MAPPING DEEP-SEA FEATURES

Bathymetric mapping of deep-sea habitats

How can deep-sea areas be mapped to facilitate exploration with a manned submersible?

This activity focuses on how bathymetric maps are created from multi-beam bathymetric data. Students will construct a false color map of the Loihi submarine volcano, using real data.

A chain of small islands and atolls stretches for more than 1,000 nautical miles northwest of the main Hawaiian Islands. While scientists have studied shallow portions of the area for many years, almost nothing is known about deeper ocean habitats below the range of SCUBA divers. Only a few explorations have been made with deep-diving submersibles and remotely operated vehicles (ROVs). These brief excursions led to the discovery of new species and species previously unreported in Hawaiian waters.

A major constraint to exploration of deepwater regions around the Northwestern Hawaiian Islands is the absence of accurate maps. In fact, recent expeditions found that some islands are not where they are supposed to be according to official nautical charts. Since time in submersibles is limited and expensive, every dive is carefully planned to ensure that the submersible goes to places of scientific interest. Good bathymetric maps are essential to good planning.

Scientists aboard the University of Hawaii's research vessel *Kilo Moana* used multi-beam swath bathymetry to create detailed pictures of the underwater topography around the Northwestern Hawaiian Islands. Multi-beam swath bathymetry also called high-resolution multi-beam mapping, uses a transducer – a combination microphone/loudspeaker – on the ship's hull to send out sound pulses in a fan-shaped pattern below the ship. It records sound reflected from the sea floor through receivers focused at different angles on either side of the ship. This system collects high-resolution water depth data, distinguishing differences of less than one meter. It also measures back scatter – the amount of sound energy returned from the sea floor – which identifies different materials such as rock, sand, or mud on the sea floor.

The multi-beam system, coupled with a global positioning system (GPS), pinpoints sea-floor locations within one meter. Data are collected in digital form for computer analysis which produces maps, three dimensional models, and even fly-by videos simulating a trip through the area in a submersible.

Bathymetric maps are the most common output. Points with the same depth are connected by lines, showing mountains and valleys as a series of concentric, irregular closed curves. Lines that appear close together indicated steep slopes while lines that are farther apart indicate more gentle slopes.

The bathymetric data provided are part of a real data set produced by a research vessel. Each data point represents the depth of water below the research vessel when the vessel was at the location of the grid coordinates. The upper left corner of grid cell 1, 1 is latitude 18^{o}45'N, longitude 155^{o} 20'W. Each grid cell is one minute (01') of latitude or longitude. You may assume the depth reading was taken at the center of each grid cell.

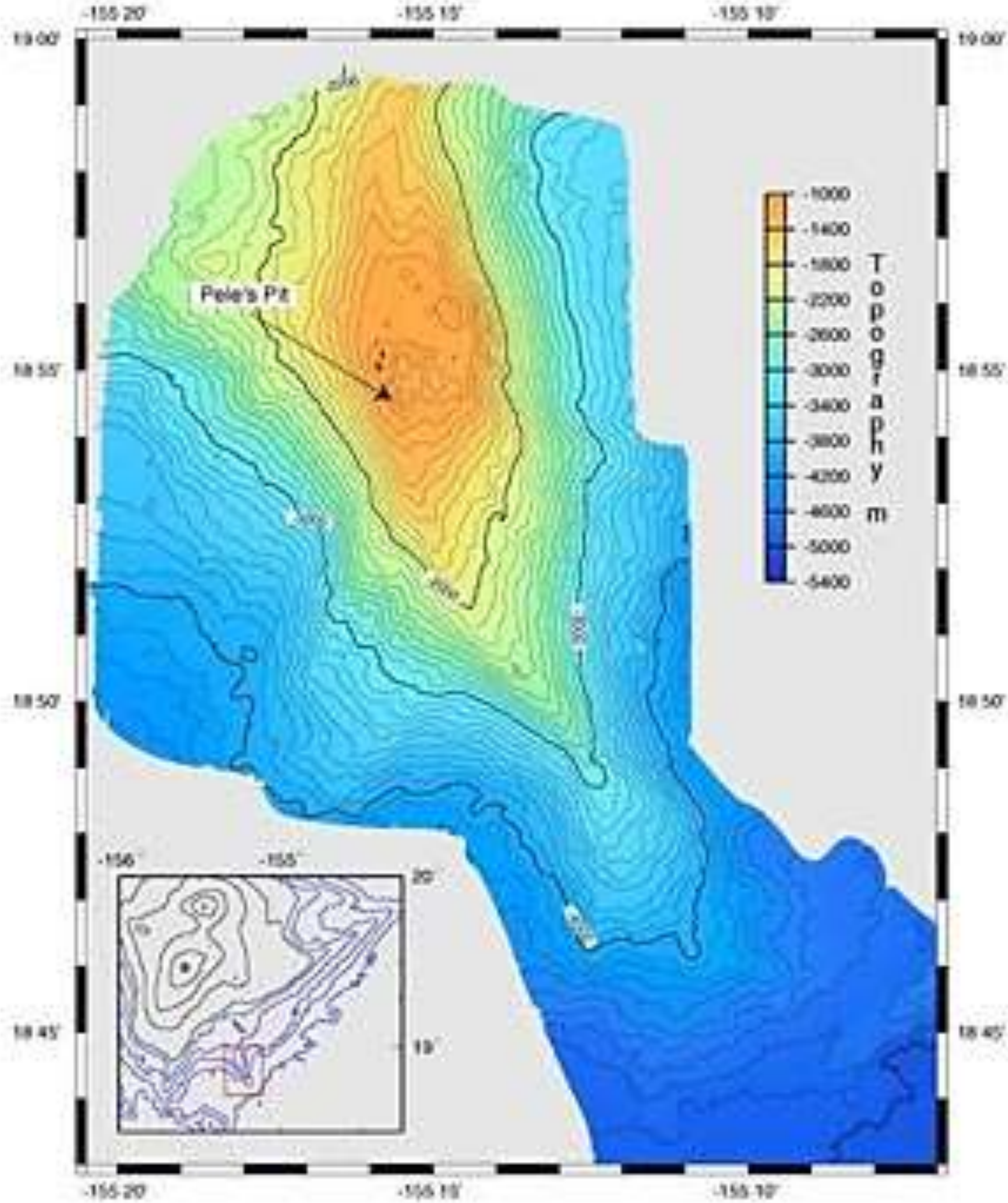
Flat regions are more likely to accumulate sediment, creating different habitats than steep places. On the other hand, steep areas have greater depth range within a short distance, so these are better places to study how depth influences the distribution of various species.

1. Enter the depth reading into the corresponding grid cells.

2. Color the entire square the assigned color for that depth. Colors may vary, but use in the sequence of the spectrum of light.

3. Discuss the advantages of various sites on the volcano for diving missions.

4. Identify dive sites that are likely to offer a variety of habitats within a short distance.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-155 15'
-155 10'
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18 55'
18 50'
18 45'
Pele's Pit
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Topography m
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