

Woods Hole Oceanographic Institution
Woods Hole Currents
Volume 4 Number 3, Summer 1995

TSUNAMI

An Earthquake's Dangerous Partner

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When the earth trembles on the seafloor, waves at the surface are created. If the earthquake is big enough, giant sets of waves called tsunamis (Japanese for "harbor waves") are set off.

Tsunamis are terrifying, and can be deadly. A tsunami roars suddenly from sea to land, at tremendous heights and at devastating speed. A tsunami can cross the

entire Pacific Ocean in just a few hours. It can strike land as an enormous wall of water, or as a sudden upwelling of the sea.

A tsunami that struck the village of Kahului on the island of Maui in 1837 is an example of the disastrous powers of these great waves. In that instance, the sea suddenly and swiftly began to retreat from the bay, as though an invisible giant were drinking it down. Fish left behind lay flapping helplessly on the sand. Some villagers rushed out to pick up the fish.

But others had an inkling of what was to come. They ran away from the shore. One person ran up a slope, and turned around to see a shocking sight. The entire village, its houses, its people and its animals, was riding on top of an enormous wave. The tsunami carried the village of Kahului far inland.

In his famous book *The Voyage of the Beagle*, British naturalist Charles Darwin described a tsunami that devastated the coast of southern Chile in February, 1835.



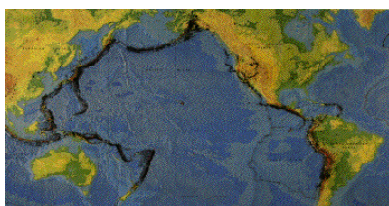
Charles Darwin

He wrote: "Shortly after the shock, a great wave was seen from the distance of three or four miles, approaching the middle of the bay with a smooth outline; but along the shore it tore up cottages and trees, as it swept onwards with irresistible force. At the head of the bay it broke in a fearful line of white breakers, which rushed up to a height of 23 vertical feet above the highest spring-tides.

"Their force must have been prodigious; for at the Fort a cannon with its carriage, estimated at four tons in weight, was moved 15 feet inwards. A schooner was left in the midst of the ruins, 200 yards from the beach. The first

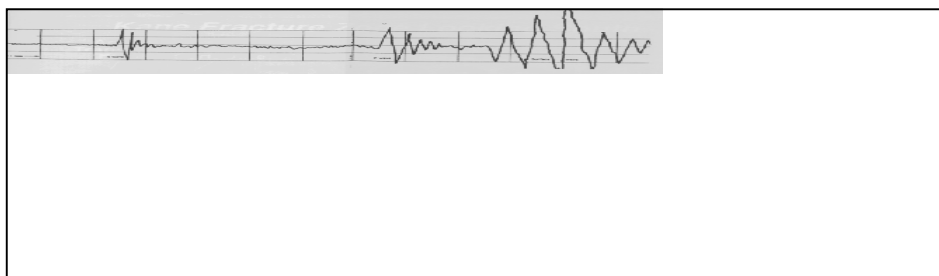
wave was followed by two others, which in their retreat carried away a vast wreck of floating objects. In one part of the bay, a ship was pitched high and dry on shore, was carried off, again driven on shore, and again carried off. In another part, two large vessels anchored near together were whirled about, and their cables were thrice wound round each other; though anchored at a depth of 36 feet, they were for some minutes aground....

"Pools of salt-water were still standing amidst the ruins of the houses, and children, making boats with old tables and chairs, appeared as happy as their parents were miserable."



Most earthquakes occur at the edges of plates in the earth's crust. This map shows active earthquake areas around the rim of the Pacific Ocean.

Tsunamis are still a great risk following any major earthquake, but people who live around the rim of the Pacific Ocean are helped by an international warning system that keeps track of ocean waves after any seafloor earthquake that has a magnitude of 6.5 on the Richter scale. If a wave is detected, a warning is sent out to local authorities.



A seismograph (above) records energy waves as they travel from an earthquake's focus deep beneath the crust up to the surface. Primary waves (P waves) reach the surface first, moving at speeds of 5.5 to 8.5 km per second (12,000 to 10,000 mph). They push and pull structures on the surface. Secondary waves (S waves) travel a little slower, at 3 to 4.6 km per second. These waves shake the ground up and down and from side to side. A third type, surface waves, can cause buildings to sway far from the earthquake's focus.

**MAKING SENSE OF THE MOTION:
A SCALE THAT MEASURES EARTHQUAKES**

In the 1930s, Charles Richter created a scale, named after him, that describes the intensity of an earthquake by measuring the amount of energy it releases. The scale increases exponentially—that is, an earthquake that measures 3 on the Richter scale is ten times more intense than one that measures 2. The largest earthquake ever measured by this method took place in Japan in 1933. It registered 8.9. By contrast, the January, 1994 earthquake in Northridge, CA measured 6.8.