GOMMI
Gulf of Maine Mapping Initiative

Gulf of Maine Council on the Marine Environment

Mapping of the Gulf of Maine sea floor is one of the essential first steps for achieving effective management of the region's marine environments.

New ways to map the seabed – New visualization and mapping methods that include multibeam sonar and laser scanning technologies greatly advance the ability of researchers to map and describe seabed habitats to resource managers as well as to the interested public. Recent advances in the integration of geophysical and biological data have improved our capacity to understand the diversity and distribution of sea floor habitats. Resource managers are in need of such state-of-the-art mapping products to facilitate their decision-making. Progress toward this goal will be slow without the seabed imagery that new mapping technologies (primarily multibeam sonar) can provide.

What is multibeam mapping, and why is it an effective and efficient technology? – Multibeam sonar mapping systems are computerized hull-mounted units that aim as many as 120 narrow beams of sound at the seabed, 60 to each side of a survey vessel, with each beam striking only a small area of the sea bottom (Fig. 1). Combined, they map a swath of sea floor that extends laterally outward from the vessel's path. Generally, the width of the swath is five times the water depth. In 100 m of water, a ribbon of seabed one-half kilometer wide is imaged in one pass of the vessel, thus making this an efficient method for surveying large areas rapidly.

Two kinds of digital image maps are produced and can be combined: (1) Shaded-relief topographic maps show sea floor features in great detail, and (2) backscatter maps show the reflectivity of the seabed materials. Strong sound reflections indicate the presence of hard seabed (gravel, coarse sand, bedrock) and weak reflections indicate soft seabed (mud, fine sand). The horizontal resolution of features is 5 to 10 percent of the water depth, and the vertical resolution is on the order of 10s of centimeters; both depend on the frequency of the mapping system's sound beams and the speed of the survey vessel. For example, multibeam images will show a patch of boulders on the seabed but generally not an individual boulder. The level of detail provided by this technology is appropriate for most research and management applications.

The multibeam mapping method can rapidly and effectively produce highly-detailed seabed images that are geo-referenced and ready for use in geographic information systems (GIS).

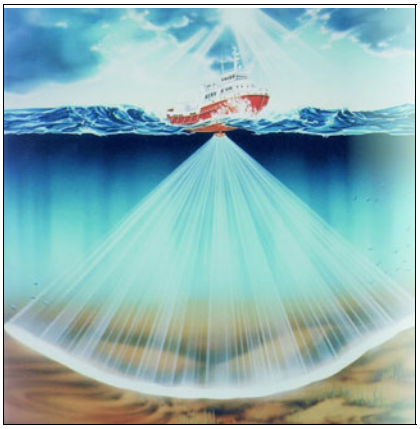

Figure 1. Vessel with multibeam sonar array maps a swath of seabed (courtesy of Simrad).

Why do we need it? – As coastal populations increase in size, the uses of the sea floor become more diverse and intensive. Major activities in coastal and marine environments requiring knowledge of sea floor characteristics for their successful management include: (1) commercial and recreational fishing, (2) sanctuaries and marine protected areas, (3) burial of fibre optic and electric power cables as well as oil and gas pipelines, (4) mining of sand, gravel and other minerals, (5) prospecting for biopharmaceutical compounds, (6) disposal of dredged materials from harbors, (7) ecotourism such as whale watching, (8) navigation and the transport of goods, (9) aquaculture, (10) generation of renewable energy from winds and tides and (11) military operations. In addition, nearshore activities such as tourism, dock and pier construction and sewage disposal are particular concerns for local communities and coastal zone managers. Experience proves that good management of similar activities on land requires the use of adequate maps.

Have parts of the Gulf of Maine already been surveyed using multibeam technology? – The Gulf of Maine region includes a part of the southern New England Shelf, Georges Bank, Northeast Channel, Browns Bank, German Bank, and the many smaller banks and deep basins that extend westward to the coasts of New England, New Brunswick, and Nova Scotia. This is an area of approximately 168,000 km^2, and is equivalent in size to Massachusetts, Maine, New Hampshire and Vermont combined.

Since 1994, several multibeam surveys in the Gulf of Maine have demonstrated the usefulness of this approach to sea floor mapping (Fig. 2). In United States waters, the United States Geological Survey (USGS) and the National Oceanic and Atmospheric Administration (NOAA) have jointly mapped the Stellwagen Bank National Marine Sanctuary off Boston, Massachusetts and part of the Great South Channel southeast of Cape Cod. In Canadian waters, the Geological Survey of Canada (GSC), in cooperation with private industry, has conducted extensive surveys of areas off the Nova Scotian coast including Georges, German and Browns

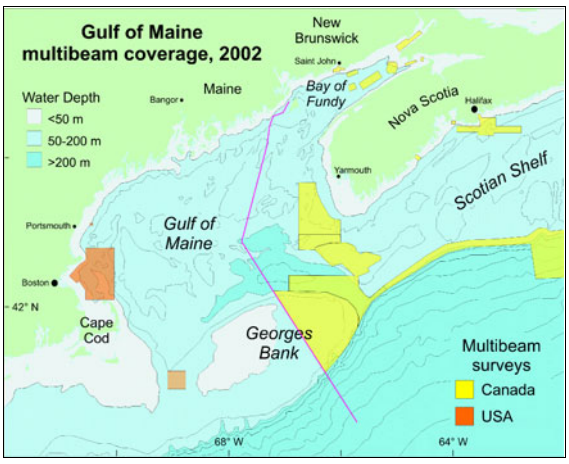

Figure 2. Location map showing multibeam mapping completed in the Gulf of Maine.

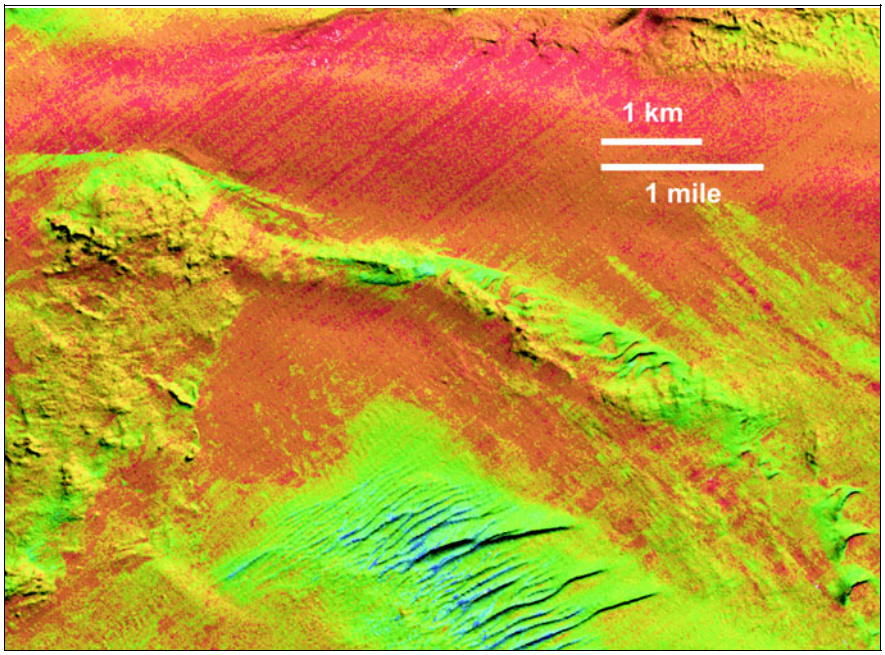

Figure 3. Multibeam image from Browns Bank showing sun-illuminated topography and backscatter strength. Blue and green represent soft sediments (mud and sand), red represents hard seabed (gravel and bedrock). Large sand dunes are present in the lower center of the image.

Banks, Northeast Channel and parts of the Scotian Shelf. All US and Canadian mapped areas combined make up approximately fifteen percent of the entire Gulf of Maine region.

A new view of the sea floor – In only a few years, multibeam technology has advanced the knowledge of seabed character from that of traditional nautical charts that show depth soundings and a few symbols describing bottom types to modern digital images that show (1) topographic features in great detail, as well as (2) an approximation of the variety of materials that make up the seabed, and (3) an indication of natural processes that shape marine environments (Fig. 3). Multibeam surveys completed to date have revealed the enormous complexity of the sea floor in a wide range of Gulf of Maine environments.

What is ground-truthing? – Even though multibeam images provide highly detailed information about the nature of the seabed, there still is a need to follow up these surveys with sampling of the bottom in order to make interpretive maps. Gathering the data on the distribution of bottom sediments, biological habitats, fauna and flora, and seabed processes, and relating this information to multibeam imagery is called ground-truthing. These data are collected through video and photo surveys, analysis of seabed sediments and biota, and studies that are designed to understand seabed processes. Other kinds of acoustical and optical equipment may also be used to provide ground-truth data.

Who benefits from high-resolution mapping of the sea floor? – The general public, as well as a wide range of institutions including private industry, federal and local management agencies, and the research community will benefit from images, maps and reports produced by mapping surveys. To date, even the limited multibeam mapping in the Gulf of Maine region has provided valuable information for fishing industries and fisheries managers, for sanctuary managers, for planning offshore materials disposal, for planning of sea floor routes for fiber optic and energy cables, and for scientists conducting research on seabed environments and essential fish habitats. Multibeam imagery will be the basis for developing a much-needed habitat classification system for the Gulf of Maine.

How will mapping of the Gulf of Maine be accomplished?– Recent experience with multibeam surveys in the Gulf of Maine has demonstrated the ability of digital mapping technology to provide excellent resolution of seabed characteristics. Ground-truthing methods have been improved and digital maps have been published on paper and on CD-ROM. There are no technological impediments to the accomplishment of the project.

The Gulf of Maine Mapping Initiative (GOMMI) will require a collaborative effort by US and Canadian interests, the acquisition of imagery by using contract and federal vessels and multibeam systems, and the production of topographic and backscatter maps by federal agencies and academic institutions. All data collection and products will conform to specific protocols and standards that are to be determined, and all data and products will be in the public domain.

How long will it take?– *GOMMI* is a multi year project. The GOMMI funding strategy is presently being considered. The time required to accomplish the survey of the Gulf of Maine depends on the number of vessels operating at one time and the water depths of survey areas. The project can be divided into two phases. Phase 1 will image the seabed and produce maps showing topography and backscatter. Deep areas can be surveyed more rapidly than shallow areas because a single mapping swath is wider in deeper water. Shallow coastal areas will be mapped by multibeam and aerial mapping surveys. It is anticipated that the Gulf will be mapped by sub-regions, and that topographic and backscatter image maps will begin to appear within six months of the start of the project. Phase 2 will focus on producing interpretive habitat maps of the seabed and will require extensive ground-truthing. This phase will be conducted in collaboration with scientists from government agencies and scientists and students from academic institutions.

GOMMI has been endorsed by the Gulf of Maine Council for the Marine Environment (GOMC).

The GOMC is a binational organization comprised of U.S. and Canadian federal, state and provincial environmental agencies and private sector representatives. It was established in 1989 by the Governors and Premiers of Nova Scotia, New Brunswick, Maine, New Hampshire and Massachusetts to foster cooperative actions within the Gulf of Maine and its watershed. The GOMC's mission is to maintain and enhance environmental quality in the Gulf of Maine and to allow for sustainable resources use by existing and future generations.

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