Activity 1
Building an Ocean Floor Profile

Background

For most of humankind's exploration of the earth, the features of the ocean floor were virtually unknown. Maps of the lands under human influence became more and more detailed and accurate, but oceans remained big blank blue areas. As shipping increased, coastal charts with accurate depths were developed, but these were limited to the reach of a lead weight on a line cast by a sailor. Typically limited to maximum depths of tens of fathoms, these charts served to identify shipping channels and warn of banks, reefs, and shoals that could ground or wreck ships. This coastal charting accounted for a tiny fraction of the oceans' total area, and for all practical purposes the ocean was bottomless beyond the reach of sailors' sounding lines.

The circuitous, globe-circling three and a half-year voyage of HMS *Challenger* beginning in December 1872 provided a wealth of new information about the oceans. *Challenger* carried a piano-wire depth sounding system that recorded the first accurate depths of the deep ocean floor, including a sounding of almost 9000 meters in the Mariana trench. Further soundings throughout the major ocean basins proved the average depth of the oceans to be beyond the predictions of the time, but failed to yield an accurate picture of the ocean floor due to the limited number of data points. A single deep-sea sounding could take over twelve hours to accomplish using the ship's steam winches to lower and retrieve the massive string of wire. A technological breakthrough was needed to get a better picture of the ocean floor.

The breakthrough would not occur until the next century with the advent of sonar (SOund Navigation And Ranging). Impulses of sound are emitted from the ship using sonar, and the time taken for the sound pulse to bounce off the bottom and return to the ship is recorded. A simple calculation then determines the depth under the ship. This allowed ships to record depths nearly continuously as they traversed the oceans, and gave rise to the field of bathymetry, the study of ocean floor topography. A ship crossing an ocean could generate an ocean floor profile along its passage, and many profiles taken across different sections of an ocean could give us the first glimpse of the magnitude of ocean floor features. This was still a very limited, two-dimensional way of analyzing the ocean floor, though, and most of the ocean floor remained uncharted. By some estimates, only about 5% of the ocean floor had been accurately charted by the 1970's.

The picture became much clearer when the *Seasat* mission was launched in 1978. This satellite used radar to accurately map sea levels, which vary proportionately with ocean depths. In the three months *Seasat* orbited the earth, more bathymetric

data was recovered than in all of the previous thousands of years of human ocean exploration. Using remote sensing and detailed sonar surveys, we now finally have a detailed picture of the entire earth, including the roughly two-thirds covered by water.

Learning Outcomes

Students Shall:

- Learn about bathymetry and ocean floor profiles and construct an ocean-floor profile of the Atlantic Ocean at 39° North latitude
- Learn about and identify ocean floor features
- Practice graphing skills
- Appreciate the depth of the oceans and the technology needed to map them.

Glossary

Abyssal Plain - Deep, flat or gently sloping areas of the ocean floor.

Bathymetry - The study of the topography of the ocean floor.

Continent - Large landmass rising abruptly from the deep ocean floor.

Continental Shelf - Shallow, gently sloping area adjacent to continents.

Continental Slope - Steeply sloping transition area between continental shelf and abyssal plain or trench.

Island - Body of land surrounded by water smaller than continent in scale.

Mid-Ocean Ridge - Ocean-bottom rise running the length of ocean basins roughly parallel to continental borders.

Ocean Floor Profile - Cross-sectional view of ocean floor features, usually with large vertical exaggeration.

Sonar - SOund Navigation And Ranging: Electronic method of determining depth using sound impulses' travel time from ship to bottom and back.

Seamount - Elevation rising significantly above seafloor but not breaking the surface.

Trench - Very deep narrow and long depression of the ocean floor.

Vertical Exaggeration - Horizontal scale divided by vertical scale; demonstrates the distortion produced by graphs using different x and y axis scales.