals and facilitates the exchange of water between the Gulf of Maine and the Atlantic Ocean. It is an important fishing ground for scallops and groundfish. Glacial ice moved southward and sculpted the region into a broad shallow depression (80 m water depth) and deposited sediment to form low gravel mounds and ridges. Modern strong tidal and storm-generated currents flow north and south through the channel. Transport of sand by these currents has constructed large east-west-trending dunes and ridges that range up to 10 m in height. The symmetry of the dunes suggests their positions



GEORGES BANK

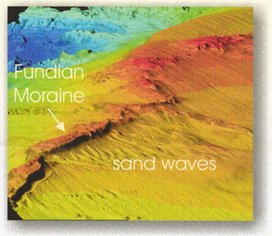
Georges Bank, like all the banks of the Gulf of Maine, was subject to Wisconsinan glaciation. During this time, glaciers deposited sediment on the banks. Following glaciation, a low stand of relative sea level occurred at about 14,000 years ago, subaerially exposing large areas of the continental shelf. The glacial sediments were reworked by the subsequent sea-level transgression and by modern currents. The resulting sediment distribution is the primary control on benthic habitat. Additional factors are water depth, sea floor geomorphology, habitat complexity and relative current strength. The multibeam bathymetric image at right illustrates a portion of Georges Bank.



Two major types of surficial sediment have been identified on Georges Bank. Sand (right) dominates on the shallowest part of the bank and comprises sand sheets and sand wave fields oriented perpendicular to the predominant semidiurnal tidal flow. Gravel (far right) dominates the remainder of the bank.

BROWNS BANK

Browns Bank is covered with a complex distribution of surficial sediments resulting from glacial deposition and subsequent reworking. The image at right is a perspective view of the bathymetry of northern Browns Bank looking from west to east. Shown on this image are geological features inherited from glaciation, including the 5 m-high terminal Fundian Moraine. Extensive areas of sand waves (see image at right) are almost barren of epifauna, contrasting with gravel lag (see image below) which hosts an abundance of species.



The shallow waters of Browns, German and Georges Banks are important spawning areas for many commercial fish species, including the giant scallop, *Placopecten magellanicus*, illustrated in the seafloor photograph at left. Scallops are strongly associated with gravel lag deposits, which are readily distinguishable from sand-covered terrain through the interpretation of multibeam backscatter data. A highly significant correlation exists between scallop catch rates and backscatter intensity. This relationship can be used for the prediction of scallop stock

NORTHEAST CHANNEL

Northeast Channel is the principal hydrodynamic connection between the shelf edge and an energetic tidal system within the Gulf of Maine and Bay of Fundy. In contrast with the surrounding shallow banks, water depths in the channel reach almost 300 m. These depths, combined with strong tidal currents, affect benthic communities. Recently-discovered deep-sea horny coral (right) attaches to cobbles and boulders and thrives in parts of Northeast Channel where currents carry an

During glacial and deglacial time, the sea floor of Northeast Channel was extensively scoured by the keels of icebergs. Under the influence of strong tidal and storm-generated currents, fine-grained sediment has been winnowed from the coarse sediment of these relict iceberg furrows (on multibeam bathymetric image at left), leaving a gravel pavement with cobbles and boulders over much of the channel sea floor. This pavement hosts abundant populations of demersal fish, brittle stars and deep-sea coral.

Thanks to Tammie Middleton, US Geological Survey, and Gary Grant and Ken Hale, Geological Survey of Canada (Atlantic), Electronic Publishing for assistance with assembling components of this poster.

The bathymetric map of the Gulf of Maine was displayed by the GSC in a Universal Transverse Mercator projection (Zone 19) at a scale of 1:2 000 000. The vertical exaggeration is 10X. The digital data were compiled by Ed Roworth and Rich Signell of the USGS at a horizontal resolution of 15 arc seconds (~500 m grid cell size). For compilation details, see http://oracle.er.usgs.gov/gomainer/.

Copies of this poster may be obtained from the Geological Survey of Canada (Atlantic), Bedford Institute of Oceanography, P.O. Box 1006, Dartmouth, Nova Scotia, Canada B2Y 4A2. Phone: (902) 426-3410. Fax: (902) 426-4465. E-mail: openfile@agc.bio.ns.ca. Web: http://agc.bio.ns.ca.

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