

# **The science of catastrophe: tsunamis and how they work**

*Five years ago, 200,000 lives were wiped out. Experts expect another a huge quake under Indonesia.*

**Reuters, 12-26-09**

The devastating 2004 Indian Ocean tsunami, caused by a major earthquake under the seafloor north of Aceh in Sumatra, struck five years ago today, killing more than 200,000 people. Scientists say another massive undersea earthquake is long overdue beneath the Mentawai islands in Indonesia and could trigger another deadly tsunami any time.

Here is some of the science behind the process.

## **How tsunamis occur**

In the Sumatra area, tectonic plates meet in a subduction zone -- a place where the boundaries of one plate are forced beneath the other plate. The Indo-Australian plate is sliding northeastward (about 2.8 inches a year) and dipping under the Eurasian plate, along a fault line called the Sunda megathrust which runs southwest from Myanmar down Indonesia toward Timor.

Tremendous geological strain builds over many decades until a section of the megathrust gives way. This rupture causes the oceanic plates beneath Sumatra to lurch forward suddenly, by many yards, in a big earthquake.

If the ocean floor ruptures, it suddenly moves a massive amount of water. This is what happened in the earthquake that caused the deadly Indian Ocean tsunamis of December 2004.

Major quakes that rupture the ocean floor are usually shallow quakes occurring at a depth of less than 44 miles. The quake that caused the 2004 tsunami was about 20 miles below the seafloor.

## **Tsunamis rise up**

On the ocean surface, tsunamis start as a ripple capable of passing under a ship unnoticed, but they become giants as they approach land and the ocean becomes shallow.

A tsunami is not a single wave, but a series of waves. The waves can travel across the ocean at speeds of up to 620 miles an hour, the speed of a jet aircraft.

The vast size of the Pacific Ocean and the large earthquakes associated with the Ring of Fire combine to produce deadly tsunamis in the Asia-Pacific. A tsunami can travel across the Pacific Ocean in less than a day.

As the waves approach land, the ocean recedes dramatically, exposing reefs as the waves draw the water out.

As the trough of the wave drags along the sea floor, slowing it down, the crest rises up dramatically and sends a giant wall of whitewater onto land. The first wave may not be the biggest.

The destructive force of a tsunami comes not from the height of the wave, but from the volume of water

moving.

It is as if the ocean floods the coast, smashing everything in its path, and then just as quickly recedes.

Many people who survive the initial wave impact are washed out to sea as the tsunami recedes.

### **World's worst**

\* The 2004 Indian Ocean tsunami was the world's most deadly, killing about 226,000 people, with a wave height about 100 feet.

\* The world's biggest tsunami, caused by a magnitude 8 quake that caused a massive landslide, hit the remote Lituya Bay in Alaska on July 9, 1958. As the wave swept through Lituya Bay, it was forced to rise up, reaching an estimated height of 1,720 feet on the other side of the bay, becoming a mega-tsunami. The sparsely populated bay was devastated, but damage was localized.

\* The Krakatau island volcanic eruption of 1883 generated giant waves reaching heights of 125 feet, killing some 30,000 people. It was the most violent volcanic eruption in modern history.