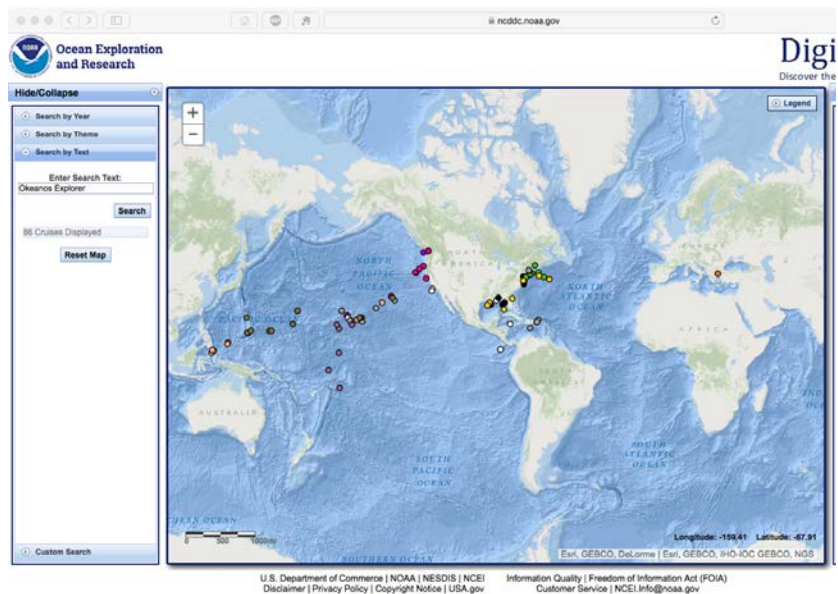


Northeast U.S. Canyons Expedition 2013: Cold Seeps

This activity illustrates how to use the Digital Atlas and how to use the Fledermaus software, and extends the Ocean Explorer Digital Atlas Supplement to explore a different location.

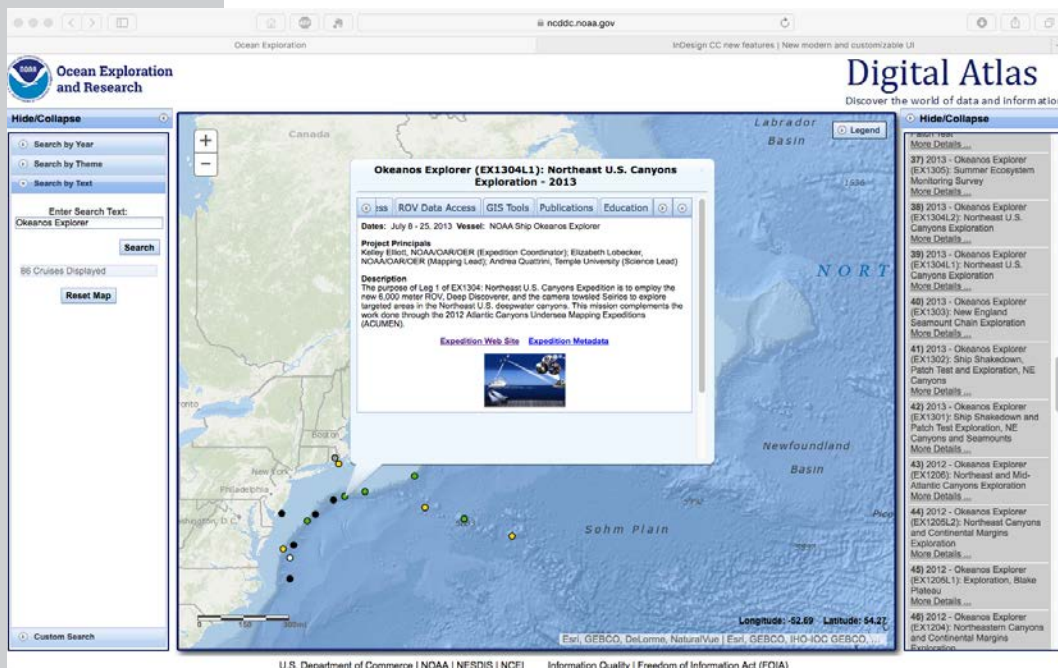
1. Open the Ocean Explorer Digital Atlas at http://www.ncddc.noaa.gov/website/google_maps/OE/mapsOE.htm.
2. In the left column click on the **Search by Text** tab at the bottom. In the text box type *Okeanos Explorer*. The dots that will appear on the map are all of the *Okeanos Explorer* expeditions color-coded by year.



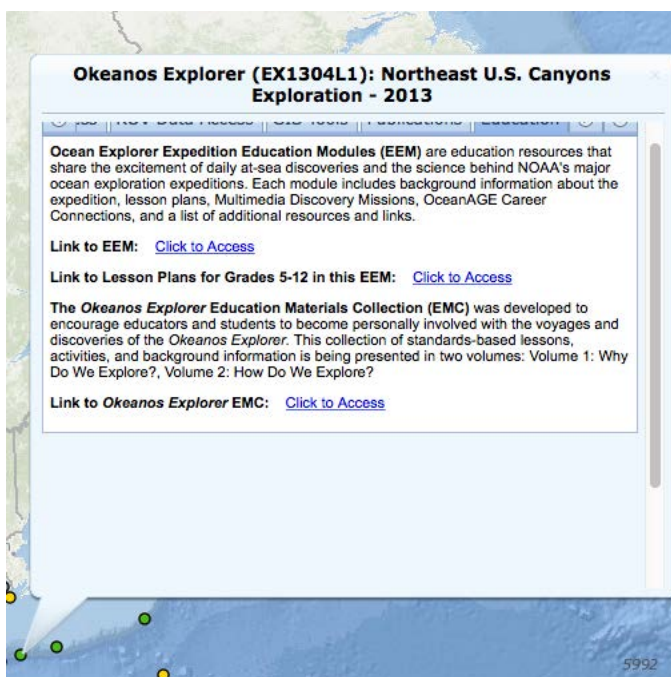
3. In the column on the right, scroll to find the 2013 *Okeanos Explorer* Northeast U.S. Canyons Expedition (EX1304L1). Tell students that cruises are named with an abbreviation of the ship name ("EX" is used as an abbreviation for *Okeanos*

A screen grab from the map on the Digital Atlas web site showing sites of Ocean Explorer cruises. The database can be searched by Expedition, Year, Theme, Text or Custom Search. https://www.ncddc.noaa.gov/website/google_maps/OE/mapsOE.htm

Explorer), the last two digits of the year in which the cruise took place ("13"), the number of the cruise (this was the fourth cruise for 2013), and the segment or leg (this was the first leg of cruise 04). Click on this cruise and you will see a pop up box as illustrated in the figure below.



Notice the tabs provided at the top of the pop up window. For educator information related to this cruise, click on the **Education** tab. This will take you to several educational resources available on the Ocean Explorer website related to this expedition including an Expedition Education Module which provides background information, an introductory video, lessons and more resources associated with the expedition.

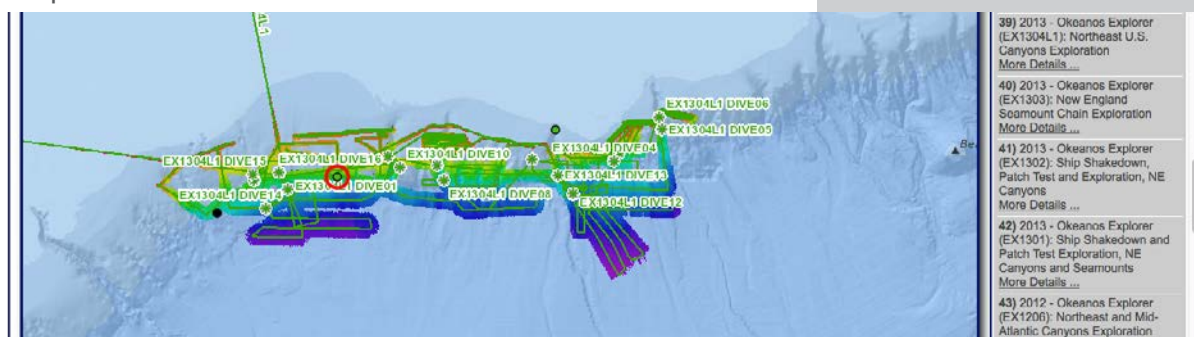


The Northeast U.S. Canyons Expedition took place during the summer of 2013. During this expedition, a team of scientists and technicians both at-sea and on shore conducted exploratory investigations on the diversity and distribution of deep-sea habitats and marine life along the Northeast U.S. Canyons and at Mytilus Seamount, located within the U.S. Exclusive Economic Zone. During this mission, the exploration team observed deep-sea coral communities, undersea canyons, seamounts and cold seeps. The 36-day expedition complemented work done through the *2012 Atlantic Canyons Undersea Mapping Expeditions (ACUMEN)* <http://oceanexplorer.noaa.gov/oceanos/explorations/acumen12/welcome.html>.

The expedition also marked the first time NOAA's new 6,000 meter remotely operated vehicle (ROV), *Deep Discoverer* <http://oceanexplorer.noaa.gov/technology/subs/deep-discoverer/deep-discoverer.html> and the *Seirios* <http://oceanexplorer.noaa.gov/oceanos/explorations/ex1708/logs/sept26/welcome.html> camera sled and lighting platform were used in a full telepresence-enabled ocean exploration with NOAA Ship *Okeanos Explorer*. When these systems were deployed from the ship, the expedition team was able to provide scientists and audiences onshore with real-time video footage from deepwater areas in important, largely unknown, U.S. waters.

- Click on the **GIS Tools** tab in the pop up window, select the first four boxes, and click **Plot on Map**. (See image at right.)

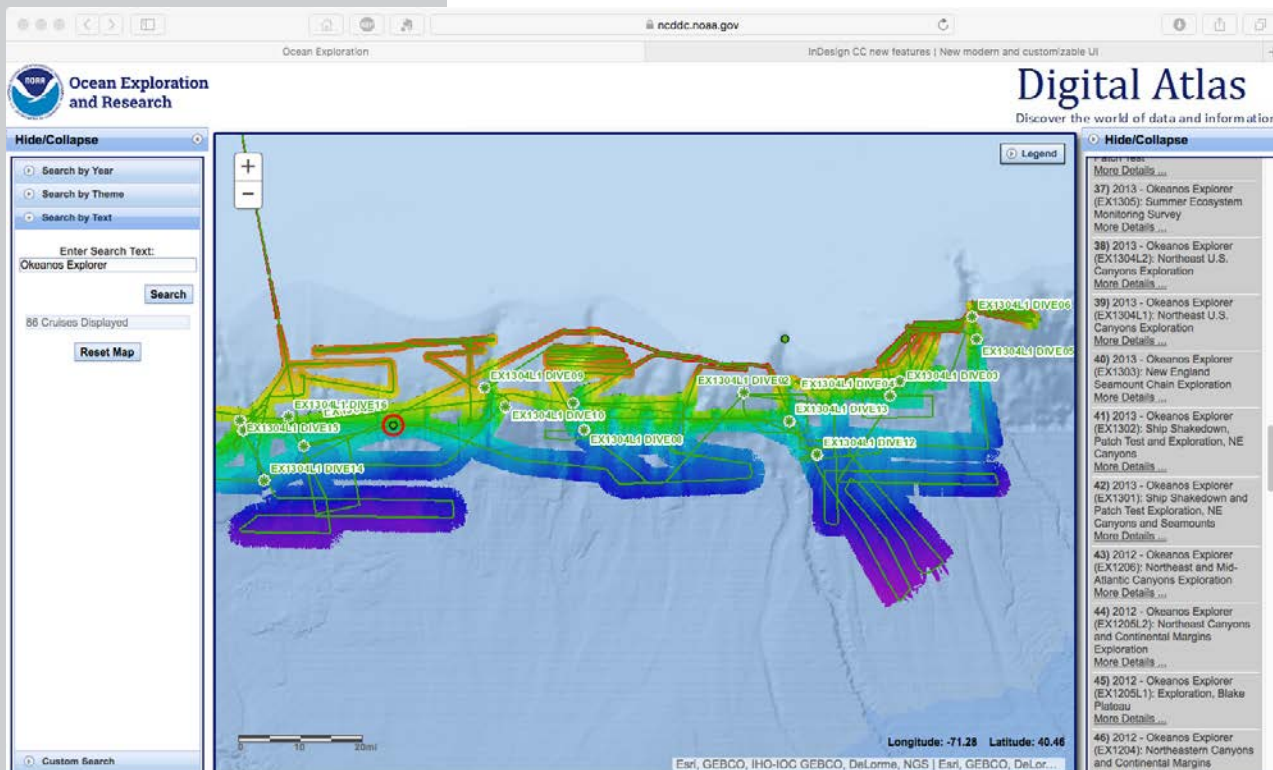
Give the map a moment to load and what appears should look like the figure below. This shows the ship's entire cruise track and the bathymetric mapping work done throughout the expedition.



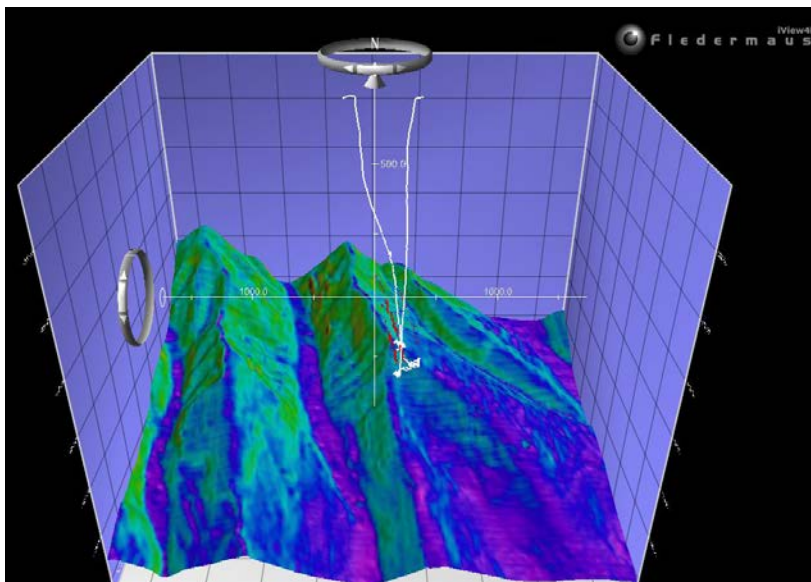
- Click on the map and holding the left cursor down, move the view slightly to the right. Zoom in until you find Dive 3 indicated with a star and EX1304L1 Dive 3.

Point out the light green line, which is the ship's track, and ask students why the ship seems to be tracking back and forth. Explain to students that the first step in the ship's exploration strategy is mapping and that the ship is obtaining high-resolution multibeam maps of the area being explored (this is called "mowing the lawn," for obvious reasons). You will see

both the track of the ship and the false color bathymetry of the mapped seafloor.



- Click on service.ncddc.noaa.gov/rdn/oer-waf/media/ex1304l1/EX1304L1_Dive03_Seeps.scene. This will open an interactive scene file of the cold seeps found at this location within a three dimensional data visualization system called Fledermaus. (This free software must be downloaded to view and manipulate the image in the figure below.)



Fledermaus image of cold seeps.

- Orientation to Fledermaus manipulation tools:
 - Notice on the top left box that the exaggeration is set at 3.00x. The actual exaggeration is 1. The image has been

exaggerated to three in order to view the structure in more detail.

- b) In the column on the left, viewers can select different views of the region being explored. Checking the first box will provide a false color map of the region with purple being the deepest points and red being the shallowest points. Checking the third box will show the slope. Checking the fourth box will show the track of the ROV. Checking the fifth and sixth boxes will reveal the bubbles from methane seeps discovered during the expedition.
- c) The white x and y axis orients the viewer to distance in meters.
- d) The rings on the left and at the top of the image can be used to manipulate the view. (Note: Use Camera and Reset Camera in the menu bar to return to the original view.)
- e) The ocean floor is shown as a three-dimensional image. The x-axis represents longitude, the y-axis represents latitude, and the z-axis represents depth. When you move the cursor over the image, the window near the bottom of the screen shows the geo coordinates (x, y, and z) for the location beneath the cursor.

Have students analyze the image and develop questions based on their own curiosity.

Questions for students to consider might include:

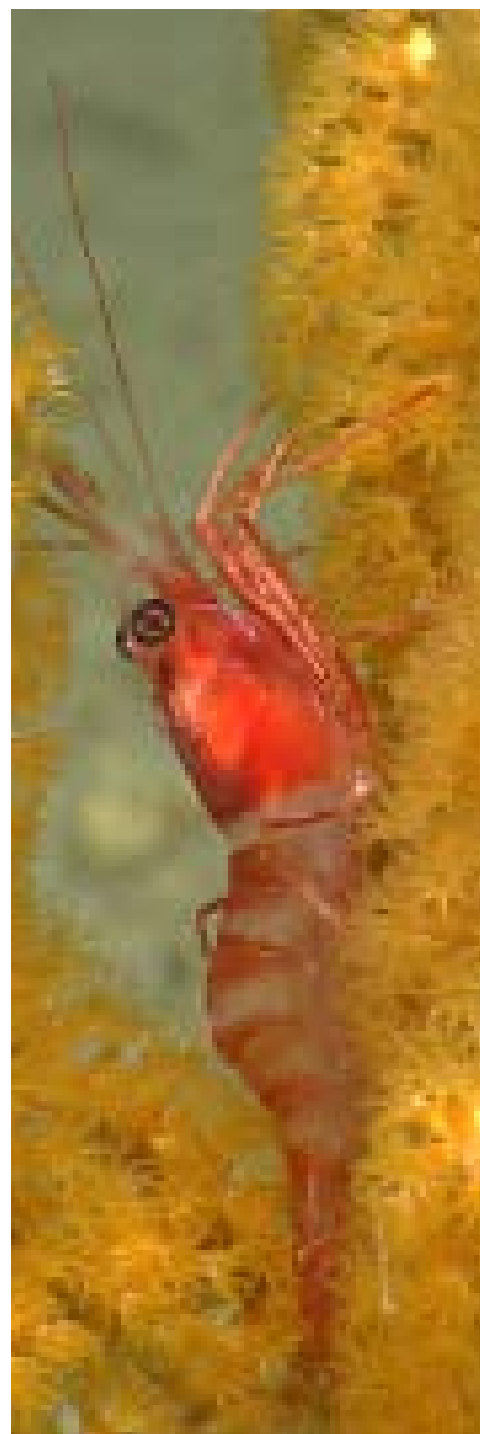
- What is the deepest point in this region?
- What is the shallowest point in this region?
- What appears to be one of the steepest points in this region?
- How deep did the ROV travel when exploring this area?
- Why is the red row of bubbles leaning to the west vs. being perfectly vertical?
- What organisms might live here? Why?
- Why did the scientists select the dive locations? If you were the scientist leading this expedition and exploring this region for the first time, where would you choose to send the ROV?
- What considerations do you think need to be made when deciding what regions to select for further exploration?

8. Now go back to the atlas and click on the expedition box on the right, EX1304L1, again. In the pop up window **Summary** tab will be a link to the expedition on the Ocean Explorer website. Click on **Expedition Website**. This is the main Northeast U.S. Canyons Expedition 2013 webpage. Find and click on the **Daily Updates** link. Scroll to Leg 1 Dive 3, July 11, 2013 to read about what was found during this dive. Also read the update from Dive 4 on July 12.

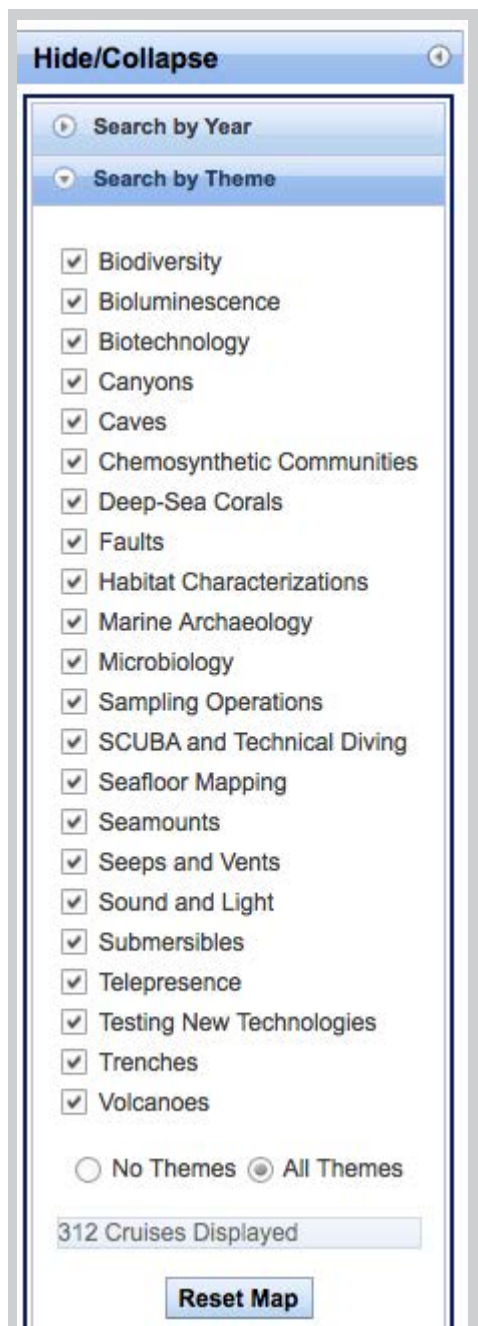
Have students:

Read the updates.

Click on the highlight videos from the ROV dives on these dates (links are under the images in each Daily Update.)



A shrimp rests on octocoral in Hydrographer Canyon Image courtesy of NOAA *Okeanos Explorer* Program, 2013 Northeast U.S. Canyons Expedition. <http://oceanexplorer.noaa.gov/okeanos/explorations/ex1304/logs/july22/media/shrimp-coral.html>



Themes that can be searched in the OER Digital Atlas.

Send Us Your Feedback

We value your feedback on this lesson, including how you use it in your formal/informal education settings. Please send your comments to: oceanexeducation@noaa.gov

Acknowledgments

Design/layout: Coastal Images Graphic Design, Charleston, SC. If reproducing this lesson, please cite NOAA as the source, and provide the following URL: <http://oceanexplorer.noaa.gov>

After reading and watching the video, ask students:

How is the *Okeanos Explorer* exploration strategy at work during this exploration? (See *Introduction to Ships of Exploration and Their Strategy for Ocean Exploration* <http://oceanexplorer.noaa.gov/okeanos/edu/collection/media/hdwe-StrategyBkgnd.pdf>)

What did you see that you would want to explore further? What would you want to know if you had the chance to go back?

What was the goal of this dive?

What do the bacterial mats found tell the scientists?

How big is the methane hydrate they found (the red lasers are 10 cm apart)?

What organisms did they find during these dives?

- Have students read the background essay *Exploration of Cold Seeps on the North Atlantic Continental Margin* <http://oceanexplorer.noaa.gov/okeanos/explorations/ex1304/background/coldseeps/welcome.html> and the Mission Log from July 12, *Chemosynthetic Communities and Gas Hydrates at Cold Seeps South of Nantucket* <http://oceanexplorer.noaa.gov/okeanos/explorations/ex1304/logs/july12/july12.html> to understand the biological and global significance of the discovery of these methane seeps.

Extension

Try the lesson *What's the Big Deal?* http://oceanexplorer.noaa.gov/okeanos/edu/collection/media/wdwe_bigdeal.pdf and have students build a methane hydrate model.

Additional Resources

Skarke, A, et. al. Widespread methane leakage from the sea floor on the northern US Atlantic margin. *Nature Geoscience* 7, 657–661. Published online 24 August 2014. – An article about how methane emissions from the sea floor affect methane inputs into the atmosphere, ocean acidification and de-oxygenation, the distribution of chemosynthetic communities and energy resources. <https://www.usgs.gov/news/natural-methane-seepage-us-atlantic-ocean-margin-widespread>

Fountain, H. Methane Is Discovered Seeping From Seafloor Off East Coast, Scientists Say, *The New York Times*, Science Scientists have discovered methane gas bubbling from the seafloor in an unexpected place: off the East Coast of the United States where the continental shelf meets the deeper Atlantic Ocean. https://www.nytimes.com/2014/08/25/science/methane-is-seeping-from-seafloor-off-east-coast-scientists-say.html?_r=0