AWESOME stories

CAUSE of BANDA ACEH QUAKE

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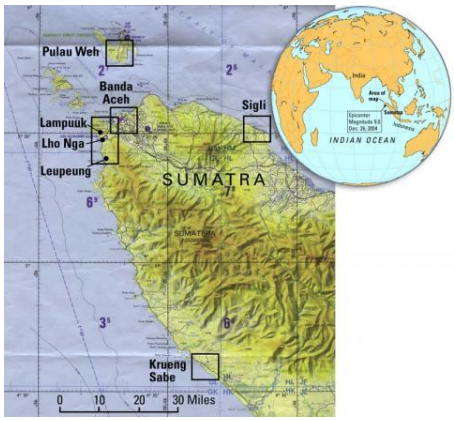

This USGS (U.S. Geological Survey) map depicts the epicenter location of the 26 December 2004 earthquake. Three months after the quake and resulting tsunami, investigators found evidence that the quake-caused tsunami waves were astonishingly high. Image online, courtesy USGS. Click on it for a better view.

Underneath the Indian Ocean lies a vast chain of underwater mountains. (Zoom-out, on the linked map, to see their location.) Higher than the Alps, on average, those mountains - part of the Mid-Ocean Ridge - have been pushing upwards, over a very long period of time, thanks to the movement of tectonic plates.

Tectonic plates - as theorized by scientists - are essentially gigantic slabs of the Earth's crust which "fit together like a puzzle." Those slabs, however, do not remain in one place without ever moving. The plates can collide against each other.

When one plate is pushed underneath the other, in a subduction zone, an underwater earthquake can occur if pressure builds to a breaking point. Such a quake can rupture the Earth's crust, causing a fault line which stretches for hundreds of miles.

Exploring the general area where the "Banda Aceh" quake likely originated, a team of scientists were stunned when a sonar image revealed that something huge was "dead ahead." They had found a shear vertical cliff, thrust upwards out of the seabed. This was evidence of a massive seismic event.

But how would anyone know when that cliff had actually burst-through the seabed? How could scientists confirm that their discovery hadn't occurred decades - or centuries - before the Great Sumatra-Andaman Earthquake of December 26, 2004? (This link provides an explanation of the "Great Sumatra-Andaman Earthquake" pdf.)

To determine whether the vertical cliff was old or new, the exploring crew had to examine the very top of the formation. If it was smooth, the event would have occurred years earlier. If it had a jagged edge - resembling the teeth of a saw - the cliff was new.

As the remote explorer reached the top of the cliff, its light revealed a very rough edge. The cliff was the result of a recent event.

Then ... scientists were really shocked. As the exploring vehicle moved upward, passing the newly formed cliff, its operators could see something else looming in the water's darkness.

It was a second, enormous cliff - much larger than the first - which had also thrust its way up from below the seabed. Along its top was a very rough edge resembling the teeth of a saw.

Scientists had discovered the cause of the "Boxing Day" quake. Two jagged-edge cliffs revealed that a mega-thrust event had suddenly ruptured the Earth's crust. It was the largest seismic occurrence, in the world, in more than forty years. Its "rupture zone" was about the size of California.

A report from the National Science Foundation (NSF) tells us that while it happened, "the ground shook more than 100 times harder than it did during the 1989 California Loma Prieta" quake (which also caused massive damage, including many casualties and a collapsed freeway).

The impact of the Indian-Ocean quake was felt around the world:

> *The ground motions during the prolonged, intense shaking of the main shock were greater than in any earthquake previously recorded by global broadband seismometers. As far away as Sri Lanka, a thousand miles from the epicenter, the ground moved up and down by more than 3.6 inches (9 centimeters). Ground motions greater than one-half inch, but too gradual to be felt, occurred everywhere on Earth's surface as seismic waves from the event spread around the globe.*

The quake also broke other records:

> *Record-setting features of the Sumatra-Andaman earthquake of Dec. 26, 2004, include the longest fault rupture ever observed (720 to 780 miles or 1,200 to 1,300 kilometers) and the longest duration of faulting (at least 10 minutes). The aftershocks included the most energetic earthquake swarm ever observed.* (Quotations from National Science Foundation, Press Release 05-079, 19 May 2005.)

Not just producing a very high number (9.1 to 9.3) on the measuring scale, this "monster earthquake" (the third-worst quake in recorded history) was capable of causing something else. Mega-thrust events, which occur underwater, can generate unbelievably powerful tsunamis.

See Alignments to State and Common Core standards for this story online at:
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See Learning Tasks for this story online at:
http://www.awesomestories.com/asset/AcademicActivities/CAUSE-of-BANDA-ACEH-QUAKE-The-Impossible

Questions 2 Ponder

How Do We Know When Earthquakes Occur Underwater?

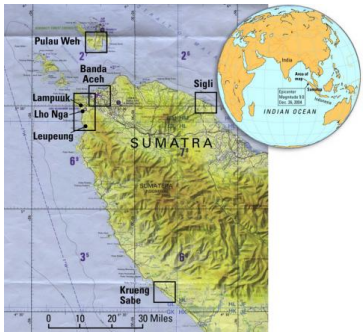
We don't observe when a rupture of the Earth's crust occurs underwater, so measuring the length of the fault rupture, which caused the Sumatra-Andaman earthquake, was no easy task.

To understand what happened, when a huge vertical cliff thrust its way up from below the seabed, investigators needed to explore underwater. That can be unnerving in an area where a massive quake had just caused widespread devastation.

How did investigators go-about determining the cause of the Sumatra-Andaman earthquake?

What surprised them the most about the vertical cliffs they noticed "dead ahead?"

Media Stream



Impact of Quake on Sumatra - 26 December 2004

This map depicts the epicenter of the earthquake which occurred off the coast of Sumatra on the 26th of December, 2004.
A few months later - in March of 2005 - a team of investigators wanted to determine the height of the earthquake-caused tsunami waves which had pounded the coastal areas of the island. They were astonished at their findings.
The USGS (U.S. Geological Survey) tells us more:
An International Tsunami Survey Team ... studying the effects of the December 26 tsunami on Indonesia's island of Sumatra documented wave heights of 20 to 30 m (65 to 100 ft) at the island's northwest end and found evidence suggesting that wave heights may have ranged from 15 to 30 m (50 to 100 ft) along a 100-km (60-mi) stretch of the northwest coast.

These wave heights are higher than those predicted by computer models made soon after the earthquake that triggered the tsunami.
Comparing (1) what computer models predicted, and (2) what the quake-caused tsunami waves actually produced, is called "groundtruthing."
Click on the image for a better view.
Image and quoted passage online, courtesy the March 2005 issue of "Sound Waves," a monthly newsletter produced by the U.S. Geological Survey (USGS).
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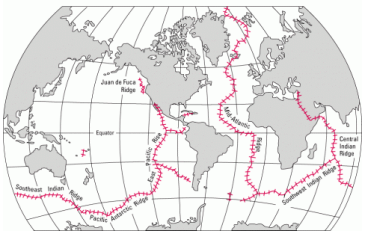

Mid-Ocean Ridge - USGS Depiction

Illustration of the Mid-Ocean Ridge by the USGS; online, courtesy USGS.
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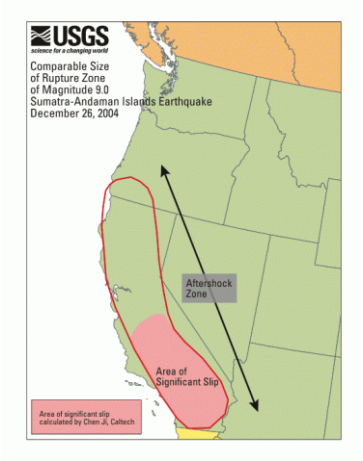
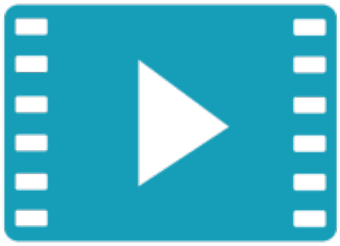


Rupture Zone - Sumatra-Andaman Earthquake

Illustration of the "rupture zone" for the earthquake - referred to, variously, as the "Great Sumatra-Andaman Islands Earthquake," the "Banda Aceh Earthquake," the "Boxing Day Earthquake" and the "Indian-Ocean Earthquake of 26 December 2004" - by the U.S. Geological Survey (USGS).
The USGS provides the following description for this drawing:
Earthquakes rupture a patch along a fault's surface. Generally speaking, the larger the rupture patch, the larger the magnitude of the earthquake. Initial estimates based on the aftershock distribution show the magnitude 9.0 Sumatra-Andaman Islands Earthquake ruptured a patch of fault roughly the size of California, and modeling of the seismic waves show that most of the slip occurred in the southern 400 kilometers of the patch. For comparison, a magnitude 5 earthquake would rupture a patch roughly the size of New York City's Central Park.
View this asset at:
http://www.awesomestories.com/asset/view/Rupture-Zone-Sumatra-Andaman-Earthquake



Megathrust Earthquakes - How They Occur

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