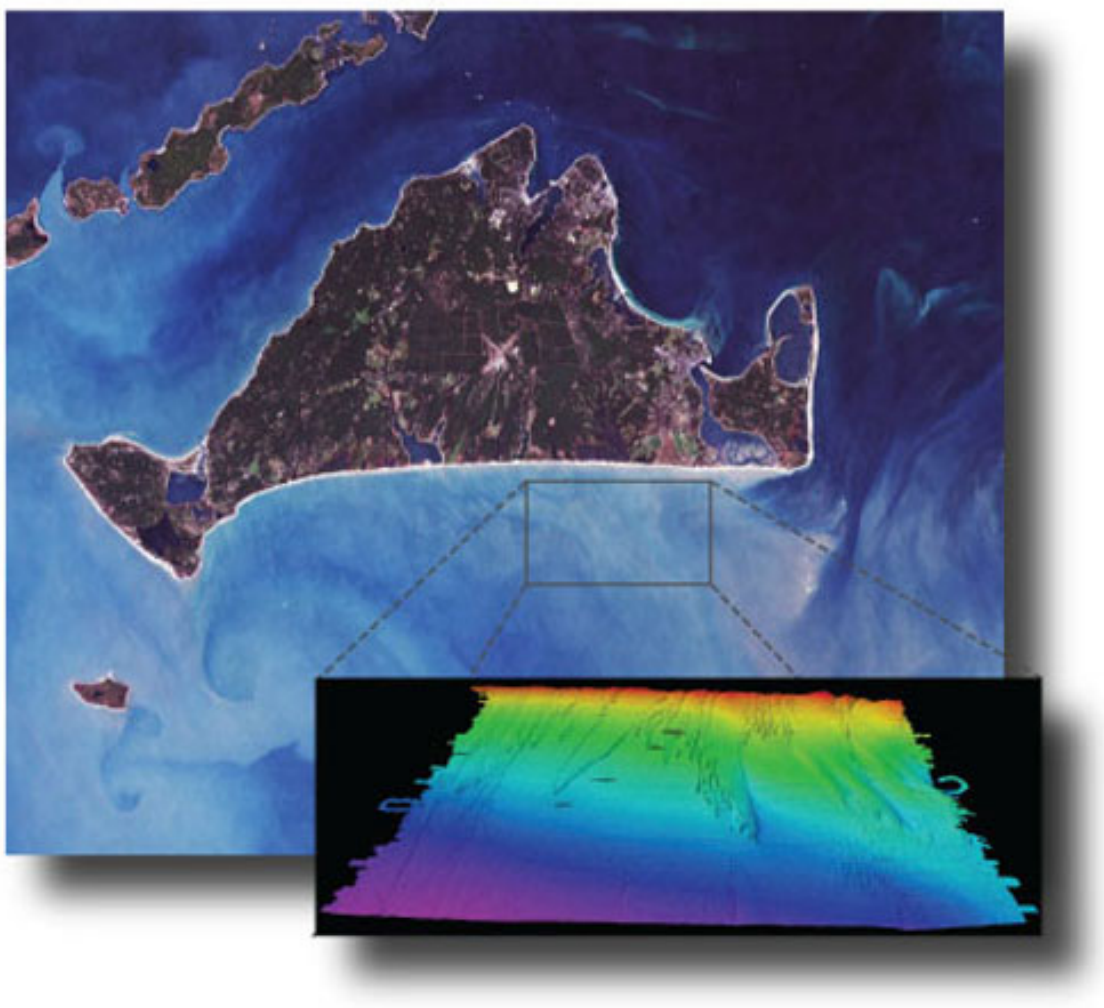
U.S. Geological Survey Open-File Report 2008-1288

Prepared in cooperation with the Office of Naval Research (ONR)

Geophysical Data Collected off the South Shore of Martha's Vineyard, Massachusetts

By J.F. Denny, W.W. Danforth, D.S. Foster, and C.R. Sherwood



Landsat 7 image of Martha's Vineyard and color shaded-relief image of swath bathymetry collected by the U.S. Geological Survey, August 9-13, 2007.

U.S. Department of the Interior
KEN SALAZAR, Secretary

U.S. Geological Survey
Marcia K. McNutt, Director

U.S. Geological Survey, Reston, Virginia: 2009

For product and ordering information:
World Wide Web: http://www.usgs.gov/pubprod
Telephone: 1-888-ASK-USGS

For more information on the USGS—the Federal source for science about the Earth, its natural and living resources, natural hazards, and the environment:
World Wide Web: http://www.usgs.gov
Telephone: 1-888-ASK-USGS

Suggested citation:
Denny, J.F., Danforth, W.W., Foster, D.S., and Sherwood, C.R., 2009, Geophysical data collected off the south shore of Martha's Vineyard, Massachusetts: U.S. Geological Survey Open-File Report 2008-1288, (Also available at http://pubs.usgs.gov/of/2008/1288/.)

U.S. Geological Survey Open-File Report 2008-1288

Geophysical Data Collected off the South Shore of Martha's Vineyard, Massachusetts

---

Contents

U.S. Geological Survey Open-File Report 2008-1288

Geophysical Data Collected off the South Shore of Martha's Vineyard, Massachusetts

List of Figures

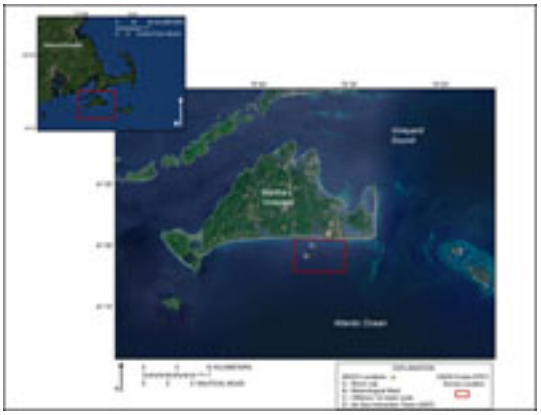


Figure 1. Location map showing the USGS Cruise 07011 survey bounds and the Woods Hole Oceanographic Institute (WHOI) Martha's Vineyard Coastal Observatory (MVCO) locations. Environmental Systems Research Institute (ESRI) USA Prime Imagery is used as background image (I-cubed, 2009). *Click on figure for larger image*.

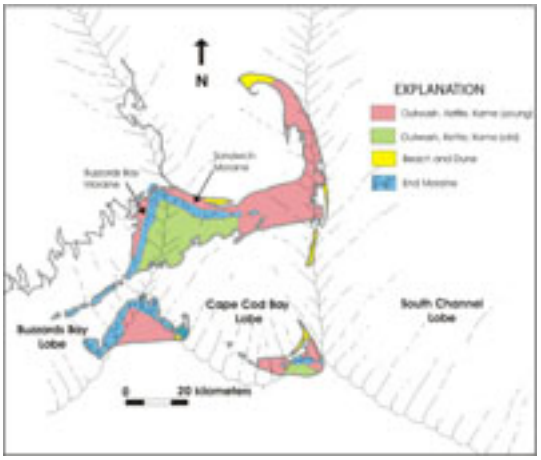


Figure 2. Geologic map of Cape Cod and the Islands, superimposed with maximum extent of ice lobes (after Oldale, 1992). *Click on figure for larger image*.

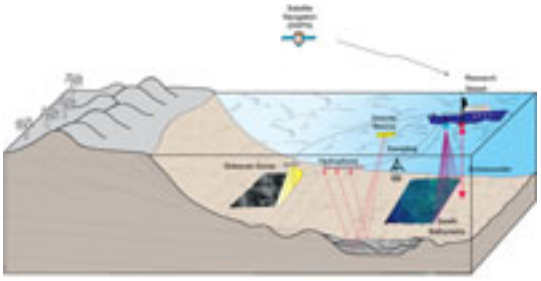


Figure 3. Illustration of the geophysical systems used to characterize the seafloor during USGS Cruise 07011. Sidescan-sonar, swath bathymetric, and seismic-reflection systems were used to define the surficial sediment distribution, depth, and underlying geology. Sampling systems were used to collect direct samples of the seafloor sediment. A Differential Global Positioning System (DGPS) was used to navigate the sidescan-sonar and swath bathymetric systems, while a Global Positioning System (GPS) was used to navigate the seismic-reflection system. *Click on figure for larger image*.

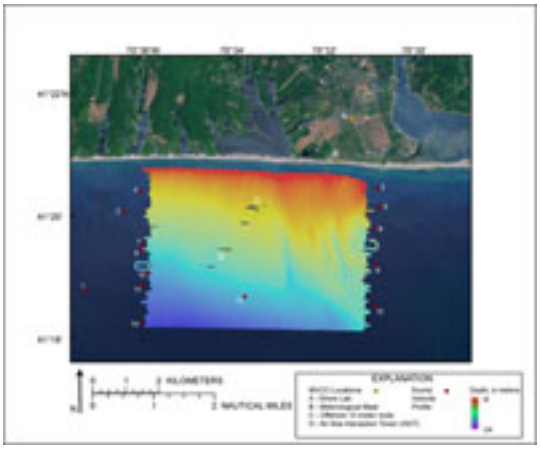


Figure 4. Color shaded-relief image of bathymetric data collected by the USGS during Cruise 07011. Depth is in meters and ranges from approximately 6 to 24 meters water depth. No data were collected in the gray regions, where moored instruments and structures were located. The locations of Martha's Vineyard Coastal Observatory (MVCO) (yellow dots) and sound velocity profiles (red dots) collected during USGS Cruise 07011 are also displayed. Environmental Systems Research Institute (ESRI) USA Prime Imagery is used as background image. *Click on figure for larger image*.

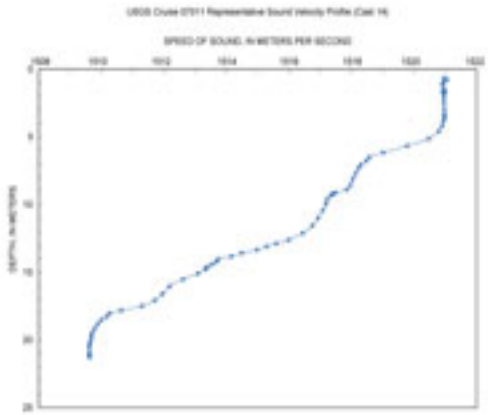


Figure 5. Representative sound velocity profile (SVP) displaying the speed of sound in the water column, in meters per second, versus water depth, in meters. These data were collected at SVP location 14 during USGS Cruise 07011. The data reveal the characteristic negative gradient, with presumably warmer surface waters overlying relatively cooler sub-surface waters. *Click on figure for larger image*.

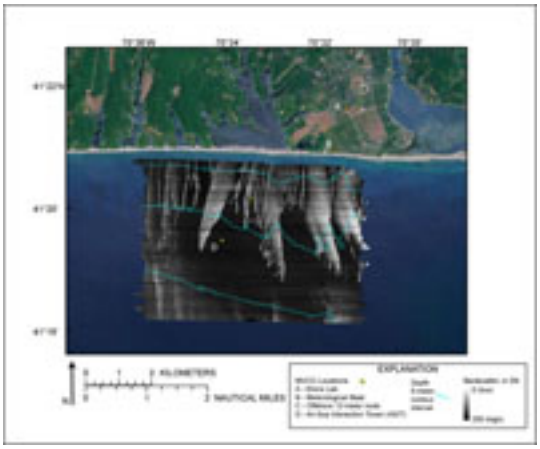


Figure 6. Sidescan-sonar mosaic collected by the USGS during Cruise 07011. Sidescan-sonar backscatter values (relative strength of return) are displayed as digital numbers (DN), on a relative scale, high backscatter is represented by light tones within the image and low backscatter is represented by dark tones. The locations of Martha's Vineyard Coastal Observatory (MVCO) (yellow dots) and 5-meter bathymetric contours are also displayed. Environmental Systems Research Institute (ESRI) USA Prime Imagery is used as background image. *Click on figure for larger image*.

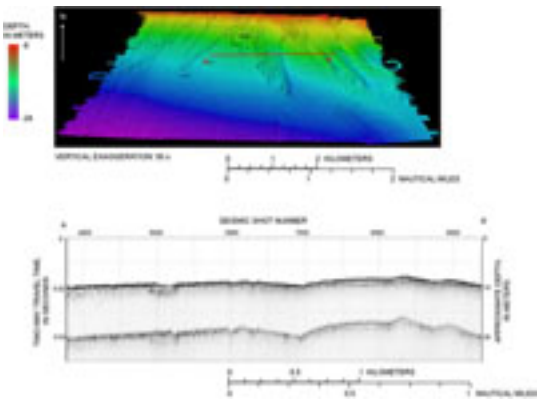


Figure 7. TOP: North-looking oblique view of color shaded-relief image of swath bathymetric data collected during USGS Cruise 07011. Depth is displayed in meters and ranges from approximately 6 to 24 meters water depth. Vertical exaggeration is 50 times. Sun illumination is from the northeast. Location of seismic-reflection line is displayed. BOTTOM: seismic-reflection data collected during USGS Cruise 07011. See top image for location. Depth is displayed as two-way travel time. Approximate depth is displayed in meters and assumes a speed of sound of 1,500 meters per second. Seismic shot number is indicated along the top of the profile. Several features are visible within the seismic image. At shot 5000, a sub-surface channel is visible within the seismic record, and reflections from shots 7000 to 9000 reveal an unconformity underlying low-relief bedforms. The bedforms are visible within the swath bathymetric image. *Click on figure for larger image*.

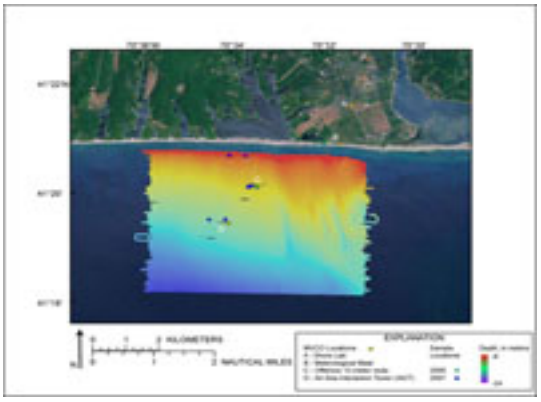


Figure 8. Color shaded-relief image of swath bathymetric data collected by the USGS during Cruise 07011. Depth is in meters and ranges from approximately 6 to 24 meters water depth. No data were collected in the gray regions, where moored instruments and structures were located. The locations of Martha's Vineyard Coastal Observatory (MVCO) (yellow dots) and beach and seafloor sediment samples collected in 2005 (green dots) and 2007 (blue dots) are also displayed. Environmental Systems Research Institute (ESRI) USA Prime Imagery is used as background image. *Click on figure for larger image*.

U.S. Geological Survey Open-File Report 2008-1288

Geophysical Data Collected off the South Shore of Martha's Vineyard, Massachusetts

Conversion Factors and Datum

SI to Inch/Pound

Multiply	By	To obtain
Length		
centimeter (cm)	0.3937	inch (in.)
meter (m)	3.281	foot (ft)
kilometer (km)	0.6214	mile (mi)
kilometer (km)	0.5400	mile, nautical (nmi)
meter (m)	1.094	yard (yd)
Area		
square kilometer (km^2)	247.1	acre
square meter (m^2)	10.76	square foot (ft^2)

Vertical coordinate information is referenced to local datum at the Woods Hole Oceanographic Institution (WHOI) Martha's Vineyard Coastal Observatory (MVCO).

Horizontal coordinate information is referenced to the World Geodetic System 1984 (WGS 84).

U.S. Geological Survey Open-File Report 2008-1288

Geophysical Data Collected off the South Shore of Martha's Vineyard, Massachusetts

Acronyms and Abbreviations

ASCII	American Standard Code for Information Interchange
B.P.	before present
CSV	Comma Separated Value
DGPS	Differential Global Positioning System
DN	digital number
DRI	Directed-Research Initiative
DTM	Digital Terrain Model
ESRI	Environmental Systems Research Institute
GeoTIFF	Georeferenced Tagged Image Format File
GIS	Geographic Information System
GPS	Global Positioning System
JPEG	Joint Photographic Experts Group
JSF	EdgeTech native format
MRU	Motion Reference Unit
MVCO	Martha's Vineyard Coastal Observatory
NGDC	National Geophysical Data Center

NOAA	National Oceanic and Atmospheric Administration
OASIS	Optics Acoustics and Stress In Situ
ONR	Office of Naval Research
PDF	Portable Document Format
RTK	Real-Time Kinematic
R/V	Research Vessel
SVP	Sound Velocity Profile
tfw	Environmental Systems Research Institute (ESRI) world files
TIFF	Tagged Image Format File
USGS	U.S. Geological Survey
UTM	Universal Transverse Mercator
WGS84	World Geodetic System 1984
WHOI	Woods Hole Oceanographic Institution
WHSC	Woods Hole Science Center
XTF	eXtended Triton Format

U.S. Geological Survey Open-File Report 2008-1288

Geophysical Data Collected off the South Shore of Martha's Vineyard, Massachusetts

By J.F. Denny, W.W. Danforth, D.S. Foster, and C.R. Sherwood

Abstract

The U.S. Geological Survey Woods Hole Science Center conducted a nearshore geophysical survey offshore of the southern coast of Martha's Vineyard, in the vicinity of the Martha's Vineyard Coastal Observatory in 2007. This mapping program was part of a larger research effort supporting the Office of Naval Research Ripples Directed-Research Initiative studies at Martha's Vineyard Coastal Observatory designed to improve our understanding of coastal sediment-transport processes. The survey was conducted aboard the Megan T. Miller August 9-13, 2007. The study area covers 35 square kilometers from about 0.2 kilometers to 5 kilometers offshore of the south shore of Martha's Vineyard, and ranges in depth from ~6 to 24 meters. The geophysical mapping utilized the following suite of high-resolution instrumentation to map the surficial sediment distribution, bathymetry, and sub-surface geology: a dual-frequency 100/500 kilohertz sidescan-sonar system, 234 kilohertz interferometric sonar, and 500 hertz -12 kilohertz chirp subbottom profiler. These geophysical data will be used to provide initial conditions for wave and circulation modeling within the study area.

U.S. Geological Survey Open-File Report 2008-1288

Geophysical Data Collected off the South Shore of Martha's Vineyard, Massachusetts

Introduction

Martha's Vineyard is located off the southeastern coast of Massachusetts, approximately 6 kilometers (km) southeast of Cape Cod and the Elizabeth Islands (fig. 1). The present coastal landscape of Martha's Vineyard and the surrounding seafloor environment are products of glacial and modern oceanographic processes acting to form and reshape the region over the past 20,000 years.

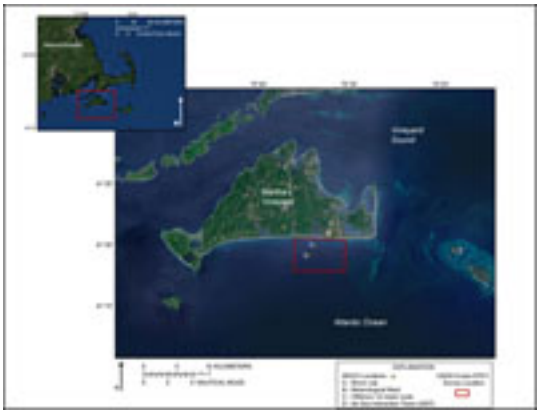
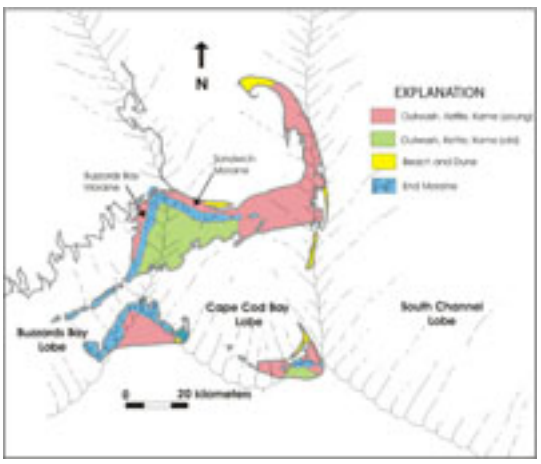


Figure 1. Location map showing the USGS Cruise 07011 survey bounds and the Woods Hole Oceanographic Institute (WHOI) Martha's Vineyard Coastal Observatory (MVCO) locations. Environmental Systems Research Institute (ESRI) USA Prime Imagery is used as background image (I-cubed, 2009) *Click on figure for larger image*.



The most recent ice sheet, the Laurentide ice sheet of the Wisconsinan glaciation, advanced across southern New England and reached its maximum extent around 21,000 years before present (B.P.) (Oldale, 1992). As the ice sheet extended to the

south, glaciers filled depressions in the underlying bedrock, forming Buzzards Bay, Cape Cod Bay, and South Channel lobes (fig. 2). Complex end moraines that formed at the junction of the Buzzards Bay and Cape Cod lobes mark the southern extent of the Laurentide Ice Sheet and lie along the northern coast of Martha's Vineyard (fig. 2). Seaward of the end moraines, extensive glacial outwash plains were deposited that now form the interior and southern shore of Martha's Vineyard (fig. 2). Subsequent to glacier retreat around 18,000 years B.P., large glacial deposits on the continental shelf became susceptible to erosion and reworking as sea level rose nearly 120 meters (m) to present-day levels (Oldale, 1992; Uchupi and Oldale, 1994). The action of waves, currents, and tides continues to shape the coast and adjacent seafloor deposits, providing an ideal setting for studying the dynamics of the coastal ocean and the processes influencing sediment transport.

Figure 2. Geologic map of Cape Cod and the Islands, superimposed with maximum extent of ice lobes (after Oldale, 1992) *Click on figure for larger image*.

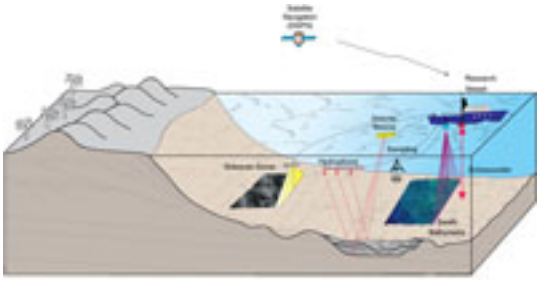


Figure 3. Illustration of the geophysical systems used to characterize the seafloor during USGS Cruise 07011. Sidescan sonar, swath bathymetric, and seismic-reflection systems were used to define the surficial sediment distribution, depth, and underlying geology. Sampling systems were used to collect direct samples of the seafloor sediment. A Differential Global Positioning System (DGPS) was used to navigate the sidescan-sonar and swath bathymetric systems, while a Global Positioning System (GPS) was used to navigate the seismic-reflection system. *Click on figure for larger image*.

Today, the inner continental shelf off the southern shore of Martha's Vineyard is the focus of collaborative research efforts investigating the oceanographic and physical processes influencing sediment transport in the coastal ocean (Goff and others, 2005; Sherwood and others, 2009; Martha's Vineyard Coastal Observatory, 2009). Research efforts have utilized the Woods Hole Oceanographic Institution's (WHOI) Martha's Vineyard Coastal Observatory (MVCO), an integrated system providing continuous sampling of atmospheric and oceanographic processes at stable platforms positioned on the beach to several kilometers offshore (MVCO, 2009).

In August 2007, the USGS conducted a high-resolution geophysical study in support of the Office of Naval Research (ONR) Ripples Directed-Research Initiative (DRI) studies at MVCO. The objectives of the survey were to define the bathymetry, sediment distribution, and underlying geology of the inner continental shelf offshore of Martha's Vineyard. These data will provide high-resolution datasets that will be used as initial conditions for oceanographic modeling (Sherwood and others, 2009) and as comparison to previously collected data (Goff and others, 2005).

This report presents the geophysical data collected by the USGS (fig. 3). Data were acquired with the following geophysical systems: a Systems Engineering and Assessment, Ltd., SWATHplus interferometric sonar; a Klein Associates 3000 dual-frequency sidescan sonar; and an EdgeTech 512i chirp sub-bottom profiling system. This report details the data processing procedures employed, and presents the processed datasets within a Geographic Information System (GIS).

This report also contains beach and seafloor sediment samples collected in 2005 and 2007. These sample data were collected to support the ONR Optics Acoustics and Stress In Situ (OASIS) and Ripples DRI instrumentation and modeling efforts rather than to ground-truth the geophysical data. Specifically, sample data were collected to locate the boundary between coarse and fine sediment prior to deployment and retrieval of instrumented tripods, and to document physical characteristics of the beach and seafloor sediment (Sherwood and others, 2009).

U.S. Geological Survey Open-File Report 2008-1288

Geophysical Data Collected off the South Shore of Martha's Vineyard, Massachusetts

Data Acquisition and Processing Overview

The following sections provide basic descriptions of shipboard acquisition and post-cruise processing of the geophysical and geospatial data contained in this report. Detailed descriptions of acquisition parameters, post-processing steps, and accuracy assessments for each data type are provided within the metadata files for geospatial data layers in the **GIS Data Catalog**.

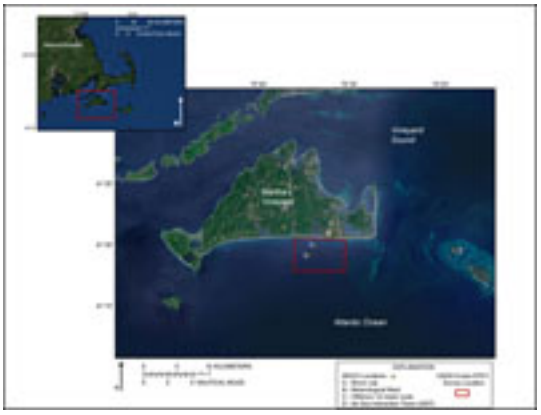
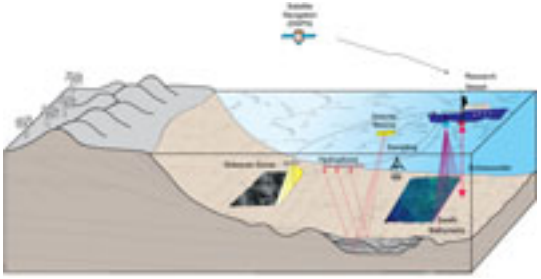


Figure 1. Location map showing the USGS Cruise 07011 survey bounds and the Woods Hole Oceanographic Institute (WHOI) Martha's Vineyard Coastal Observatory (MVCO) locations. Environmental Systems Research Institute (ESRI) USA Prime Imagery is used as background image (I-cubed, 2009). *Click on figure for larger image.*

Field Program

In August 2007, the USGS WHSC conducted a nearshore geophysical mapping effort off the south coast of Martha's Vineyard in the vicinity of the WHOI MVCO aboard the Megan T. Miller (fig. 1).



The study area covers 35 square kilometers (km²) from ~0.2 km to ~5 km offshore and ranges in depth from ~6 to 23 m. The following high-resolution systems were used to map bathymetry (depth), the surficial sediment distribution, and the sub-surface geology: a Systems Engineering and Assessment, Ltd., SWATHplus interferometric (swath) sonar (234 kilohertz (kHz)), a Klein Associates 3000 dual-frequency (100/500 kHz) sidescan sonar, and an EdgeTech 512i chirp subbottom profiler (500 Hz -12 kHz) (fig. 3).

All geophysical systems were run concurrently at shore-parallel line spacing ranging from 40-m spacings in water depths less than 15 m and 70-m line spacing in water depths greater than 15 m. Swath bathymetric and seismic data were also collected along shore-perpendicular lines with a 500-m to 1-km line spacing.

Swath Bathymetry

During USGS Cruise 07011, approximately 660 km of swath bathymetric data were acquired with a SEA Ltd. SWATHplus 234-kHz interferometric

Figure 3. Illustration of the geophysical systems used to characterize the seafloor during USGS Cruise 07011. Sidescan-sonar, swath bathymetric, and seismic-reflection systems were used to define the surficial sediment distribution, depth, and underlying geology. Sampling systems were used to collect direct samples of the seafloor sediment. A Differential Global Positioning System (DGPS) was used to navigate the sidescan-sonar and swath bathymetric systems, while a Global Positioning System (GPS) was used to navigate the seismic-reflection system. *Click on figure for larger image*.

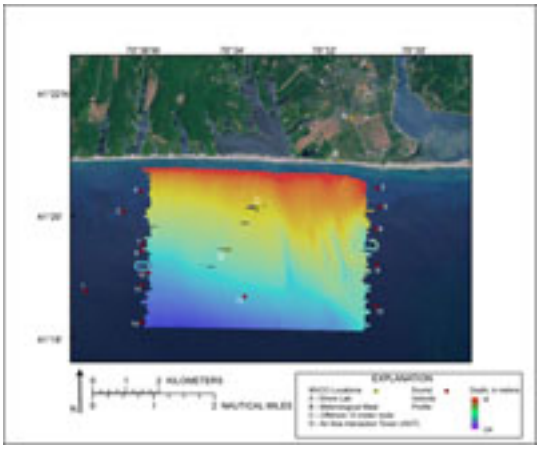


Figure 4. Color shaded-relief image of bathymetric data collected by the USGS during Cruise 07011. Depth is in meters and ranges from approximately 6 to 24 meters water depth. No data were collected in the gray regions, where moored instruments and structures were located. The locations of Martha's Vineyard Coastal Observatory (MVCO) (yellow dots) and sound velocity profiles (red dots) collected during USGS Cruise 07011 are also displayed. Environmental Systems Research Institute (ESRI) USA Prime Imagery is used as background image. *Click on figure for larger image*.

bathymetric sonar (Systems Engineering and Assessment, Ltd., 2009) (fig. 4). The SWATHplus transducers and a CodaOctopus F180R Motion Reference Unit (MRU) (CodaOctopus Group, Inc., 2009) were mounted on a rigid vertical pole and positioned on the starboard side of the Megan T. Miller about 2.5 m below the water line. Two Differential Global Positioning System (DGPS) navigation antennas and one Real-Time Kinematic (RTK) navigation antenna were mounted directly above (6.76 m) the transducers and MRU on a rigid horizontal pole as part of the sidemount configuration.

SWATHplus acquisition software was used to acquire the swath bathymetry at a 0.125 second (s) ping rate and digitally log the data at a 2 kilobyte (kB) sample rate. Ship motion (pitch, heave, roll, and heading) and position were acquired with the F180R series MRU and transmitted via network connections to the SWATHplus acquisition software. Fourteen sound velocity profiles (SVP) were collected at various locations throughout the survey area at time intervals ranging from 2 to 12 hours using an Applied

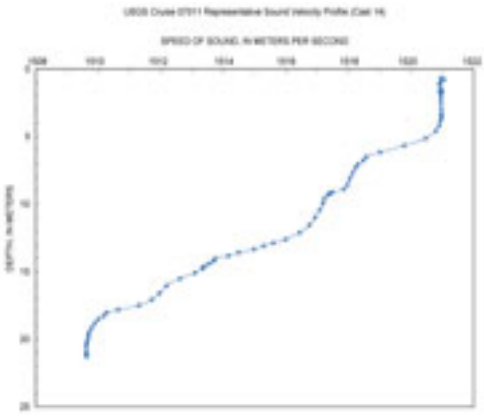


Figure 5. Representative sound velocity profile (SVP) displaying the speed of sound in the water column, in meters per second, versus water depth, in meters. These data were collected at SVP location 14 during USGS Cruise 07011. The data reveal the characteristic negative gradient, with presumably warmer surface waters overlying relatively cooler sub-surface waters. *Click on figure for larger image*.

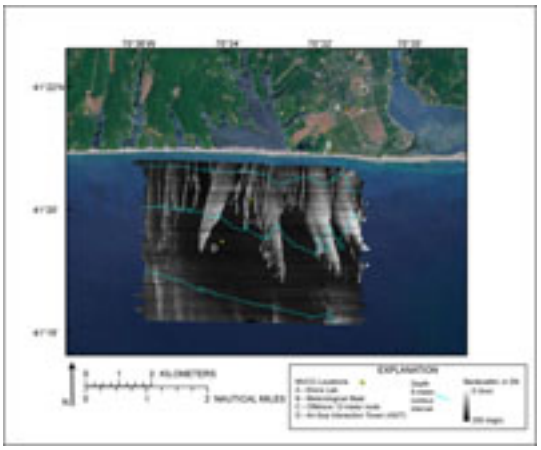


Figure 6. Sidescan-sonar mosaic collected by the USGS during Cruise 07011. Sidescan-sonar backscatter values (relative strength of return) are displayed as digital numbers (DN), on a relative scale, high-backscatter is represented by light tones within the image and low backscatter is represented by dark tones. The locations of Martha's Vineyard Coastal Observatory (MVCO) (yellow dots) and 5-meter bathymetric contours are also displayed. Environmental Systems Research Institute (ESRI) USA Prime Imagery is used as background image. *Click on figure for larger image*.

Microsystems SV Plus v2 sound velocimeter (Applied Microsystems, 2009). SVP data were incorporated into the SWATHplus acquisition software and used to minimize refraction artifacts due to changes in the sound velocity structure of the water column. SVPs were generally collected at the eastern and western ends of the survey area. This procedure was followed primarily to coordinate collection of SVPs with the beginning or end of tracklines, simplifying SVP data collection and minimizing the need to stop and restart geophysical data collection and maneuver the ship within the middle of the survey area. Ideally, SVPs would be collected continuously throughout the survey area in order to map fine-scale changes in the speed of sound structure of the water column. However, only small variations in the speed of sound and negligible refraction artifacts present in the swath bathymetric data allowed for broad-scale mapping of the speed of sound within the study area. Generally, the shallow-water SVPs displayed a negative gradient, with presumably warmer surface waters, ranging in depth from

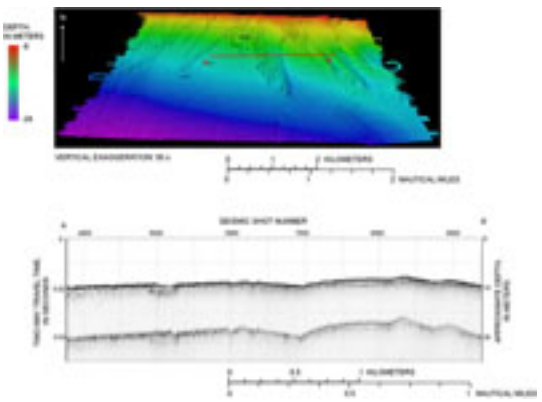
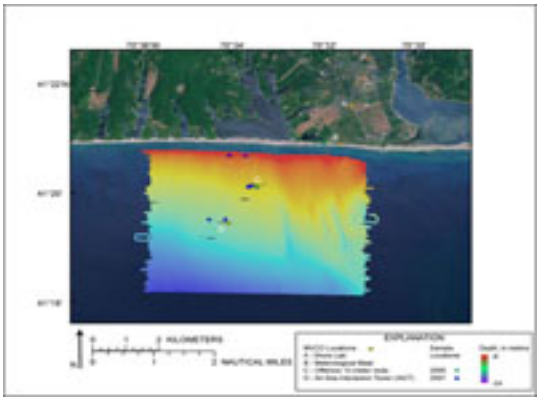


Figure 7. TOP: Color-shaded image of swath bathymetric data collected during USGS Cruise 07011. Depth is displayed in meters and ranges from approximately 6 to 24 meters water depth. Vertical exaggeration is 50 times. Sun illumination is from the northeast. Location of seismic-reflection line is displayed. BOTTOM: seismic-reflection data collected during USGS Cruise 07011. See top image for location. Depth is displayed as two-way travel time. Approximate depth is displayed in meters and assumes a speed of sound of 1,500 meters per second. Seismic shot number is displayed across the top of the profile. Several features are visible within the seismic image. At shot 5000, a sub-surface channel is visible within the seismic record, and reflections from shots 7000 to 9000 reveal an unconformity underlying low-relief bedforms. The bedforms are visible within the swath bathymetric image. *Click on figure for larger image*.



roughly 2 to 10 m, overlying relatively cooler, deeper waters ranging in depth from roughly 5 to 15 m (fig. 5).

Figure 8. Color shaded-relief image of bathymetric data collected by the USGS during Cruise 07011. Depth is in meters and ranges from approximately 6 to 24 meters water depth. No data were collected in the gray regions, where moored instruments and structures were located. The locations of MVCO and beach and seafloor sediment samples collected in 2005 (green dots) and 2007 (blue dots) are also displayed. Environmental Systems Research Institute (ESRI) USA Prime Imagery is used as background image. *Click on figure for larger image*.

Swath bathymetric data were referenced to a local vertical datum at the WHOI MVCO. MVCO maintains an instrumented node at a depth of 12 m that records a variety of oceanographic data including water level heights above the node (fig. 4). Recorded oscillation of the water level above the node was used to reference the bathymetric data. These data are not tied into any chart datum (that is, Mean Lower Low Water) but, rather, represent a long-term mean water depth directly above the MVCO node (11.68 m, August 2006 - present). This local vertical reference system was chosen as the vertical datum because several datasets, all relative to the MVCO node, will be utilized in oceanographic modeling.

SWATHplus, Computer Aided Resource Information System (CARIS, 2009), and Interactive Visualization Systems (IVS, 2009) processing software packages were used to post-process the swath bathymetric data. Navigation data were edited to remove outliers (that is, poor-quality navigation positions), and raw bathymetric soundings were filtered to remove spurious soundings, rectified for ship motion and changes in the speed of sound within the water column, and referenced to the local vertical datum (MVCO) within SWATHplus. CARIS software was used to grid the processed data at a 2-m cell size by averaging the high-density data and to apply a 5x5 grid cell median filter to the composite grid. The tight line spacing during data acquisition provided complete seafloor coverage, thus limiting the need for interpolation within the gridded data to infill data gaps between survey tracklines. Data gaps exist where the ship had to steer around obstacles, such as the components of the MVCO. IVS software (IVS, 2009) was used to generate Digital Terrain Models (DTM) and export Environmental Systems Research Institute (ESRI) format ASCII raster grids for inclusion in a GIS. All gridded data are projected in Universal Transverse Mercator (UTM), Zone 19 N, meters, referenced to WGS84 horizontal datum.

Sidescan Sonar

Approximately 620 km of shore-parallel sidescan-sonar data were acquired with a Klein System 3000 digital sidescan-sonar (Klein Associates, Inc., 2009) (fig. 6). This dual-frequency sonar acquires data at nominal frequencies of 100 and 500 kHz (actually 132 and 445 kHz). The 100-kHz data were used to generate the composite sidescan-sonar mosaic (fig. 6).

The sidescan sonar was towed from the starboard side of the Megan T. Miller. A DGPS antenna positioned on the starboard aft roof of the USGS mobile acquisition lab was used to acquire positions. A digital cable-out display was used to measure towfish layback. Layback and DGPS input, and their relative offsets, were used by the Klein SonarPro acquisition software to calculate position of the sonar towfish. SonarPro acquired raw data files in eXtended Triton Format (XTF) format at a 0.03-s ping rate yielding a 50-m range (100-m swath).

XSonar/Showimage sonar processing software packages were used to correct for geometric and radiometric distortions inherent in the sonar data (Danforth, 1991; 1997). PCI Geomatica software (Geomatica, 2009) was used to generate georeferenced sidescan-sonar mosaics for the 100-kHz sidescan-sonar data (Paskevich, 1996). Gray-scale TIFF images were produced at a 0.5-m resolution and referenced to the World Geodetic System of 1984 (WGS84), Universal Transverse Mercator (UTM-Zone 19) Coordinate System. A linear stretch was applied to the TIFF image to increase the dynamic range of the data. TIFF images were incorporated into a GIS. Environmental Systems Research Institute (ESRI) world files (*tfw) are associated with each TIFF image and define the upper left coordinates and image resolution.

Chirp Seismic Reflection

Approximately 680 km of seismic-reflection data were collected using an EdgeTech Geo-Star full spectrum sub-bottom (FSSB) system and a SB-0512i towfish with a swept frequency range of 0.5 – 12 kHz (EdgeTech, 2009) (fig. 7). The 512i towfish was mounted on a catamaran and towed approximately 5 m off the stern of the Megan T. Miller and 1.5 m below the sea surface. A GPS navigation receiver was

mounted on the seismic catamaran to provide towfish navigation. GPS positions were transmitted to a receiver positioned on the center, aft of the USGS mobile acquisition van and input to the seismic acquisition software. EdgeTech J-Star seismic acquisition software was used to control the Geo-Star topside unit and digitally log trace data in EdgeTech native format (JSF) (Edgetech, 2009). Data were acquired using a 0.25-s shot rate, 5 millisecond (ms) pulse length, and a 0.5-to 8.0-kHz swept frequency. Recorded trace lengths were approximately 250-ms.

The JSF format trace data were converted to SEG-Y format using an in-house C program, jsf2segy. SIOSEIS (SIOSEIS, 2007) and Seismic Unix (Stockwell and Cohen, 2007) were used to post-process the raw chirp seismic-reflection data. Navigation data were inspected and edited to remove outliers, static corrections were applied to correct for towfish depth beneath the sea surface, seafloor reflections were identified by peak amplitude, and sea-surface heave was removed. Final trace data, plotted as JPEG images, and geo-located shot-point trackline files are presented in this report. JPEG images and seismic navigation are also incorporated within a GIS.

Supplemental Data: Sediment Samples

Included within this data release are onshore beach and seafloor sediment samples collected near the MVCO by investigators participating in the ONR-funded OASIS and Ripples (DRI) projects(fig. 8). Beach and seafloor samples were generally collected to locate the boundary between coarse and fine sediment along low-amplitude rippled bedforms prior to deployment and retrieval of instrumented tripods and to document the physical characteristics of the beach (Sherwood and others, 2009). Samples were not collected to ground-truth the geophysical data acquired during USGS Cruise 07011.

The sample data are contained within the GIS catalog and in a Comma Separated Value (CSV) file. All samples were processed for grain-size analyses in the Woods Hole Science Center's sediment lab using sieve and coulter counter techniques (Poppe and others, 2005). Beach samples (top 2 centimeters (cm)) were hand sampled with a Teflon-coated scoop. The majority of seafloor samples were obtained by SCUBA divers with short (~15 to -30-cm

long x -4.5-cm diameter) push cores, but a few samples were collected with a modified Van Veen grab sampler and subsampled to obtain representative material from the top 2 cm. Samples were collected in September 2005 and August and October 2007.

U.S. Geological Survey Open-File Report 2008-1288

Geophysical Data Collected off the South Shore of Martha's Vineyard, Massachusetts

Geographic Information System Data Catalog

1. Data Access

The spatial data in this report are delivered in two different formats:

- raster data
- vector data

Selected raster and vector data can be viewed within an ArcMap™ 9.2 map document (**2008-1288.mxd**). Refer to the "Raster and Vector Data Description" section below for details on file descriptions and locations.

Projection:
Raster data: Universal Transverse Mercator (UTM) M, Zone 19N, WGS84 Datum.
Vector data: Geographic Coordinate System, WGS84 Datum.

Viewing the data:
The data can be accessed in several ways depending on software availability:

- ArcGIS® 9.2 or higher
- ArcGIS Explorer (available at no cost: http://www.esri.com/software/arcgis/explorer/index.htm)

Viewing the map documents:
ArcGIS® 9.2 or higher:

To download the data from the Web, copy the **GIS_Catalog** folder or

the **GIS_Catalog zip file** (approximately 790 megabytes (MB)) to a local computer and open the ArcMap™ 9.2 map document **2008-1288.mxd**. This map document is saved with relative paths to the data files. As long as the file structure remains the same under the parent directory (**GIS_Catalog**) there is no need to change drive letters or pathways. Approximately 2 gigabytes (GB) of free space is needed in order to save and extract the data to a local drive.

Data download:
Raster and vector data are stored and compressed within **zip** files in order to facilitate Web downloads. WinZip® files of the individual data layers are linked within the **Data Preview** section. **Data Preview** also lists specific download instructions.

Raster grids are stored as ESRI® binary grid format in the **GIS_Catalog** (included in the **GIS_Catalog.zip** file) and as ASCII raster files within individual data-set **zip** files. The ASCII raster files can be converted easily to ESRI® grid format in ArcGIS® with Spatial Analyst extension (ASCII to Raster). Vector data are stored as shapefiles within the **zip** file.

If WinZip® is not currently installed on the local system, go to **WinZip®** http://www.winzip.com to download the latest version of the WinZip® utility.

---

2. Data Description

This section describes the location of the raster and vector data within the directory structure of the Web page. Raster data are delivered as ESRI® Binary Grids, ASCII Raster Grids, or TIFF images. Vector data are delivered as ESRI® Shapefiles. Text files are delivered as CSV files.

Grid: floating point ASCII with ESRI® header (included within individual dataset **zip** files) and ESRI® binary grid format within the **GIS_Catalog.zip** file.

Image: binary image (TIFF, GeoTIFF, and JPEG formats).

Shapefile: ESRI® file format for point, polyline, or polygon vector data.

Text Files: CSV files and raw data files.


GIS_Catalog

This folder contains:

Basemaps

1. ***mv_topobath.tif*** – Image: National Oceanic and Atmospheric Administration (NOAA), National Geophysical Data Center (NGDC) Coastal Relief Model of southeastern coast of Massachusetts.
2. ***MVCO.shp***– Point Shapefile: Locations of the WHOI MVCO components

Bathy

1. ***bathy_2m*** – Grid: Bathymetry at 2-m resolution
2. ***bathy_2mh*** – Grid: Bathymetric hillshade at 2-m resolution
3. ***bathy_2m_csh*** – GeoTIFF: Color shaded-relief bathymetry at 2-m resolution
4. ***con_5m*** – Polyline Shapefile: 5-m bathymetric contours
5. ***svp.shp*** – Point Shapefile: Location of sound velocity profiles (SVP)

svp

This folder contains JPEG images of charts displaying the sound velocity profiles collected during USGS Cruise 07011 and CSV files containing the sound velocity profile data.

The JPG images are hotlinked to the svp locations shapefile (svp.shp) within the ArcMap™ 9.2 map document **2008-1288.mxd**.

Using hotlink within ArcGIS 9.2 or higher:

In order to hotlink to these data, the shapefile must be selected within the Table of Contents. The hotlink feature (lightning bolt ) within the tools menu can then be used to display the SVP chart associated with an individual map object.

- Open 2008-1288.mxd
- Select shapefile of interest (that is, svp.shp) in the Table of Contents
- Select the lightning bolt tool () and click on a map object to view an image of the data.

Nav

This folder contains the raw HYPACK®, Inc., navigation stored in individual Julian Day directories (Julian Days 221 through 225). These data are not incorporated in the ArcMap™ 9.2 map document **2008-1288.mxd**. They are included in this report in order to provide the raw Real-Time Kinematic (RTK) navigation associated with the USGS Cruise 07011. Individual navigation files stored within each Julian Day directory were saved in HYPACK® format. File name convention is LLL_TTTT.DDD, where LLL is the HYPACK® line number, TTTT is the 24 hour

time for the beginning of the file, and DDD is the Julian Day. A full description of these data is included in the metadata linked within the table below, ***Data Preview***.

 **Samples**

1. ***samples*** – Point Shapefile: Beach and seafloor samples collected in 2005 and 2007
2. ***samples_csv.csv*** – CSV file: Beach and seafloor samples collected in 2005 and 2007. Contains the same data as the samples point shapefile.

 **Seisimage**

This folder contain JPEG images of seismic-reflection profiles. These images are hotlinked to the geophysical tracklines within the ArcMap™ 9.2 map document **2008-1288.mxd**. See description under SVP for instructions on accessing hotlinks in map documents.

 **Sonar**

1. ***sonar_05m.tif*** – GeoTIFF Image: Sidescan-sonar mosaic at 0.5-m resolution (TIFF)
2. ***sonar_05m_str.tif*** – GeoTIFF Image: Sidescan-sonar mosaic at 0.5-m resolution with a linear stretch applied (TIFF)

 **Tracklines**

**** Within 2008-1288.mxd: Seismic-reflection tracklines are hotlinked to JPEGs stored within the"Seisimage" directory. ****

1. ***bathy_10sec.shp*** – Point Shapefile: 10-s navigation for swath bathymetric data
2. ***bathy_trknav.shp*** – Polyline Shapefile: Swath bathymetric tracklines
3. ***seismic_100sht.shp*** – Point Shapefile: Shot points at 100-shot interval for seismic data
4. ***seismic_500sht.shp*** – Point Shapefile: Shot points at 500-shot interval for seismic data
5. ***seismic_trknav.shp*** – Polyline Shapefile: Seismic tracklines
6. ***sonar_1min.shp*** – Point Shapefile: 1-minute navigation for sidescan-sonar data
7. ***sonar_trknav.shp*** – Polyline Shapefile: Sidescan-sonar tracklines

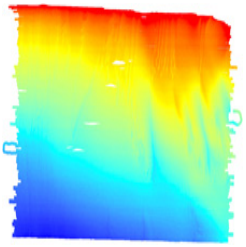
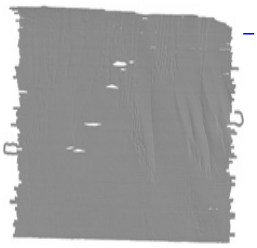
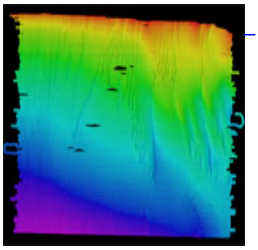
Map document:

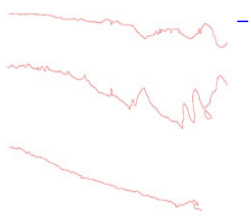
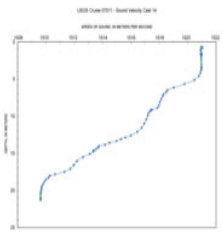
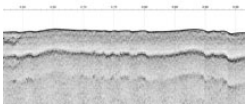
2008-1288.mxd – ArcMap™ 9.2 map document containing selected data layers described above.

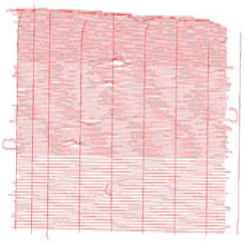
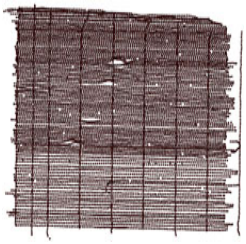
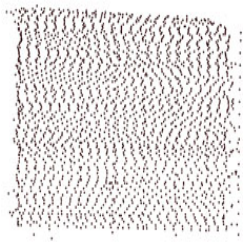
---

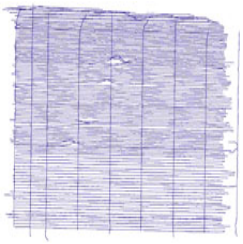
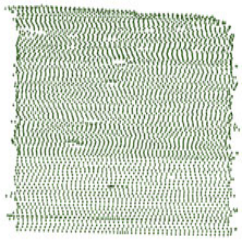
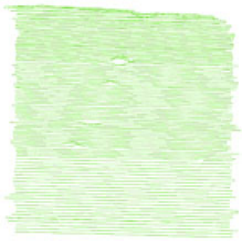
3. Data Preview

Downloading data:
To download raster and vector data, right click on the link within the **'Download zip file'** column in the table below. **'Save Target As...'** to save a compressed WinZip® file to the local hard drive. If WinZip® is not currently installed on the local system, go to WinZip® to download the latest version of the WinZip® utility.

File description	File name (Metadata)	View	File format	File location	Download zip file
NOAA NGDC Coastal Relief Model (UTM)	mv_topobathy		GeoTIFF Image	GIS_catalog/ Basemaps	mv_topobathy.zip (609 KB)
WHOI MVCO Locations (Geographic Coordinate System)	MVCO		ESRI Shapefile Points	GIS_catalog/ Basemaps	mvco.zip (35 KB)
Bathymetry (2-m cell size) (UTM)	bathy_2m bathy_2m_asc.asc		ESRI Grid 32 bit floating point (ASCII raster in zip file)	GIS_catalog/ Bathy	bathy_2m.zip (8 MB)
Bathymetric Hillshade (2-m cell size) (UTM)	bathy_2mh bathy_2mh_asc.asc		ESRI Grid 8 bit integer (ASCII raster in zip file)	GIS_catalog/ Bathy	bathy_2mh.zip (5 MB)
Color Shaded-Relief Bathymetric Image (2-m cell size) (UTM)	bathy_2m_chs.tif		GeoTIFF Image	GIS_catalog/ Bathy	bathy_2m_chs.zip (24 MB)

5-meter Bathymetric Contours (Geographic Coordinate System)	con_5m		ESRI Shapefile Polylines	GIS_catalog/Bathy	con_5m.zip (100 KB)
Sound Velocity Profile Locations (Geographic Coordinate System)	svp		ESRI Shapefile Points	GIS_catalog/Bathy	svp.zip (36 KB)
Charts of Sound Velocity Profiles	svp_jpg		JPEG Image	GIS_catalog/Bathy/svp	svp_jpg.zip (247 KB)
Sound Velocity Profiles	svp_csv	No Image	Comma Separated Value Files (*.csv)	GIS_catalog/Bathy/svp	svp_csv.zip (40 KB)
HYPACK Navigation	hypack	No Image	HYPACK raw navigation files	GIS_catalog/Nav	hypack.zip (27 MB)
Sample Locations (Geographic Coordinate System)	samples		ESRI Shapefile Points	GIS_catalog/Samples	samples.zip (54 KB)
Sample Locations	samples	No Image	Comma Separated Value Files (*.csv)	GIS_catalog/Samples	samples_csv.zip (44 KB)
Seismic-Reflection Profiles	seisimage		JPEG	GIS_catalog/Seisimage	seisimage.zip (135 MB)

Sidescan-Sonar Mosaic (0.5-m cell size) (UTM)	sonar_05m.tif		TIFF 8 bit integer	GIS_catalog/ Sonar	sonar_05m.zip (80 MB)
Sidescan-Sonar Mosaic with linear stretch (0.5-m cell size) (UTM)	sonar_05m_str.tif		TIFF 8 bit integer	GIS_catalog/ Sonar	sonar_05m_str.zip (80 MB)
10-second Interval Trackline Navigation - Swath Bathymetry (Geographic)	bathy_10sec.shp		ESRI Shapefile Points	GIS_catalog/ Tracklines	bathy_10sec.zip (1.2 MB)
Swath Bathymetric Tracklines (Geographic)	bathy_trknav.shp		ESRI Shapefile Polylines	GIS_catalog/ Tracklines	bathy_trknav.zip (366 KB)
100-interval Seismic Shots (Geographic)	seismic_100sht.shp		ESRI Shapefile Points	GIS_catalog/ Tracklines	seismic_100sht.zip (550 KB)
500-interval Seismic Shots (Geographic)	seismic_500sht.shp		ESRI Shapefile Points	GIS_catalog/ Tracklines	seismic_500sht.zip (184 KB)

Seismic Shots (Geographic)	seismic_sht.shp		ESRI Shapefile Points	GIS_catalog/ Tracklines	seismic_sht.zip (9 MB)
Seismic Tracklines (Geographic)	seismic_trknav.shp		ESRI Shapefile Polylines	GIS_catalog/ Tracklines	seismic_trknav.zip (2 MB)
1-minute Interval Sidescan-Sonar Navigation (Geographic)	sonar_1min.shp		ESRI Shapefile Points	GIS_catalog/ Tracklines	sonar_1min.zip (266 KB)
Sidescan-Sonar Tracklines (Geographic)	sonar_trknav.shp		ESRI Shapefile Polylines	GIS_catalog/ Tracklines	sonar_trknav.zip (84 KB)

U.S. Geological Survey Open-File Report 2008-1288

Geophysical Data Collected off the South Shore of Martha's Vineyard, Massachusetts

Acknowledgments

Funding for this research was provided by the U.S. Geological Survey Coastal and Marine Geology Program, the Office of Naval Research (ONR), and the Optics Acoustics and Stress In Situ (OASIS) project. Assistance in the field was provided by Charles Worley, Emile Bergeron, Brian Buczkowski, Elizabeth Pendleton, and Bené Ferré of the USGS and the captain and crew of the Megan T. Miller. This report benefited from reviews by Elizabeth Pendleton, Seth Ackerman, and VeeAnn Cross.

U.S. Geological Survey Open-File Report 2008-1288

Geophysical Data Collected off the South Shore of Martha's Vineyard, Massachusetts

References Cited

Applied Microsystems, 2009, Sound velocity: SV Plus v2., accessed July 1, 2009, at http:www.appliedmicrosysstems.com/products/productDetails.aspx?id=1.

Computer Aided Resource Information System (CARIS), 2009, Geomatics Software Solutions, CARIS: HIPS and SIPS, accessed July 1, 2009, at http://www.caris.com/products/hips-sips.

CodaOctopus Group, Inc., 2009, Octopus F180 Attitude and Positioning System, accessed July 1, 2008, http://www.codaoctopus.com/motion/f180/index.asp.

Danforth, W.W., O'Brien, T.F., and Schwab, W.C., 1991, USGS image processing system: near real-time mosaicking of high-resolution sidescan-sonar data: Sea Technology, p. 54-59.

Danforth, W.W., 1997, Xsonar/ShowImage, a complete system for rapid sidescan sonar processing and display: U. S. Geological Survey Open-File Report 97-686, available online at http://pubs.er.usgs.gov/usgspubs/ofr/ofr97686.

EdgeTech, 2009, EdgeTech: sub-bottom profilers and topsides & software, accessed July 1, 2009, at http://www.edgetech.com/productlinemarine.html.

Goff, J.A., Mayer, L.A., Traykovski, P., Buynevich, I., Wilkens, R., Raymond, R., Gland, G., Evans, R.L., Olson, H., and Jenkins, C., 2005, Detailed investigation of sorted bedforms, or "rippled scour depressions," within the Martha's Vineyard Coastal Observatory, Massachusetts: Continental Shelf Research, v. 25, pp. 461-484.

I-cubed, 2009, USA Prime Imagery Collection: Ft. Collins, CO, accessed Jully 1, 2009, at http://premium.arcgisonline.com/Server/rest.

Interactive Visualization Systems (IVS), accessed July 1, 2009, at http://www.ivs3d.com.

Klein Associates, Inc., 2009, Klein System 3000 Sonar System, accessed July 1, 2009, at http://www.l-3klein.com/3000series/3000.html.

Martha's Vineyard Coastal Observatory (MVCO), accessed July 1, 2009, at http://mvcodata.whoi.edu/cgi-bin/mvco/mvco.cgi.

Oldale, R.N., 1992, Cape Cod and the Islands, the geologic story: Parnassus Imprints, East Orleans, Massachusetts, 208 p.

Paskevich, V.F., 1996, MAPIT: An improved method for mapping digital sidescan sonar data using the Woods Hole Image Processing System (WHIPS) Software: U.S. Geological Survey Open-File Report 96-281.

PCI Geomatica, accessed July 1, 2009 at http://www.pcigeomatics.com.

Poppe, L.J., Williams, S.J., and Paskevich, V.F., 2005, U.S. Geological Survey East-Coast sediment analysis procedures, database, and GIS data: U.S. Geological Survey Open-File Report 2005-1001, available online at http://woodshole.er.usgs.gov/openfile/of2005-1001/index.htm.

Sherwood, C.R., Butman, B., Rubin, D.M., Signell, R.P., Warner, J.C., 2009, National Community Sediment-

Transport Modeling Project, available online at http://woodshole.er.usgs.gov/projects/project_get.php?proj=29210GW&style=html.

SIOSEIS, 2007, SIOSEIS -The introduction, accessed July 1, 2008, at http://sioseis.ucsd.edu/sioseis.html.

Stockwell, J.W., Jr., and Cohen, J.K., 2007, The New SU User's Manual (version 3.3): Golden, Colo., Center for Wave Phenomena - Colorado School of Mines, 153 p.

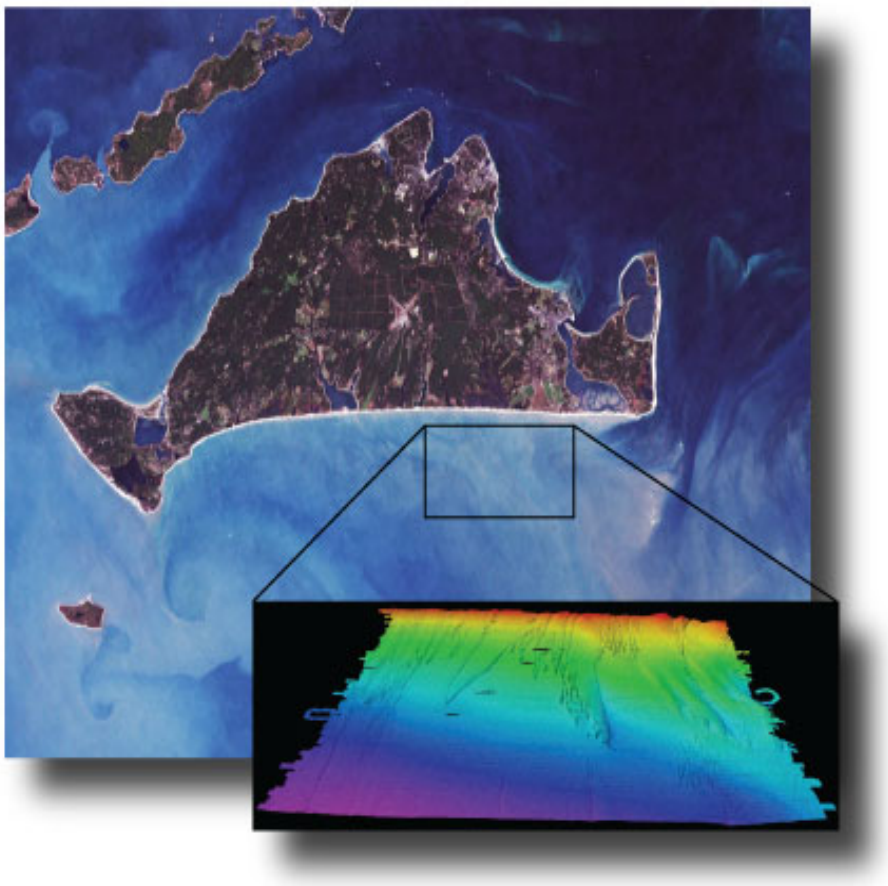
Systems Engineering & Assessment Ltd (SEA), 2009, SWATHplus - Wide Swath Bathymetry & Sidescan, accessed July 1, 2009, at http://www.sea.co.uk/swathpluspi.aspx?nav=products.

Uchupi, E., and Oldale, R.N., 1994, Spring sapping origin of the enigmatic relict valleys of Cape Cod and Martha's Vineyard and Nantucket Island, Massachusetts: Geomorphology, v. 9, p. 83-95.

Prepared in cooperation with the Office of Naval Research (ONR)

Geophysical Data Collected off the South Shore of Martha's Vineyard, Massachusetts

By J.F. Denny, W.W. Danforth, D.S. Foster, and C.R. Sherwood



Abstract

The U. S. Geological Survey Woods Hole Science Center conducted a nearshore geophysical survey offshore of the southern coast of Martha's Vineyard, in the vicinity of the Martha's Vineyard Coastal Observatory in 2007. This mapping program was part of a larger research effort supporting the Office of Naval

First posted

January 2010

- OFR 2008-1288

For additional information contact:
Jane Denny
U.S. Geological Survey
Coastal and Marine Geology Program
Woods Hole Science Center
384 Woods Hole Road
Woods Hole, MA 02543
(508)457-2311

Research Ripples Directed-Research Initiative studies at Martha's Vineyard Coastal Observatory designed to improve our understanding of coastal sediment-transport processes. The survey was conducted aboard the Megan T. Miller August 9-13, 2007. The study area covers 35 square kilometers from about 0.2 kilometers to 5 kilometers offshore of the south shore of Martha's Vineyard, and ranges in depth from ~6 to 24 meters. The geophysical mapping utilized the following suite of high-resolution instrumentation to map the surficial sediment distribution, bathymetry, and sub-surface geology: a dual-frequency 100/500 kilohertz sidescan-sonar system, 234 kilohertz interferometric sonar, and 500 hertz -12 kilohertz chirp subbottom profiler. These geophysical data will be used to provide initial conditions for wave and circulation modeling within the study area.

Suggested citation:

Denny, J.F., Danforth, W.W., Foster, D.S., and Sherwood, C.R., 2009, Geophysical data collected off the south shore of Martha's Vineyard, Massachusetts: U.S. Geological Survey Open-File Report 2008-1288, (Also available at http://pubs.usgs.gov/of/2008/1288/.)

Contents

References Cited