Image captions/credits on Page 2.

supplemental datasheet

Okeanos Explorer Multibeam Sonar Supplemental Datasheet #1 for Cruise 12.02

This Supplement provides data that can be analyzed using techniques developed in the lesson, "Tools for Classroom Explorers – How to Use Multibeam Sonar Data" to investigate discoveries made during the NOAA Ship Okeanos Explorer Gulf of Mexico 2012 Expedition.

Focus

Multibeam sonar data and exploration activities during the NOAA Ship *Okeanos Explorer* Gulf of Mexico 2012 Expedition

Grade Level

5-12 (Physical Science/Earth Science)

Focus Question

How are multibeam sonar data used during exploration activities of the NOAA Ship *Okeanos Explorer* Gulf of Mexico 2012 Expedition?

Learning Objectives

- Students explain the role of multibeam sonar data in the exploration strategy used during the NOAA Ship *Okeanos Explorer* Gulf of Mexico 2012 Expedition.
- Students interpret three-dimensional multibeam sonar data of underwater features mapped by the *Okeanos Explorer* during the Gulf of Mexico 2012 Expedition.

Materials

- ❑ Copies of the *Multibeam Sonar Student Investigation Guide #1 for Cruise 12.02*; one copy for each student group
- ❑ Computers with Internet access

Background for the Gulf of Mexico 2012 Expedition

Background information about the mission of the NOAA Ship *Okeanos Explorer* and its multibeam sonar system is provided in the lesson, *Tools for Classroom Explorers – How to Use Multibeam Sonar Data*.

The purpose of the Gulf of Mexico 2012 Expedition is to explore unknown and poorly known ocean areas in the Gulf of Mexico. Specifically, the northern West Florida Escarpment, the DeSoto Canyon in the northeastern Gulf, the vicinity of the Deepwater Horizon or Macondo Well, and deepwater shipwrecks (Figures 1 – 5). A major objective of the expedition is to use the *Okeanos Explorer's* state-of-

the-art ocean exploration capabilities to investigate the diversity and distribution of deep-sea habitats and marine life in the target areas. Even after extensive investigations following the Deepwater Horizon blowout event in 2010, much of the Mississippi Canyon area where the event occurred remains unexplored. Throughout the deep Gulf of Mexico the situation is much the same: the ecology and even the basic distribution of seeps and deep-sea ecosystems remain poorly understood. For additional information about the Gulf of Mexico 2012 Expedition, please see the *Gulf of Mexico 2012 Okeanos Explorer Expedition Education Module* http://oceanexplorer.noaa.gov/okeanos/explorations/ex1202/background/edu/edu.html.

The Gulf of Mexico 2011 Expedition (http://oceanexplorer.noaa.gov/okeanos/explorations/ex1105/welcome.html) demonstrated that the *Okeanos Explorer's* deepwater multibeam sonar system can be used to map the location of gaseous seeps, and this capability will be used to search for hydrocarbon seeps in all of the areas to be explored. While much of the exploration of deepwater ecosystems in the Gulf of Mexico has been driven by their association with hydrocarbon seeps that may indicate the presence of undiscovered petroleum deposits, these are also unique biological communities whose importance is presently unknown. (For more about hydrocarbon seeps and their associated ecosystems, please see *Lessons from the Deep: Exploring the Gulf of Mexico's Deep-Sea Ecosystems Education Materials Collection*; http://oceanexplorer.noaa.gov/edu/guide/welcome.html.)

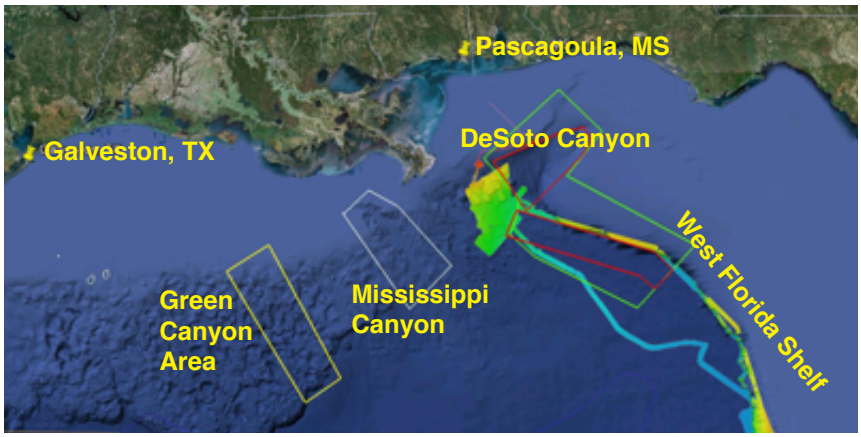


Figure 1 – Google Earth map showing general priority areas for the Gulf of Mexico 2012 Expedition.

Images from Page 1 top to bottom:
Bobby Mohr, Tom Kok, and Jeff Williams discuss 'the plan' on the back deck. Image courtesy of the NOAA *Okeanos Explorer* Program.
http://oceanexplorer.noaa.gov/okeanos/explorations/ex1202/logs/hires/mar21-2-hires.jpg

Anchor resting on the top of the Site 15429 wreck. *Lophelia* coral is also visible.
After a great first marine archaeology dive on March 27, everyone was excited about exploring a second target. Site 15429 was initially located in 2009 with the National Institute for Undersea Science and Technology's (NIUST) *Eagle Ray* autonomous underwater vehicle (AUV). The data showed a potential vessel resting on the seafloor. The remotely operated vehicle (ROV) dive confirmed what several members of the Science Team expected. The wreck appears to be a hotspot for *Lophelia* coral. It was a great day for both the marine archaeologists and the biologists. Image courtesy of NOAA *Okeanos Explorer* Program.
http://oceanexplorer.noaa.gov/okeanos/explorations/ex1202/logs/hires/mar29_hires.jpg

Image of gridded bathymetry shown as a wireframe and draped over gridded backscatter data. Ever since the Team on Leg I of the Gulf of Mexico expedition mapped the DeSoto Canyon area in early March 2012, there was lots of speculation about one specific seafloor feature in approximately 400 meters of water. Not only did the feature seem to be the one spot of significant relief in an otherwise fairly flat area, but it also showed up in the backscatter data as a very 'hard' target. Image courtesy of NOAA *Okeanos Explorer* Program.
http://oceanexplorer.noaa.gov/okeanos/explorations/ex1202/logs/hires/mar28_update_hires.jpg

Through the power of technology, scientists on the ship and on shore are able to view and learn about the complex ecosystems in the Gulf of Mexico. Deep-sea corals flourish in the dark depths of the Gulf of Mexico, providing foundations that attract lush communities of other animals, including brittle stars, anemones, crabs, and fish. This diversity of life on the seafloor may be out of sight, but it is has been squarely on the minds of scientists seeking to determine the short- and long-term ecological impacts of the Deepwater Horizon oil spill. Image courtesy of the NOAA *Okeanos Explorer* Program.
http://oceanexplorer.noaa.gov/okeanos/explorations/ex1202/logs/hires/mar24-2-hires.jpg

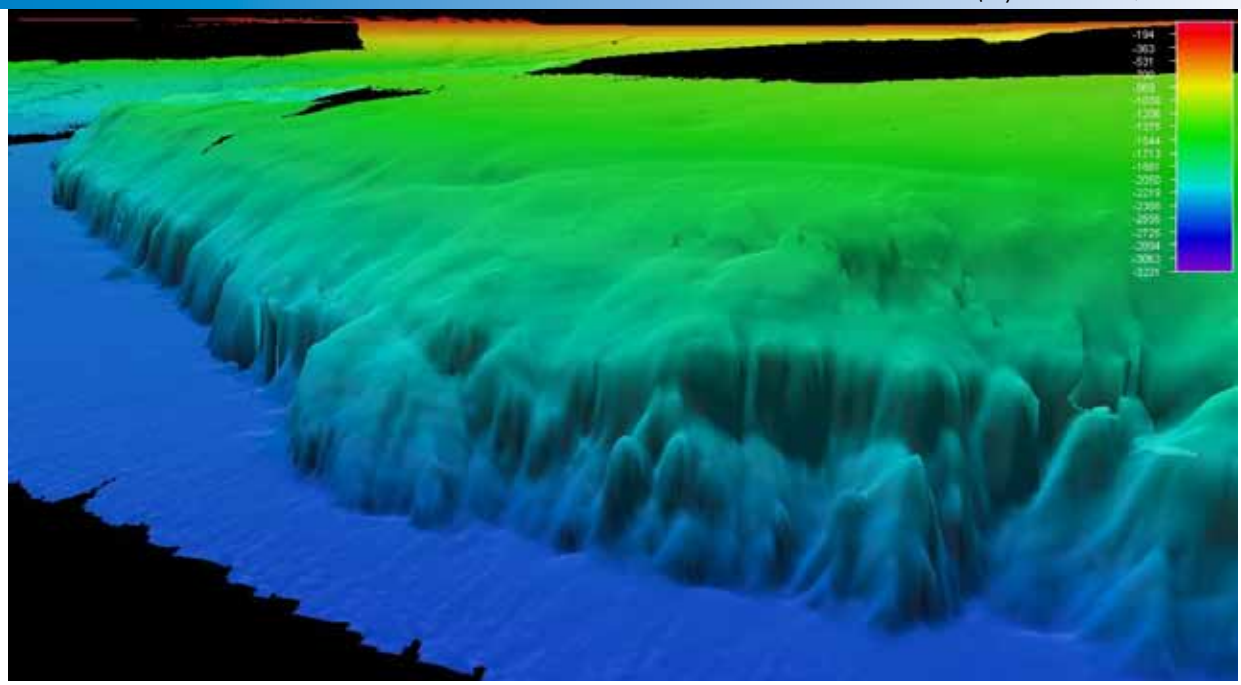


Figure 2 – Bathymetry of the West Florida Escarpment. The base of the escarpment (2,600 meters depth) is shown in blue with the upper rim more than 600 meters above. The expedition will identify at least four dive sites that cover the diverse soft sedimented and hard carbonate rock bottom between 2,300 and 400 meters to explore the physical structure of the seafloor and biodiversity on soft and hard bottom habitats (Multibeam data from EX1105, EX1106, and this expedition, EX1202). Image courtesy of the NOAA *Okeanos Explorer* Program. [*http://oceanexplorer.noaa.gov/okeanos/explorations/ex1202/background/hires/science-1-hires.jpg*]

Figure 3 – Bamboo corals (with an attached crinoid) on a scarp wall in the DeSoto Canyon area (2,055 meters depth). Image courtesy of the NOAA *Okeanos Explorer* Program. [*http://oceanexplorer.noaa.gov/okeanos/explorations/ex1202/background/hires/science-3-hires.jpg*]

Figure 4 – Corals and associated animals living with them in the vicinity of the Deepwater Horizon oil spill (within 11 kilometers) as captured by a time-lapse camera image. Image courtesy of C. Fisher and T. Shank, Woods Hole Oceanographic Institution. [*http://oceanexplorer.noaa.gov/okeanos/explorations/ex1202/background/science/media/science-2-600.jpg*]

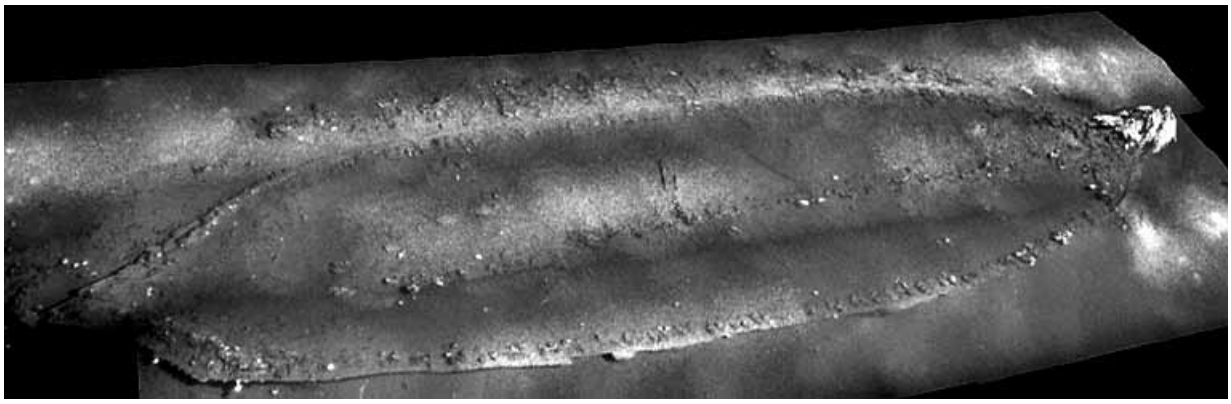


Figure 5 – Mosaic of the Ewing Bank Wreck at 621 meters depth in the Gulf of Mexico. This three-dimensional perspective of the Ewing Bank Wreck was produced by "draping" the photo mosaic over the multibeam bathymetry. The photos and multibeam data were collected with the C-Surveyor autonomous underwater vehicle. Image courtesy of C & C Technologies, Inc.; video courtesy of *Lophelia* II 2009: Deepwater Coral Expedition: Reefs, Rigs, and Wrecks Exploration. [*http://oceanexplorer.noaa.gov/okeanos/explorations/ex1202/background/hires/science-4-hires.jpg*]

Procedure

1. To prepare for this activity:
   a. Ensure that students are familiar with procedures described in the lesson, *Tools for Classroom Explorers – How to Use Multibeam Sonar Data*.
   b. Make copies of *Multibeam Sonar Student Investigation Guide #1 for Cruise 12.02* for each student group.
   c. Download the data file EX1202_mb_1.sd from http://oceanexplorer.noaa.gov/okeanos/edu/resources/media/ex1202_mb_1.sd, and install this on computers that students will use to complete the *Investigation Guide* activities.

d. Ensure that the iView4D software (http://www.ivs3d.com/products/iview4d/) is installed on computers that students will use to complete the Investigation Guide activities. Alternatively, you may have students download this software and the data file to their own computers.
e. Review the Mission Plan and Background Essays for the Gulf of Mexico 2012 Expedition (linked from http://oceanexplorer.noaa.gov/okeanos/explorations/ex1202/background/welcome.html). You may also want to review Daily Updates and Mission Logs for March 20 – 23, 2012, and consider assigning these as the basis for short student reports to give a more complete impression of the expedition's activities.

2. Briefly review the purpose of the Gulf of Mexico 2012 Expedition. If assigned, have students present their reports based on Daily Updates and Mission Logs.

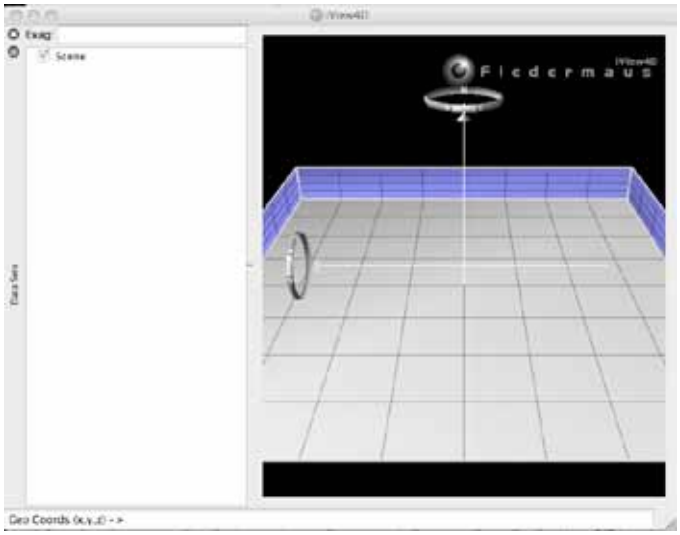
3. Provide each student group with a copy of the *Multibeam Sonar Student Investigation Guide #1 for Cruise 12.02*, and have them complete the activities described in the *Guide*.

4. Discuss students' answers to *Investigation Guide* questions. These should include:
- The depth of the location at latitude 26°28'11.99", longitude -84°46'48" is about 450 m.
- The location in the vicinity of latitude 26°28'11.99", longitude -84°46'48" is near a drop-off that runs roughly southeast-northwest. The drop is from a broad, flat shelf to the east that is about 400 m deep. To the west, the bottom slopes gradually from about 450 m to about 900 m at the edge of the image.
- This location was selected for the first ROV dive of the Gulf of Mexico 2012 Expedition because it is relatively shallow, and does not appear to have rough terrain that might be difficult to navigate.
- The depth of the location at latitude 27°55'12", longitude -86°2'24" is about 1,583 m.
- The location in the vicinity of latitude 27°55'12", longitude -86°2'24" is at the top of a cliff that drops from about 1,600 m to about 2,400 m at the base of the cliff. The edge of the cliff runs roughly east-west. The terrain south of the cliff base is rugged, with a series of ridges and valleys that extend from the northeast to the southwest (this is even more apparent when the image is rotated so that the view is from south to north).
- To have the best chance of seeing a variety of habitats and animals starting at the location at latitude 27°55'12", longitude -86°2'24", the ROV should first be steered to the south down the cliff face, then east or west over the ridges and valleys, because varying terrain is more likely to include different habitats.
- Depth should not be a problem for *Little Herc* at this location, because the maximum depth in the surrounding area is less than 3,200 m.

Multibeam Sonar
Student Investigation Guide #1 for Cruise 12.02

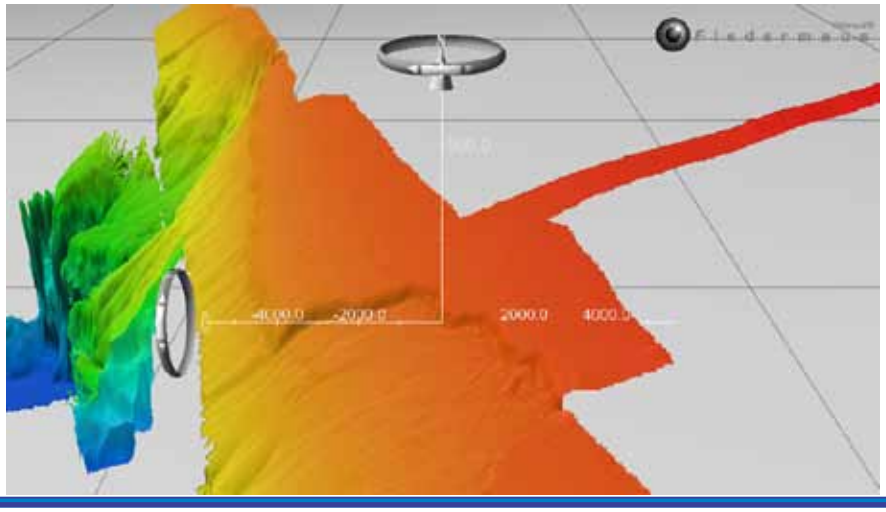
1. Launch the iView4D software. Your screen should resemble Figure 1. Note the Rotation Control Rings near the top center and mid-left side of the screen. If your screen doesn't look like Figure 1, be sure "Bounds" is checked under the "View" drop-down menu.

Figure 1.



2. Open the file, EX1202_mb_1.sd. This is a multibeam sonar image of the western Florida Escarpment surveyed by NOAA Ship *Okeanos Explorer* during the Gulf of Mexico 2012 Expedition. Place your cursor on the location at latitude 26°28'11.99", longitude -84°46'48", and zoom in to this location so that your screen resembles Figure 2. [HINT: It is easier to put your cursor on the approximate location, right-click (control-click on a Macintosh platform) to center the image on this point, then hold the mouse button down while you drag to zoom the image. Repeat this process until you have reached the desired zoom level and the desired location is centered in the image.] What is the depth at this location?

Figure 2.

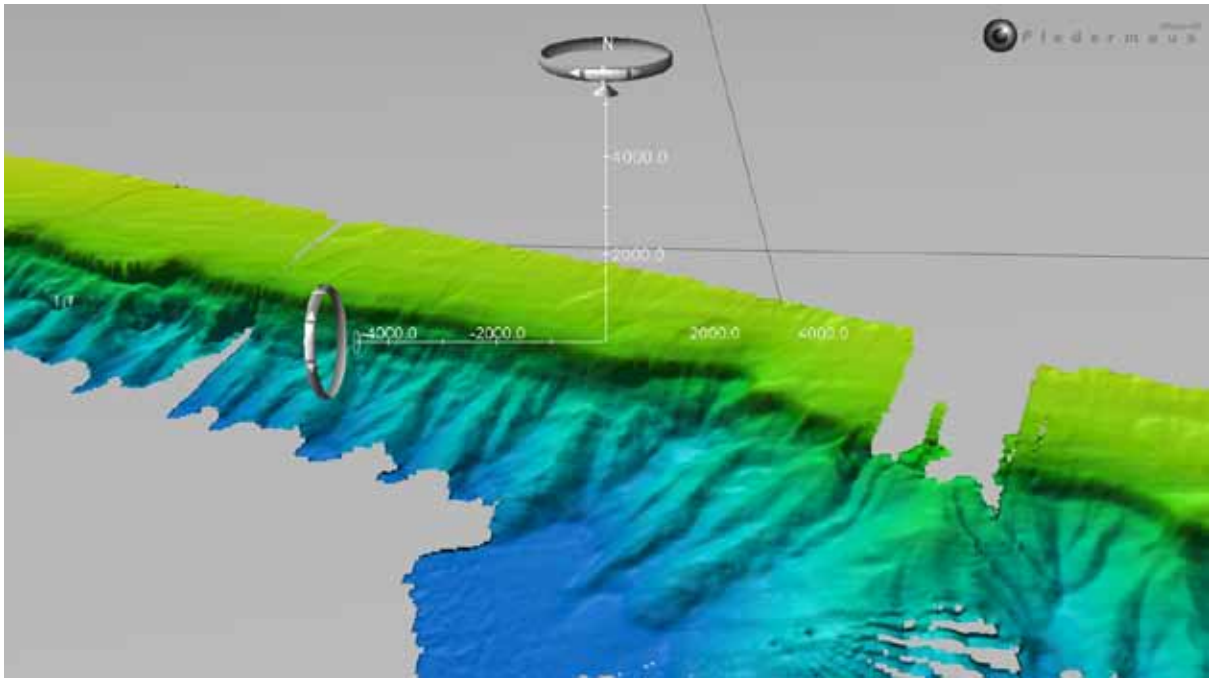


3. Adjust the vertical exaggeration to 1.00 (no exaggeration). Rotate the image in several directions to get a general idea of the terrain surrounding this location. How would you describe this terrain?

4. This location was selected for the first ROV dive of the Gulf of Mexico 2012 Expedition, which took place on March 20, 2012 (you can read about this dive and link to video highlights from the dive here: http://oceanexplorer.noaa.gov/okeanos/explorations/ex1202/logs/dailyupdates/dailyupdates.html). Why do you think this location was selected?

5. Zoom out, and place your cursor on the location at latitude 27°55'12", longitude -86°2'24." Zoom in so that your screen resembles Figure 3. What is the depth at this point?

Figure 3.



6. Be sure the vertical exaggeration is set at 1.00. Rotate the image in several directions to get a general idea of the terrain surrounding this location. How would you describe this terrain?

7. This location was the starting point for the Gulf of Mexico 2012 Expedition's third ROV dive on March 23, 2012 (you can link to video highlights from the dive here: http://oceanexplorer.noaa.gov/okeanos/explorations/ex1202/logs/mar23/media/movies/highlights0323_video.html). If you were planning this dive, and wanted to have the best chance of seeing a variety of habitats and animals, how would you steer the ROV?

8. The maximum depth for ROV *Little Hercules* is 4,000 m. Would depth be a problem for *Little Herc* if it attempted to explore the deepest parts of area covered by this scene?