LOMA PRIETA: 20 YEARS LATER

Measuring quakes, deep in sea canyon

SEISMOMETER FEEDS DATA TO UNDERSEA NETWORK

By JANE PALMER
Herald Staff Writer

When the Loma Prieta earthquake shook Monterey Bay in 1989, the Monterey Bay Aquarium Research Institute was in its infancy.

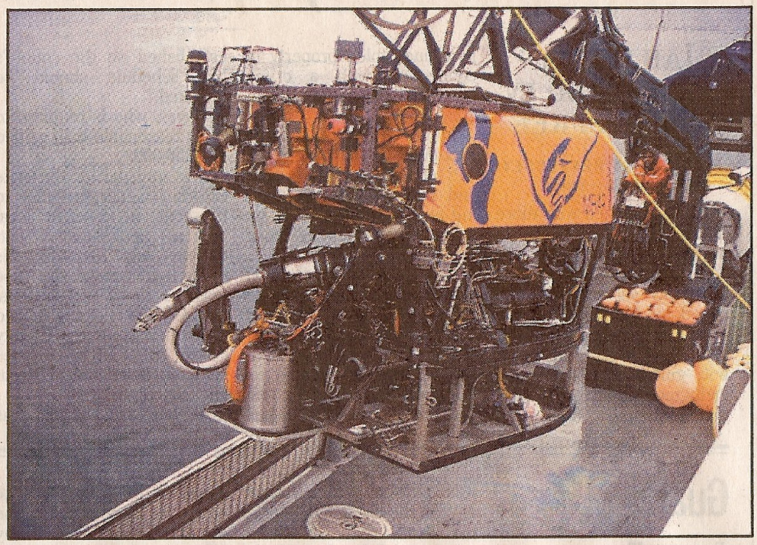
Twenty years later, it can boast a unique feat of engineering: the only underwater broadband seismometer west of the San Andreas Fault.

The Monterey Ocean Bottom Broadband seismometer measures and records earthquakes. It is 3,000 feet beneath the ocean's surface on a rocky ridge in the Monterey Canyon, 25 miles west of Moss Landing.

Connected to an undersea computer network, the Monterey Accelerated Research System, it transmits information directly to the University of California-Berkeley. Scientists there use the information to help determine the precise magnitude and location of earthquakes that occur west of both the San Andreas and San Gregorio faults.

"Two-thirds of the world is covered with water, so to get a 360-degree look at earthquakes, you have to have stations in the ocean," MBARI electrical engineer Paul McGill said.

But while land-based seismometers have been used for some time, placing seismometers underwater and getting the information back to shore has proved a challenge, McGill said.



TODD WALSH/MBARI

The launch of the ROV Ventana and the seismometer.

"The ocean is a very harsh environment," McGill said. "Saltwater is very corrosive, the pressure 1,000 meters below sea level is high, and you need to be able to make and break electrical connections underwater."

And while everything can be done by hand on a land-based seismometer, deep in the ocean everything has to be done by robots. The robot used to install the seismometer, the remote-operated vehicle Ventana, weighs more than 7,000 pounds and is the size of a van.

Unfortunately, it moves a lot slower than a van.

"It is certainly not a Lamborghini," said Craig Dawes, the ROV Ventana pilot and operation manager for MARS. "It slugs along at a mere 1.5 knots."

But the ROV Ventana was essential to installing the seismometer, as was the underwater cabled network operated by MARS that provides both power and connections to experiments running in the deep sea.

Paul McGill
MBARI engineer works with the institute's underwater seismometer.

"MARS is like that router that provides data to your house: It distributes data to a whole group of science experiments, the (seismometer) being only one of them," Dawes said.

Scientists plugged the seismometer into the MARS network in February — a feat that has saved both time and money. Previously, a boat crew of more than a dozen people traveled out four times a year to change the device's batteries and collect data.

"It has probably saved us $50,000 a year and thousands of gallons of diesel fuel that we don't have to burn," McGill said.

Also important is the fact that information is now relayed directly to the laboratory. Scientists do not have to wait three months to collect recordings.

"MARS changed everything," Dawes said. "You don't have to wait to find out if your experiment worked. You know now."

And the seismometer has more than worked. After the 2004 earthquake in Sumatra, which resulted in a tsunami that killed nearly 300,000 people, scientists were able to see the seismic waves on the Monterey Bay seismometer as they passed around the world.

"That's how sensitive this instrument is," said McGill. "We could see these signals after they had gone around the world five times. The world simply rings like a bell."

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MBARI/Special to The Herald

The seismometer is lowered into a plastic caisson on the seafloor of Monterey Canyon.

Installing an underwater seismometer

The only visible sign of the seismometer is a large yellow cable emerging from the sandy sea bottom.

- Step one requires the ROV Ventana to "dig" a hole big enough to house the beer-keg-sized device. Scientists have to bury the device, said MBARI electrical engineer Paul McGill, to prevent water currents from shaking the seismometer and disturbing its recordings.
- The robotic arm of the ROV Ventana sinks a large hollow PVC pipe into the sediment and a second arm vacuums out the sand. The robotic arm then quickly lowers the device and its casing into the space. Titanium encases the seismometer — a metal that can both withstand corrosion and the extreme pressure at 3000 feet below sea level.
- Once it has placed the device, the Ventana arm pours minuscule glass beads, a hairs-breadth wide, over it to prevent water currents from rattling the housing. Only beads will pour at that depth, McGill said, sand merely clogging the pipes. Sand, however, then naturally covers the beads until the surface is smooth and the seismometer is invisible.
- If scientists want to visit the seismometer for routine maintenance, the robot arm has to follow the cable to find the hidden device.