What is Bathymetry?

Bathymetry is just an oceanographer's term for undersea topography. It is just the water depth, measured downward from the ocean's surface. Just like cartographers make maps of the land's surface, oceanographers make maps of bathymetry measurements, which show the undulations in the ocean bottom.

In the days before electronics, bathymetry was measured by lowering a weight on a cable down to the ocean bottom. When the weight touched bottom, the length of the line was measured. This simple method has several drawbacks. First, you must stop the ship and in deep water, it takes many hours for the weight to reach the ocean bottom and come back up. Second, currents may push the weight and line off-vertical, so that the measured depth is not accurate. Third, if the water is deep, the large weight of the line makes it difficult to tell when the weight has hit bottom.

There had to be a better way and since the 20th century, most bathymetry depths have been measured using sound waves. Sound travels easily through water, so a sound wave sent through the water will bounce off the ocean bottom and return. If the depth of the water is D, the amount of time it takes the sound wave to come back is $T = 2D/V$, where T is the time and V is the speed of sound in water. In average salinity ocean water, $V = 1500$ meters per second. So if the water depth is, say, 750 meters, the time, T, is one second.

Around the time of World War I, the sonar was developed to find submarines. The sonar sends out a sound pulse and listens for a reflection back off of something in the water. During the war, of course, the target was submarines. But Navy sonar operators also found the sound bounced off the ocean bottom and the echosounder was born. This device is on the hull of a ship, pointed downward. It sends out a pulse directly down and then listens for the sound wave to come back. It measures the time, T, and turning the equation above around, the depth is calculated: $D = VT/2$.

For much of the 20th century, the echosounder was the standard way oceanographers measured ocean depths. As a ship cruised along, the echosounder would repeatedly fire off sound pulses, listen, and determine the depth (Figure 1). With this technique a ship could compile hundreds of soundings per hour as it moved along. Soon the shape of the ocean bottom started to become clearer. But there was still a problem with the simple echo sounder. The ship could only determine the depth directly beneath the echo sounder and ships are slow and expensive while the ocean bottom is vast. Bathymetry maps were made with huge gaps between ship tracks where the scientists could only guess the nature of the ocean bottom.

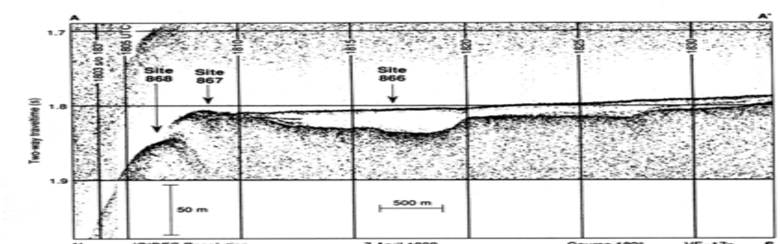

Figure 1. Bathymetry profile from a 3.5 kHz (that's the sound frequency) echosounder on the D/V *JOIDES Resolution*.

The plot shows the level or sound reflected back to the echosounder and dark areas are strong sound pulses. The scale at left is enlarged and shows the time that the sound waves took to return, called two-way-travel time. The returned sound level for each sounding is plotted sequentially as a vertical stripe and in aggregate these stripes blend together to make a picture. Thus, the horizontal axis is the time. In this plot, the ocean bottom is the uppermost strong reflection that hits the right edge at about 1.79 seconds. This frequency echosounder penetrates through soft sediments, so another reflector can be seen beneath the seafloor. This profile is from a sunken atoll in the Pacific. The strong reflector at nearly 1.8 seconds is the top of the coral bank atop the ancient atoll. The gap between the seafloor and this reflector represents a thin mantle of soft ooze sediments. At the left side of the picture, the ocean floor descends off the summit platform of the undersea platform. (From Sager and Winterer, 1995)

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http://www.oceanleadership.org/sea90e/education/InfoArticles/about_bathymetry1.html