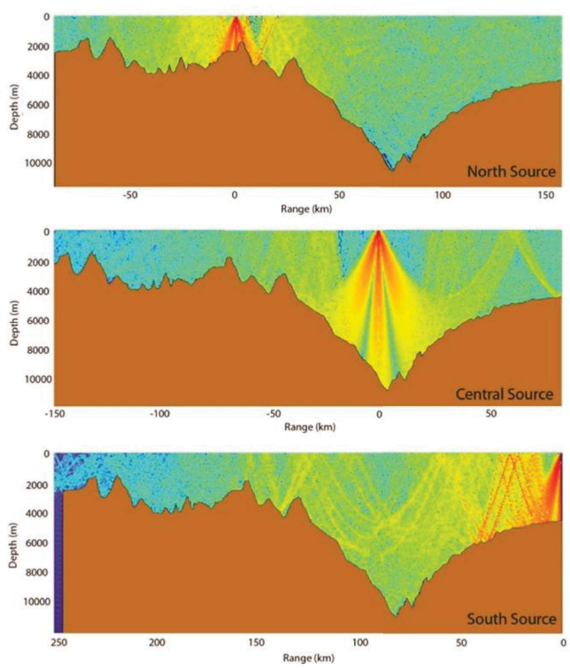
Listening to Earth

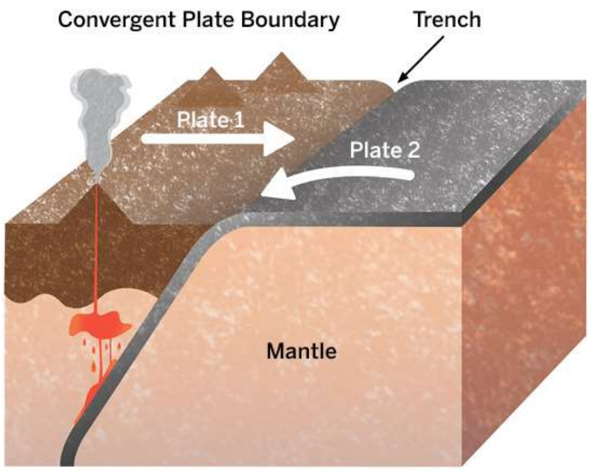
Bob Dziak (zee-AK) studies plate boundaries in a surprising way: he listens to them. Dziak is a scientist who works for the National Oceanic and Atmospheric Administration (NOAA), a government department that studies the ocean and the atmosphere. Dziak and his team wanted to know more about what happens on the ocean floor, especially at plate boundaries. Sending people to the bottom of the ocean is difficult, so Dziak and his team used hydrophones—powerful microphones that are built to travel deep under water. The team sent hydrophones 10.99 kilometers (6.83 miles) down into the deepest place in the ocean, an area known as Challenger Deep. Challenger Deep is an underwater canyon, part of a larger landform called the Mariana Trench. Dziak and his team didn't expect to hear very much noise so deep below the ocean's surface. What they actually found surprised them—their hydrophones picked up sounds from many different sources!

Bob Dziak is a scientist who studies sound in the ocean.



This diagram shows how sound travels around deep trenches like the Mariana Trench. Here, sound is represented by red and yellow lines. If the source of a sound is directly over the trench, like it is in the middle panel, sound will easily travel into the deepest parts of the trench. However, if the source of the sound is not directly over the trench, most of the sound does not make it to the bottom of the trench.

One type of sound collected by Dziak and his team was the sound of plate motion in the form of earthquakes. Earthquakes happen at plate boundaries all over the world—they are caused by the motion of plates. Dziak travels all over the world studying plate boundaries under the ocean and using hydrophones to collect data about the earthquakes that happen there. By recording earthquakes at different plate boundaries, Dziak and his team are using sound to study the ways that plates move on Earth.



This is a cross section of a convergent boundary. At convergent boundaries, two plates are moving toward one another. One plate is forced underneath the other.

Listening to Convergent Boundaries

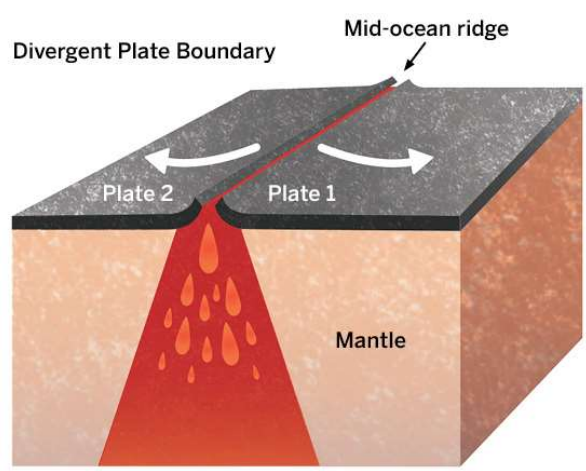
The Mariana Trench lies on a convergent boundary. In fact, the trench IS a convergent boundary, formed by one plate sinking under another. Since plate boundaries tend to have a lot of earthquakes, Dziak and his team weren't surprised to hear some earthquakes on their recordings. However, they heard many more earthquakes than they had expected! Dziak explained that when they recorded sounds from Challenger Deep, "there were even more earthquakes than we thought there would be. Our recordings taught us that plate motion is always moving along."

At convergent boundaries, two plates are moving toward each other. When the two plates collide, or run into each other, one is forced underneath the other. This collision is very slow, but the forces that cause it are very strong and affect both plates. Over long periods of time, the plate that is on top can bend and fold. The plate on the bottom is shoved into the mantle, bending downward and forming a deep trench at the boundary. As the bottom plate sinks into the mantle, it is destroyed and becomes part of the mantle. Both earthquakes and volcanic activity are common at convergent boundaries.

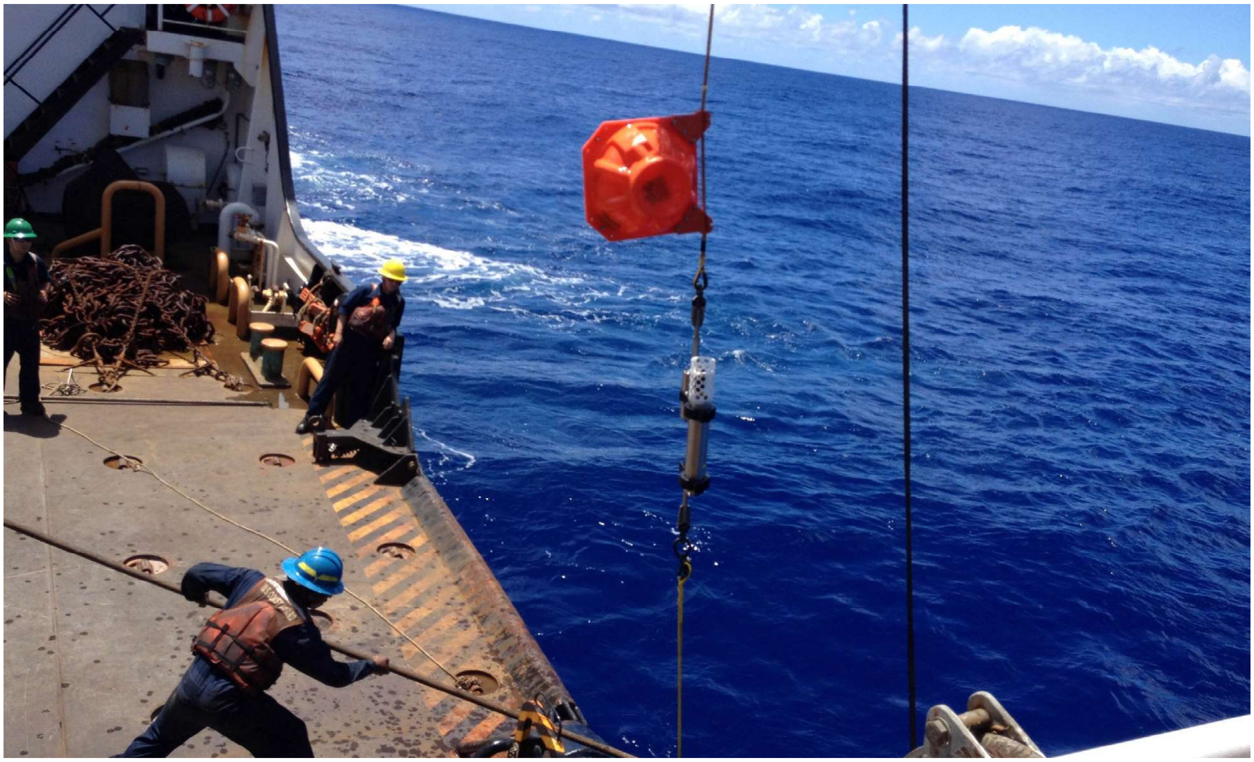
Listening to Divergent Boundaries

Bob Dziak and his team don't just listen to the ocean near convergent boundaries. They also use their hydrophones to listen in on divergent boundaries. Divergent boundaries are the opposite of convergent boundaries: they are places where two plates are moving away from each other. As the plates move, hot material from the mantle comes up to fill the space between them. The hot mantle material cools and hardens and adds new rock to the edge of each plate. Over time, these additions of rock form a mountain range, made up of a long chain of volcanoes. When this process happens on the ocean floor, scientists call the landform a mid-ocean ridge. Mid-ocean ridges can be thousands of kilometers long!

By listening to the ocean around divergent boundaries, Dziak and his team can detect earthquakes and volcanic eruptions that humans wouldn't know about in any other way—after all, mid-ocean ridges are deep underneath



This is a cross section of a divergent boundary. At divergent boundaries, two plates move away from each other. Magma from inside Earth rises into the empty space between them and hardens, forming a ridge.



This person is pulling a hydrophone out of the deep ocean, where it's been recording sound.

the ocean's surface and may also be thousands of kilometers from land where people can easily observe them. By lowering a hydrophone into the water near a mid-ocean ridge and letting it record for a long time, Dziak and his team can hear how many earthquakes and volcanic eruptions are taking place.

Dziak uses hydrophones to study the smaller earthquakes, called foreshocks, that occur at divergent boundaries before major earthquakes. "Big earthquakes at divergent boundaries have a clear pattern of foreshocks," he says. "It's not something you see on land, and we're finding this pattern at divergent boundaries all over the world." Dziak believes studying earthquakes in the middle of the ocean may help scientists refine the tools they use to study earthquakes on land. "If earthquakes had this kind of predictability on land, it might be something we could use later on," he says.

Putting It All Together

By studying both convergent and divergent plate boundaries, Dziak is studying the ways that plates move all over our planet. In some places, the motion of Earth's plates works like a conveyor belt: most plates have a convergent boundary on one side and a divergent boundary on the other. On the side with the convergent boundary, plate material is sinking into the mantle and being destroyed. On the side with the divergent boundary, new plate material is being made at a mid-ocean ridge. The motion takes place at a rate of only centimeters per year, but since one side of the plate is being destroyed and the other keeps getting new plate material, they keep moving. Dziak's research is helping us understand more about how plate motion happens—we just have to listen!