READING SELECTION

EXTENDING YOUR KNOWLEDGE

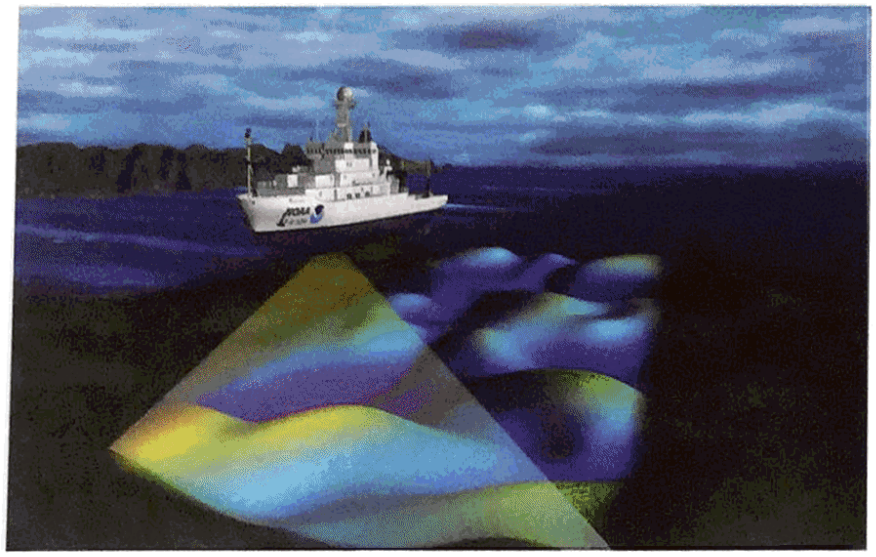
USING WAVES TO EXPLORE THE EARTH'S INTERIOR

The deepest that scientists have drilled into the earth is 12 kilometers (7.5 miles). That's less than 0.2 percent of the distance from the surface of the earth to its center! So how do scientists know so much about the layers of earth's interior? How do they know, for example, that the lithosphere is rigid? Or that the asthenosphere is soft, like taffy? Or that the outer core is liquid?

To understand how scientists study the earth's interior, think about how they study the deepest parts of the ocean floor, which, like the depths of the earth, have never been explored directly by humans. Scientists study the ocean floor and the inner earth using waves. To study the ocean, they analyze sound waves, using a technique called sonar. To study the inside of the earth, they analyze earthquake, or seismic, waves.

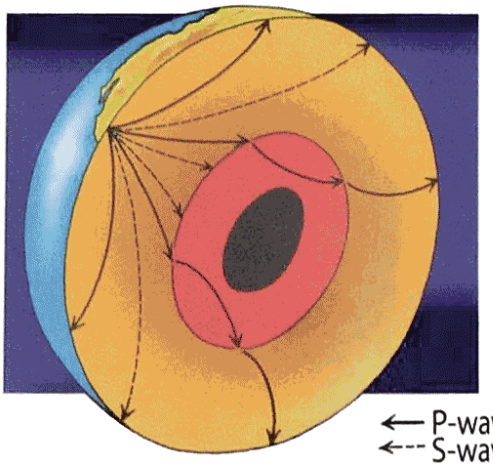
SONAR WAVES

"Sonar" stands for Sound Navigation and Ranging. A sonar system consists of a transmitter and a receiver, just like a walkie-talkie, a phone, or any other two-way communication device. The sonar transmitter sends waves from a ship to the ocean floor. The waves bounce off the ocean floor, as shown in the illustration. A receiver detects the reflected waves. Oceanographers measure the time it takes for the sound waves to complete a round trip. Because they know how far sound can travel in a certain amount of time, the scientists can then determine the depth of a specific area of the ocean. They can also combine information from many sound waves to create a profile that shows the shape of specific areas of the ocean floor.

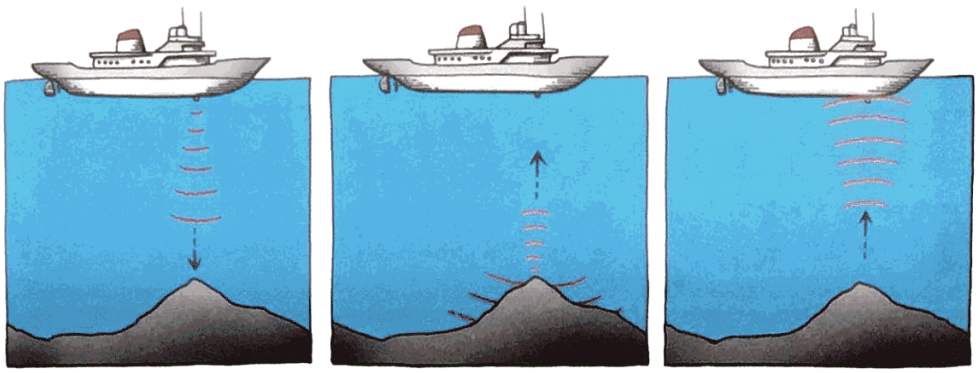


SOUND WAVES EMANATING FROM A SONAR SYSTEM ON A SHIP'S HULL COLLECT SONAR DATA IN A FAN-SHAPED AREA ON THE SEAFLOOR.

PHOTO: National Ocean Service/NOAA



THE PATHS OF P- AND S-WAVES PROVIDE SCIENTISTS WITH INFORMATION ABOUT THE EARTH'S INTERIOR STRUCTURE. FOR EXAMPLE, S-WAVES, UNLIKE P-WAVES, DO NOT TRAVEL THROUGH LIQUIDS.



Sound pulse transmitted from ship

Sound wave hits and is reflected back from bottom

Reflected sound wave received by ship

SOUND WAVES BOUNCE OFF THE OCEAN FLOOR AND RETURN TO THE RECEIVER ABOVE.

OCEAN SCIENTISTS ABOARD A U.S. COAST GUARD SHIP LOWER SONAR EQUIPMENT INTO THE WATER FOR THEIR MAPPING OF THE SEAFLOOR NORTH OF ALASKA. THEY HOPE TO BETTER UNDERSTAND CURRENTS AND CLIMATE THROUGH THEIR RESEARCH.

PHOTO: National Ocean Service/NOAA

EARTHQUAKE WAVES

Seismologists use earthquake waves to map the structure of the interior of the earth in much the same way oceanographers use sonar to map the ocean floor. As the earthquake waves move through the different layers of the earth, they change speed and direction. Sometimes they even stop. In other words, earthquake waves behave differently, depending on what substance they are traveling through. Because scientists know the average speed of P- and S-waves and also know how the waves travel, they can make educated guesses about the substances that make up the earth's interior. For example, they know that the outer core is liquid, because S-waves, which cannot travel through liquids, do not travel through the core.

The more scientists learn about sound waves and seismic waves, the more they may discover about the earth's most hidden area—its interior. ■

DISCUSSION QUESTIONS

1. Why do waves move at different speeds through different layers of the earth?
2. Why might S-waves travel more slowly than P-waves? Use Internet or library resources to see if your hypothesis is correct.