



NOAA Ship *Okeanos Explorer* Seafloor Mapping, *Little Hercules* ROV, and *Sentry* AUV Data Use in Ocean Exploration and Public Data Holdings

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Abstract

Within the National Oceanic and Atmospheric Administration (NOAA) Office of Ocean Exploration and Research, the *Okeanos Explorer* Program's tools for initial ocean exploration and site characterization include a Kongsberg EM 302 multibeam sonar (30 kHz), Kongsberg EK 60 singlebeam sonar (18 kHz), and Knudsen subbottom profiler (3.5 kHz Chirp). Key sites are selected for finer scale remotely operated vehicle (ROV) and autonomous underwater vehicle (AUV) exploration based on initial shipbased mapping results. During the 2012 field season, the *Okeanos Explorer* Program conducted multiple expeditions in the Gulf of Mexico and U.S. Atlantic Margin to confirm and further demonstrate the EM 302 multibeam sonar's water column backscatter data capability to detect gaseous seeps and vents. Once detected, fine scale exploration was conducted with the *Little Hercules* ROV and *Sentry* AUV. Using the ship's telepresence technology, all data products developed on the ship were sent to scientists and the public onshore for exploration collaboration. All raw and processed data products are archived and freely available to the public at the end of each cruise conducted by the NOAA Ship *Okeanos Explorer*.

1. Gulf of Mexico Seeps and Deep Water Coral Exploration with *Little Hercules* ROV

While mapping in the seafloor and water column in the vicinity of the salt domes of the Northern Gulf of Mexico, the EM 302 detected over two hundred distinct seeps in the water column. Several seeps were explored in finer detail using high definition cameras and lighting systems of the remotely operated vehicle *Little Hercules* and the camera platform *Seirios*. This included filming bubbles escaping from the seafloor at locations determined by the EM 302 data to ground truth observations and deduce other properties of these gas seeps e.g. gas flux, and effect of these seeps on surrounding ecosystem. These seeps are now a major research focus area by scientists at the University of New Hampshire's Center for Coastal and Ocean Mapping and other academic institutions around the U.S., and the U.S. Bureau of Ocean Energy Management.

2. Blake Ridge Diapir Complex Exploration with *Sentry* AUV

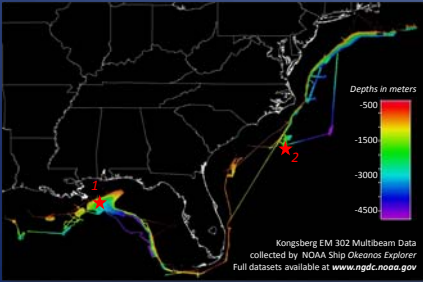
While mapping the Blake Ridge and Cape Fear Diapirs, at least seven distinct seeps were detected, each rising approximately 900 meters from the seafloor in water depths ranging from 2200 to 2500 meters. Several of these seeps were further explored with Woods Hole Oceanographic Institute's *Sentry* AUV, utilizing its Reson 7125 high resolution multibeam, photo imagery, sidescan, subbottom, and various in-situ sensors to characterize the local environment.

3. Public Data Archives

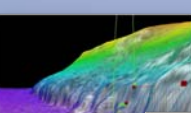
Okeanos Explorer data are collected with regard to the Integrated Ocean and Coastal Mapping Center's concept to "map once using many times", which aims to encourage and enable the multidisciplinary use of seafloor mapping data, including by the fields of marine archaeology, hydrographic mapping, extended continental shelf, biology, geology, geophysics, biopharmaceutical, ocean energy and resources, marine managed areas, fisheries, corals, oceanography, hazards modeling and assessments, education and outreach. To this end, all mapping, CTD and meteorological and oceanographic datasets collected by the NOAA Ship *Okeanos Explorer* are monitored and evaluated in the field for quality control purposes, and are made available in direct partnership with the NOAA National Coastal Data Development Center through NOAA's public archives within 60 to 90 days of data collection, in useable formats and with associated metadata records. Additionally, all datasets collected by vehicles onboard the ship, including ROVs and AUVs, are made available directly following each cruise via public archives.

RELATED PRESENTATIONS AT AOU 2012 FALL MEETING:

- 0541E-05: Evidence of Extensive Gas Venting at the Blake Ridge and Cape Fear Diapirs. L. Brothers, C.L. VanDover, C.B. German, D.B. Yoergler, C.L. Kanar, M. Lobecker, A.D. Skarke, D.B. Yoergler
- 0551D-1507: The Evolution of Information Management in Oceanographic Exploration. B. Reay, S. Moxley, E. Gledhill
- 0551D-1508: Telepresence field research experience for undergraduate and graduate students on RV *Okeanos Explorer*/AUV *Sentry* seeps study. C.L. Van Dover, C.B. German, D.B. Yoergler, C.L. Kanar, L. Brothers
- 0551B-1918: NOAA Ship *Okeanos Explorer* 2012 Field Season in the Northern Gulf of Mexico and U.S. Atlantic Continental Margin. A.D. Skarke, E. Lobecker, M. Malik, N. Verplank
- 0551D-1504: Integrating telepresence technologies with AUV operations for exploration of cold seep communities in the vicinity of Blake Ridge and Cape Fear Diapirs in the Western Atlantic. K. Blum, C.L. Van Dover, C.B. German, C.L. Kanar, L. Brothers, C.B. German, C.C. Kelley, C. Coleman, C. Martinez, W. Pinner, B.R. Kennedy



NOAA Ship *Okeanos Explorer*

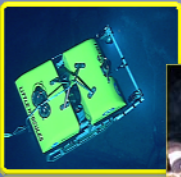


Kongsberg Maritime EM 302 Multibeam (30 kHz)
 NOAA National Geophysical Data Center
www.ngdc.noaa.gov

Kongsberg Maritime EK 60 Singlebeam (18 kHz)
 NOAA National Geophysical Data Center
www.ngdc.noaa.gov

Meteorological and oceanographic sensors
 NOAA National Oceanographic Data Center
www.nodc.noaa.gov

Little Hercules ROV



High definition video footage
 Tethys FTP hosted at the University of Rhode Island
tethys.gso.uri.edu

Still images (high and low resolution)
 Tethys FTP hosted at the University of Rhode Island
tethys.gso.uri.edu

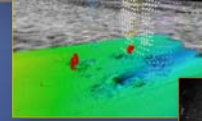


Knudsen 3260 Subbottom Profiler (3.5kHz Chirp)
 NOAA National Geophysical Data Center
www.ngdc.noaa.gov

Sentry AUV

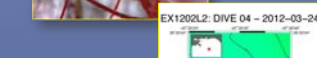


Reson 7125 Multibeam (400 kHz)
 Woods Hole Digital Archives
www.whoi.edu/data/



High dynamic range (12-bit) 1
 024x1024 Digital
 Still Images
www.whoi.edu/data/

All AUV mounted sensor data including:
 Optical Backscatter
 Koichi Nokomura EH Sensor
 APS 1540 Magnetometer(s)
 Oceanographic Data
 AUV Navigation and Attitude Data
www.whoi.edu/data/

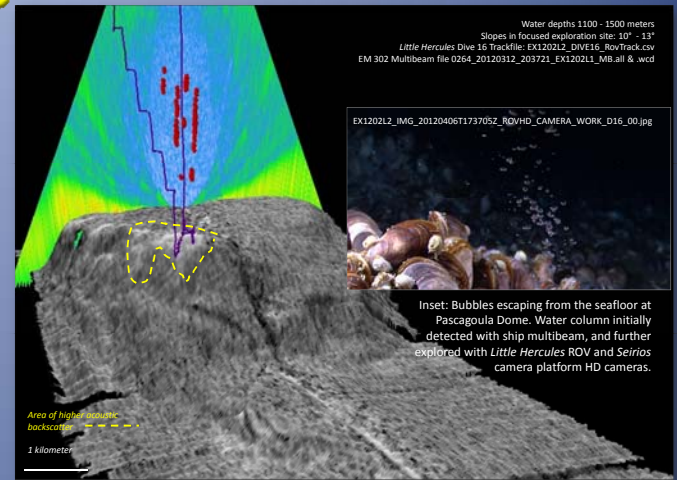


ROV Navigation Data
 Tethys FTP hosted at the University of Rhode Island
tethys.gso.uri.edu

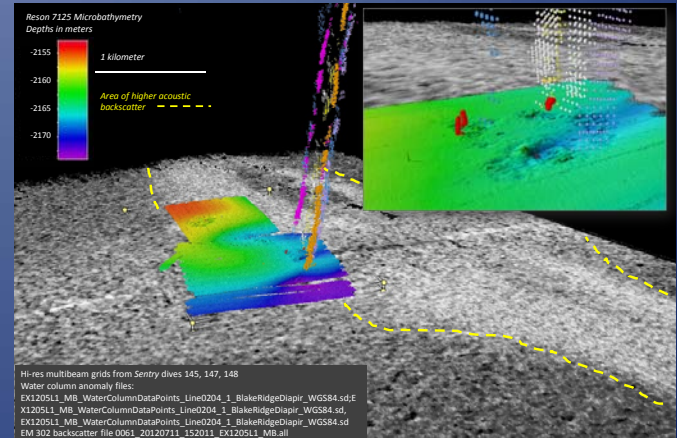
Meteorological and oceanographic sensors
 NOAA National Oceanographic Data Center
www.nodc.noaa.gov



EdgeTech Sidescan Sonar (120 kHz / 410 kHz)
 EdgeTech Subbottom Profiler (4-24 kHz)
www.whoi.edu/data/



1. A targeted exploration site at Pascagoula Dome, a salt dome in the Northern Gulf of Mexico, explored during cruise EX1202 Leg 2. Data displayed includes water column anomalies detected with ship multibeam (red spheres); ship multibeam water column beam fan; ship multibeam seabed backscatter draped over ship multibeam bathymetry; and *Little Hercules* ROV dive track (purple). Yellow dashed line indicates targeted exploration area based on interpreted high seabed backscatter return values ('brighter' colors, i.e. lighter greys). All data shown in figures above and below is available through public archives in usable formats. Data displayed in QPS Fledermaus. Freeware is available.



2. Water column anomalies rising up to 1300 meters above the seafloor at Blake Ridge Diapir detected using ship multibeam during cruise EX1205 Leg 1. EM 302 acoustic bottom backscatter data shown as seafloor, with higher acoustic returns denoted with dashed yellow polygon. Inset: Red spheres indicate water column anomalies detected with *Sentry* AUV's Reson 7125 multibeam sonar while flown at 80 meters above seabed.

Hi-res multibeam grids from *Sentry* dives 145, 147, 148
 Water column anomaly files:
 EX1205L1_MB_WaterColumnDataPoints_Line0204_1_BlakeRidgeDiapir_WGS84.sdf
 EX1205L1_MB_WaterColumnDataPoints_Line0204_1_BlakeRidgeDiapir_WGS84.sdf
 EX1205L1_MB_WaterColumnDataPoints_Line0204_1_BlakeRidgeDiapir_WGS84.sdf
 EM 302 backscatter file 0061_20120711_152011_EX1205L1_MB.all