



## DEVASTATING TSUNAMI!

One of earth's most devastating and powerful natural hazards is the tsunami. Yet until recently most of the world—even many coastal dwellers—had never heard of this ocean wave of all waves.

On December 26, 2004, a 9.0-magnitude earthquake off the west coast of northern Sumatra generated a gigantic tsunami that radiated outward in all directions from the earthquake's epicenter. Although the intense earthquake killed some people, the huge tsunami waves killed most of the estimated 60,000 to 100,000. Coastal residents throughout South and Southeast Asia were impacted and some deaths occurred as far away as Somalia in East Africa.

*Tsunamis* (sue-NAH-mes)—also called seismic sea waves—are different from all other ocean waves. In fact, almost all other ocean waves are created by wind blowing over water. *Tsunami* is a Japanese word now accepted throughout scientific literature for large seismic sea waves, often mislabeled as *tidal* waves.

Tsunamis are triggered by any major land disturbance under or near the ocean. Underwater and coastal landslides, earthquakes, volcanic island collapses and asteroid impacts are the most common sources of tsunamis throughout the history of the earth.

Any of these causes can displace ocean water, creating seismic waves, or shock waves, that radiate away from the source. The geographic pattern is much like the circles that spread outward when a pebble is dropped into a lake.

There are fundamental differences, however. Seismic waves move along the

ocean floor at speeds as great as 600 m.p.h. (1,000 k.p.h.). The energy creating the tsunami is transferred to the water just above the speeding seismic wave. On the surface of the deep ocean, the tsunami's passing is hardly perceptible, perhaps generating only low ocean swells.

As the tsunami reaches shallow waters of coastal regions, however, energy is compressed between the ocean floor and the water surface. This first creates a trough, whereby ocean water retreats from the shore, then surges forward. As the water returns, the drag along the ocean floor creates enormous curling waves.

The surge, not unlike a storm surge, results from waves literally piling on top of one another, sending water tearing through coastal zones for great distances from the beach. Damage and loss of life from such tsunamis can be horrific.

Although all coastal zones are susceptible to tsunamis, those facing active margins of the earth's tectonic plates are particularly so. Pacific islands experience frequent tsunamis because the margins of the Pacific Ocean's plates are very active geologically.

For example, the Hawaiian Islands, located near the center of the Pacific Ocean, have experienced numerous tsunamis. A May 22, 1960, earthquake off the coast of Chile created a Pacific-wide tsunami with an estimated loss of life at more than 1,000. The tsunami arrived at

Sumatra in present Indonesia, literally blew its top and collapsed back into the ocean in 1883. The gigantic tsunami that spread from the island killed an estimated 36,000 people on surrounding shores and as far away as the Ganges and Brahmaputra deltas at the head of the Bay of Bengal.

The tsunami from a similar explosion and collapse of the Mediterranean volcano of Santorini in 1450 B.C. left a wave mark 1,500 feet (457 m) above sea level at the eastern end of the Mediterranean Sea.

Tsunami wave scars of similar or higher elevations are recorded around the world from earthquake events, notably in Alaska. Scientists suspect that asteroid impacts in the earth's history may have generated tsunami several times higher than those associated with the highest caused by earthquakes.

The U.S. National Oceanic and Atmospheric Administration (NOAA) and the U.S. Geological Survey help monitor tsunami potentials around the world. These agencies provide information to groups such as the Pacific Tsunami Warning System about speed, timing and size of tsunamis.

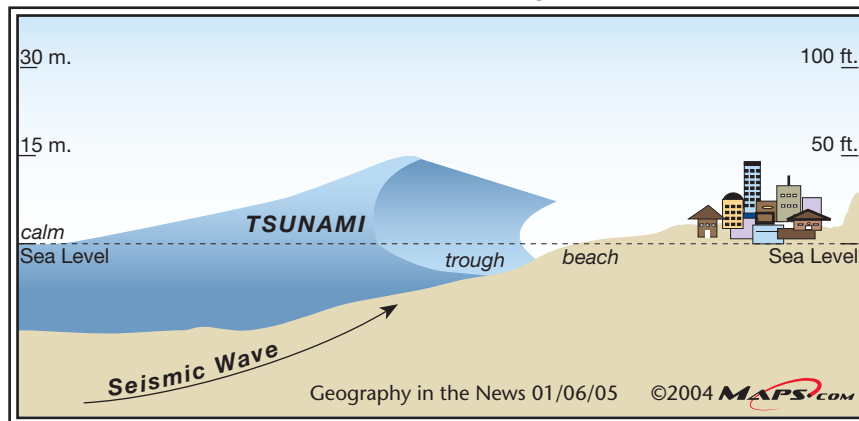
The latest Sumatra earthquake and tsunami struck when coastal hotels across the region were filled to capacity with holiday vacationers from around the world, many escaping the cold Northern Hemisphere winter. Whole villages were swept away, making it very difficult to obtain an accurate death count.

Most earth scientists will agree that the potential for loss of life from tsunamis in coastal regions of the world exceeds even that of earthquakes and hurricanes for any given decade. The loss of life from the recent tsunami in South and Southeast Asia is the greatest in recorded history.

And that is Geography in the News™, December 31, 2004. #766.

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### Tsunami Warning!



Hilo, Hawaii, covering the 7,200 miles (11,600 km) in less than 15 hours. According to the National Geophysical Data Center, sixty-one died in Hilo and the damage was estimated at \$24 million.

There are two historical tsunamis that stand out for extreme losses of human life. Krakatoa (KRACK-ah-TOE-ah), a volcanic island located between Java and