



By Chris Jozefowicz

Here's what scientists have learned about the superquake that caused the disastrous Indian Ocean tsunami one year ago.

RIPPLE EFFECT

THE GIANT TSUNAMI

that struck Asia last December killed more people than any natural disaster had in almost 30 years. The estimated death toll was more than 280,000. One year later, some of the areas hit by the tsunami are still in ruins, and thousands of people who escaped with their lives remain homeless.

Why was the disaster so terrible? In the past year, scientists have been piecing together data from all over the globe to find an answer. Among other things, they have discovered that the geological event that triggered the tsunami—an earthquake—was even more powerful than originally thought.

TECTONIC ACTION

A tsunami is a series of very large waves caused by abrupt movements of the ground underwater. A tsunami can be triggered by a volcanic eruption, a landslide, or an earthquake. The Indian Ocean tsunami formed when a huge earthquake rocked the seafloor, beginning about 300 kilometers (186 miles) west of the island of Sumatra.

Earthquakes usually occur at the edges of *tectonic plates*, huge sections of Earth's crust that move slowly over the surface of the planet. Plates can move toward, alongside, or apart from one another. The Asian tsunami started over an area where two plates, the Indian Plate

and the Burma Plate, are slowly converging in a *subduction zone*. The Indian Plate is diving under the Burma Plate, says Peter Shearer, a *seismologist* (a scientist who studies earthquakes) at the Scripps Institution of Oceanography in La Jolla, Calif.

As the Indian Plate moves down, it sticks in places and pulls the edge of the Burma Plate with it. Sometimes, the edge of the Burma Plate snaps up, causing an earthquake. The motion of the snap also pushes the water above the subduction zone toward the surface. At the surface, the water forms a hill that spreads out, making the gigantic waves of a tsunami. "Subduction-zone quakes are tsunami generators," Shearer says.

STRONGEST AND LONGEST

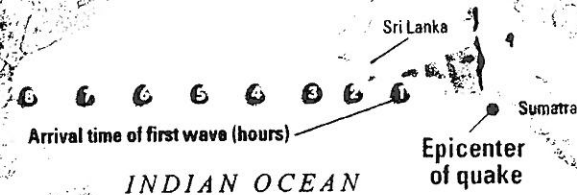
Subduction-zone quakes are also the strongest earthquakes. Shearer says the quake that caused the Indian Ocean tsunami was the most powerful in more than 40 years. "It was really, really big," says Shearer. "Earthquakes this big don't happen very often, fortunately."

Scientists determine the *magnitude* (intensity) of an earthquake by measuring its *seismic waves*, or vibrations in the ground. Such vibrations are recorded on *seismographs*.

The seismograph readings of the Asian quake, now called the Sumatra-Andaman earthquake, originally told

A month after the Indian Ocean tsunami washed over this beach in Thailand, locals and tourists held a candlelight vigil to remember the victims and to remind the world of the need for a tsunami warning system.

DEADLY TIDE



The tsunami spread from the epicenter of the earthquake. The largest waves struck all of the surrounding landmasses within about two hours. Smaller waves began reaching Africa about seven hours later.

scientists that it had a magnitude of 9.0. Quakes that powerful happen about once every 10 years. Later, as scientists looked at more data from around the world, they discovered that the quake was actually about three times stronger (magnitude 9.3), making it either the second- or third-strongest earthquake ever recorded.

It was also one of the longest. The quake traveled along the Indian-Burma Plate boundary for more than 1,200 kilometers (750 miles) and lasted for about 8 minutes. Using seismograph data collected in Japan, Shearer and some of his colleagues measured the progress of the quake. They found that the rupture moved at about 2.8 kilometers per second, or more than 6,000 miles per hour!

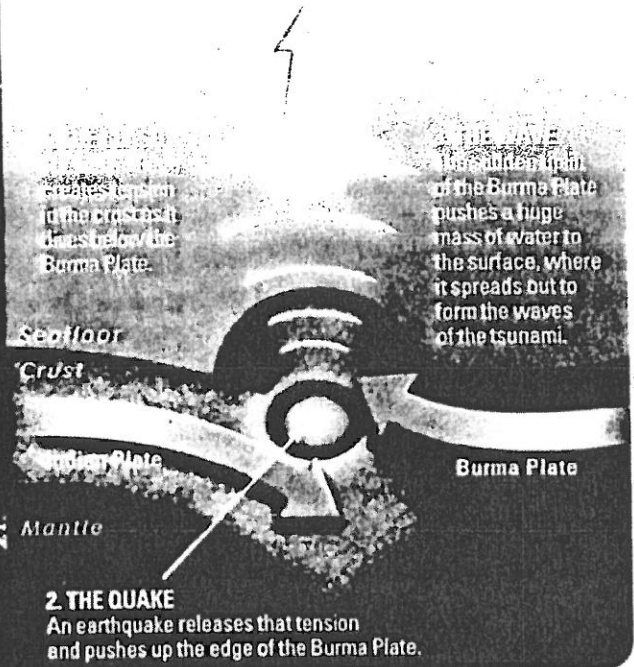
WAVE WARNINGS

The tsunami generated by such an earthquake was sure to be devastating. The killer waves struck nearby Sumatra in just minutes. Crossing the Indian Ocean, they slammed into Sri Lanka about two hours later.

Unfortunately, most of the people living around the Indian Ocean, both near to and far from the quake, had

MAKING WAVES

The Indian Ocean tsunami resulted from the abrupt release of stress between two tectonic plates off the coast of Sumatra. That moved the seafloor suddenly.



no way of knowing what was coming. No warning system was in place that could have detected the giant waves and sent a message to the coastal regions likely to be hit by the tsunami. "Even if people wanted to warn others," Shearer says, "there was no way to do it."

In the northern Pacific Ocean, a tsunami warning system protects the coasts of Canada, Japan, the United States, and more than 20 other countries. The system includes a network of seismic stations, which monitor the ground for earthquakes, and six floating buoys tethered to the seafloor, which monitor the water for tsunami waves. When the system sounds an alarm, a warning is sent to local authorities right away, says Delores Clark, a spokesperson for the National Oceanic and Atmospheric Administration, which oversees the Pacific Tsunami Warning Center. "We need to get it out in a big hurry," Clark says, "almost instantaneously." With that warning, people on the coasts can then hurry to higher ground.

Shearer says every vulnerable shoreline in the world needs such protection. "The biggest lesson [from the Indian Ocean tsunami] is that there needs to be a worldwide tsunami warning system," he says.

Representatives from the United States and countries around the Indian Ocean have been meeting in the months since the quake in an effort to create an Indian Ocean tsunami warning system. Such a system, experts say, could be in place in as little as two years. **CS**

Name _____

Date _____

SKILLBUILDERS

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CURRENT SCIENCE

Ripple Effect (Page 10)

True or False

Read each statement and decide whether it is true (T) or false (F).

Write your response in the space provided.

- ___ 1. The Sumatra-Andaman earthquake happened where the Indian and Nazca plates are in contact.
- ___ 2. Tsunamis are caused by storms at sea.
- ___ 3. Earthquakes often occur at the edges of tectonic plates.
- ___ 4. A seismic wave travels through water.
- ___ 5. The Indian Ocean tsunami struck the Horn of Africa about four hours after the earthquake happened.
- ___ 6. A subduction zone is an area where one tectonic plate moves below another.
- ___ 7. Tectonic plates move very slowly over the surface of Earth.
- ___ 8. Seismologists study the weather.
- ___ 9. The intensity of an earthquake is called the magnitude.
- ___ 10. The Indian Ocean tsunami was one of the least deadly tsunamis on record.