

USGS



A magnitude 8.6 earthquake occurred about 260 miles off the Aceh coast of northern Sumatra. This M 8.6 great earthquake was followed by a (continuing) vigorous aftershock sequence including a M 8.2 about two hours later.

Only minor damage has been reported.



The shadows of Indonesian soldiers directing traffic are cast by the afternoon sun as people evacuate to higher ground after a strong earthquake was felt in Banda Aceh, Aceh province, Sumatra island, Indonesia.

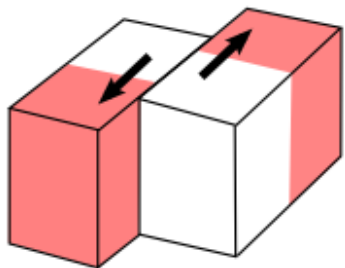
Two massive earthquakes triggered back-to-back tsunami warnings for Indonesia on Wednesday, sending panicked residents fleeing to high ground in cars and on the backs of motorcycles. There were no signs of deadly waves, however, or serious damage, and a watch for much of the Indian Ocean was lifted after a few hours. (AP Photo/Heri Juanda)

Magnitude 8.6 OFF W COAST NORTHERN SUMATRA

Wednesday, April 11, 2012 at 08:38:37 UTC

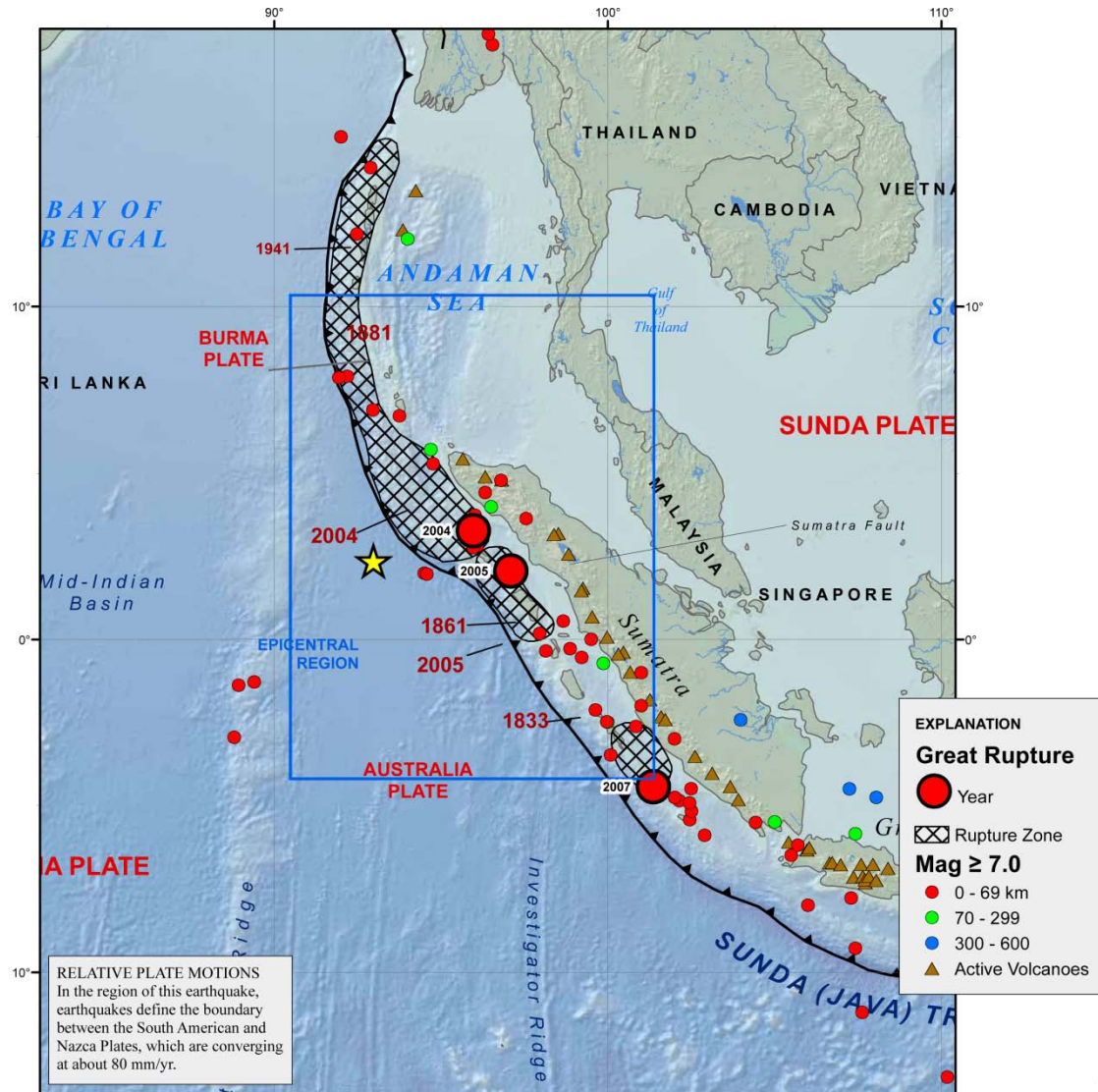
This earthquake occurred as a result of strike-slip faulting within the oceanic lithosphere of the Indo-Australia plate.

The quake was located approximately 100 km to the southwest of the major subduction zone that defines the plate boundary between the Indo-Australia and Sunda plates offshore Sumatra. It was on this subduction zone that a 1300 km long segment ruptured in December of 2004 producing a massive M 9.1 earthquake.



strike-slip fault

Image courtesy of the US Geological Survey



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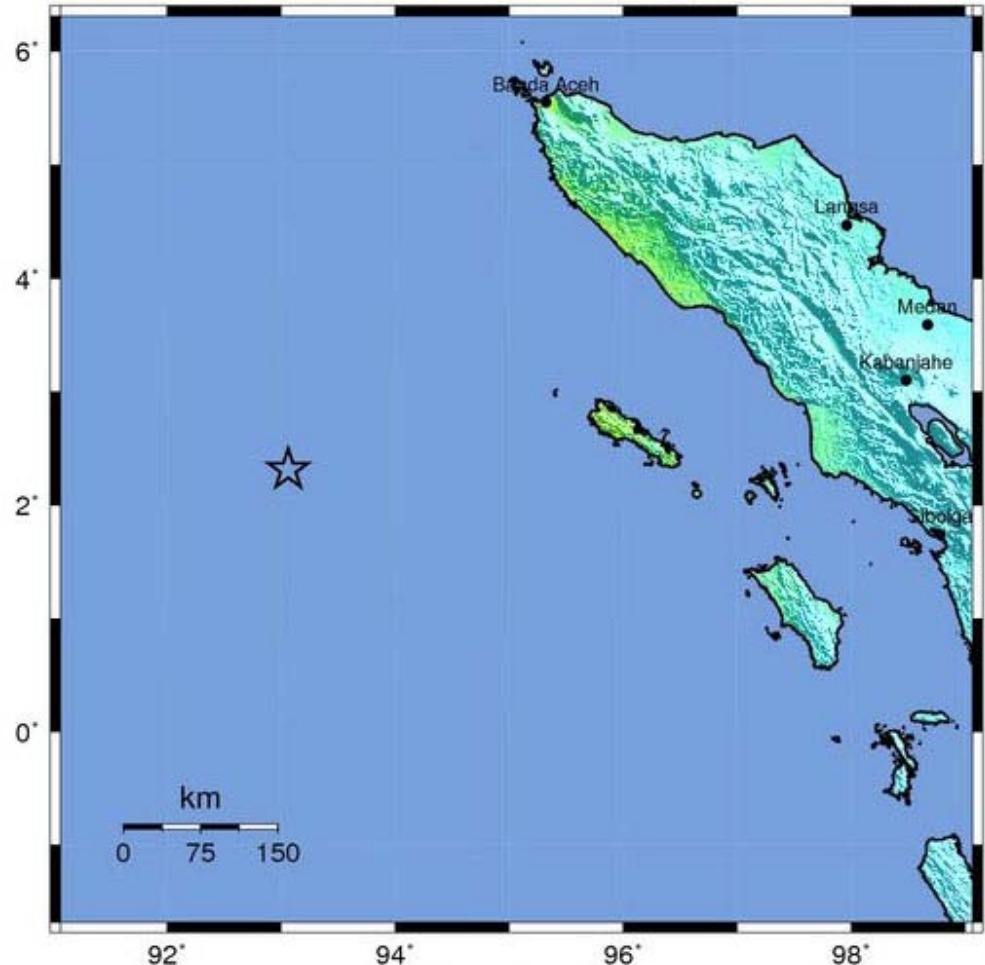
Shaking intensity scales were developed to standardize the measurements and ease comparison of different earthquakes. The Modified-Mercalli Intensity scale is a twelve-stage scale, numbered from I to XII. The lower numbers represent imperceptible shaking levels, XII represents total destruction. A value of IV indicates a level of shaking that is felt by most people. This M 8.6 event produced moderate shaking in northern Sumatra.

Modified Mercalli Intensity

X
IX
VIII
VII
VI
V
IV
II-III
I

Perceived Shaking

Extreme
Violent
Severe
Very Strong
Strong
 Moderate
 Light
 Weak
 Not Felt



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USGS PAGER

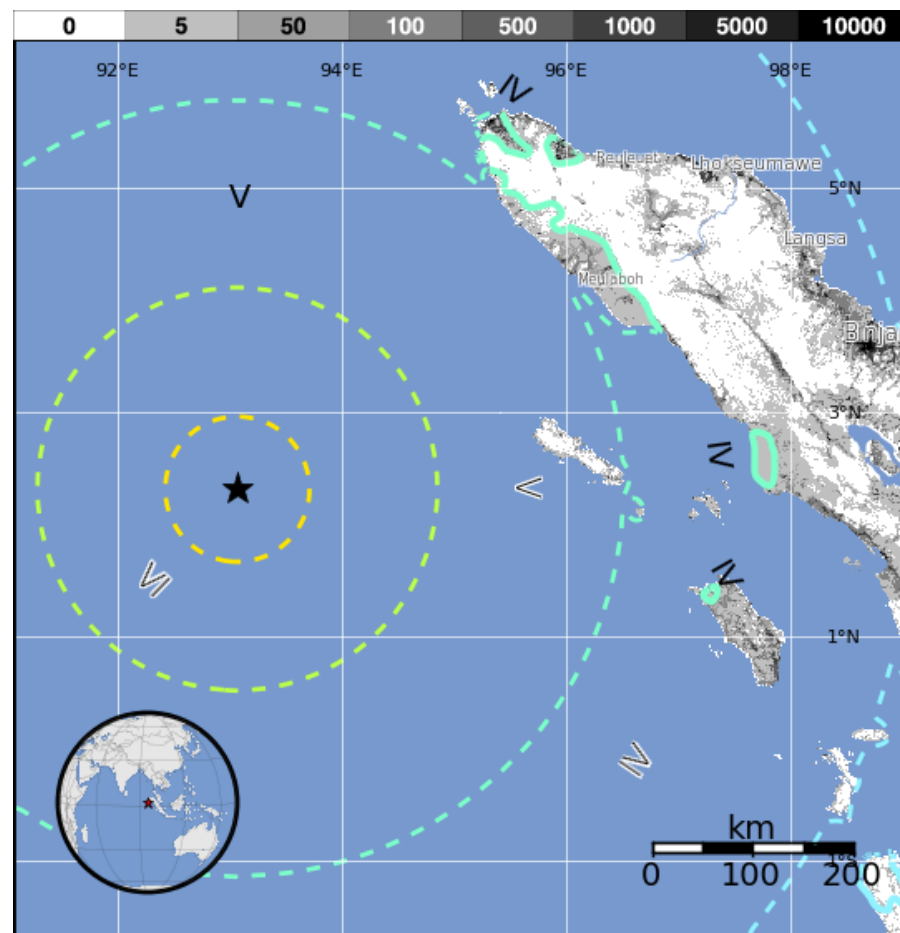
Population Exposed to Earthquake Shaking

The USGS PAGER map shows the population exposed to different Modified-Mercalli Intensity (MMI) levels. MMI describes the severity of an earthquake in terms of its effect on humans and structures and is a rough measure of the amount of shaking at a given location.

Overall, the population in this region resides in structures that are vulnerable to earthquake shaking, though some resistant structures exist. About 2.5 million people experienced moderate shaking from this M 8.6 earthquake.

The color coded contour lines outline regions of MMI intensity. The total population exposure to a given MMI value is obtained by summing the population between the contour lines. The estimated population exposure to each MMI Intensity is shown in the table below.

Image courtesy of the US Geological Survey



Estimated Modified Mercalli Intensity	I	II-III	IV	V	VI	VII	VIII	IX	X
Est. Population Exposure	--*	21k*	10,881k*	2,459k*	143k	0	0	0	0
Perceived Shaking	Not Felt	Weak	Light	Moderate	Strong	Very Strong	Severe	Violent	Extreme

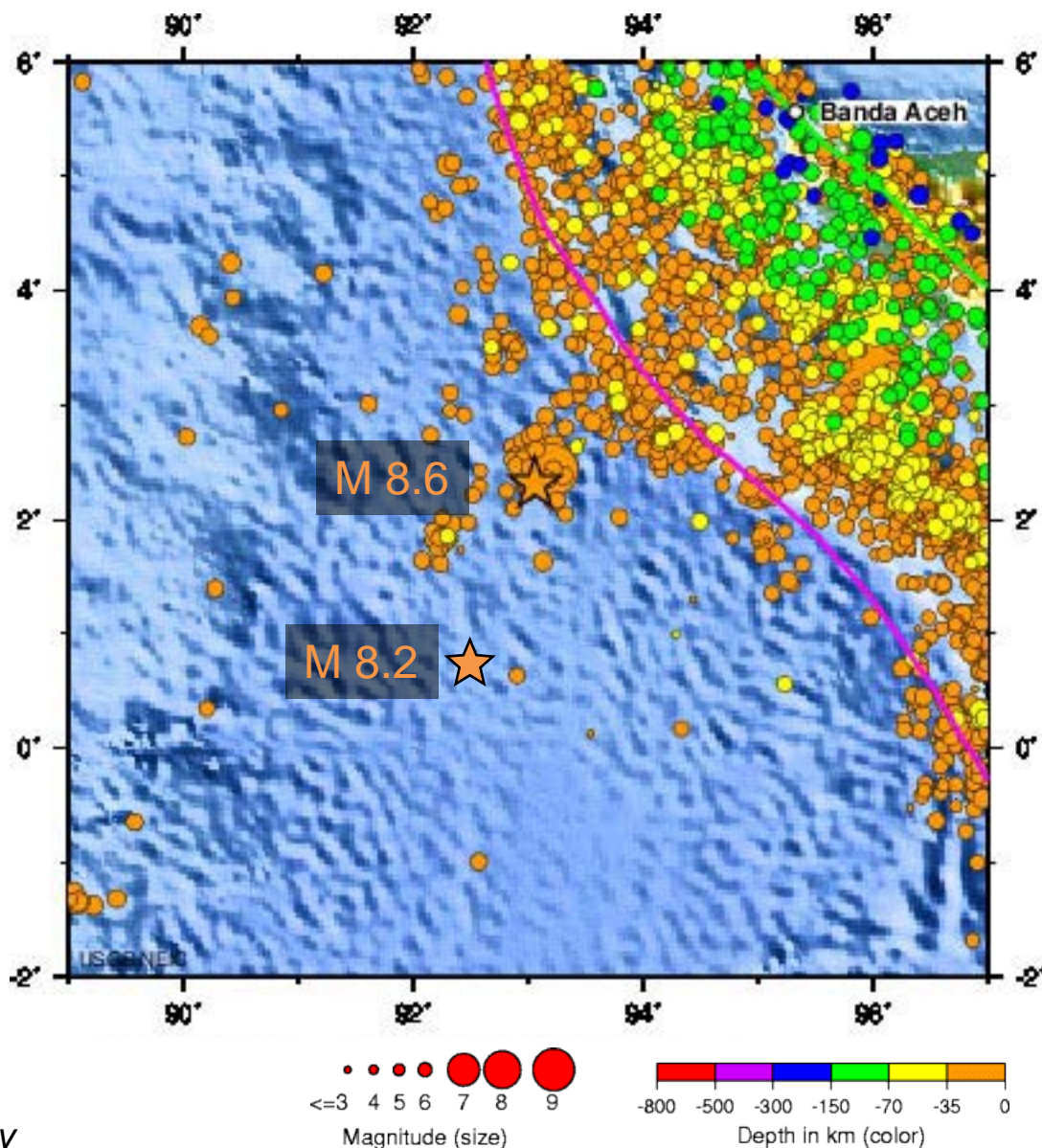
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The map on the right shows historic earthquake activity from 1990 to present near the epicenters (stars) of the April 11 great earthquakes. Both the M 8.6 and M 8.2 events are located west of the Sunda Trench where the Indian Plate subducts beneath the southeast Asia promontory of the Eurasian Plate.

These events are clearly “intraplate” earthquakes produced by displacement on faults within the oceanic lithosphere of the Indian Plate.

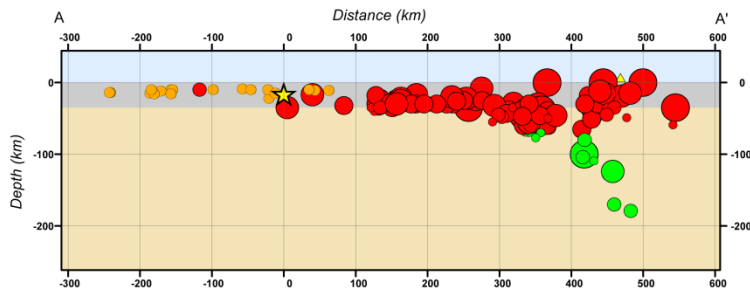
A nearby but much smaller M 7.2 intraplate earthquake occurred earlier this year on January 10.



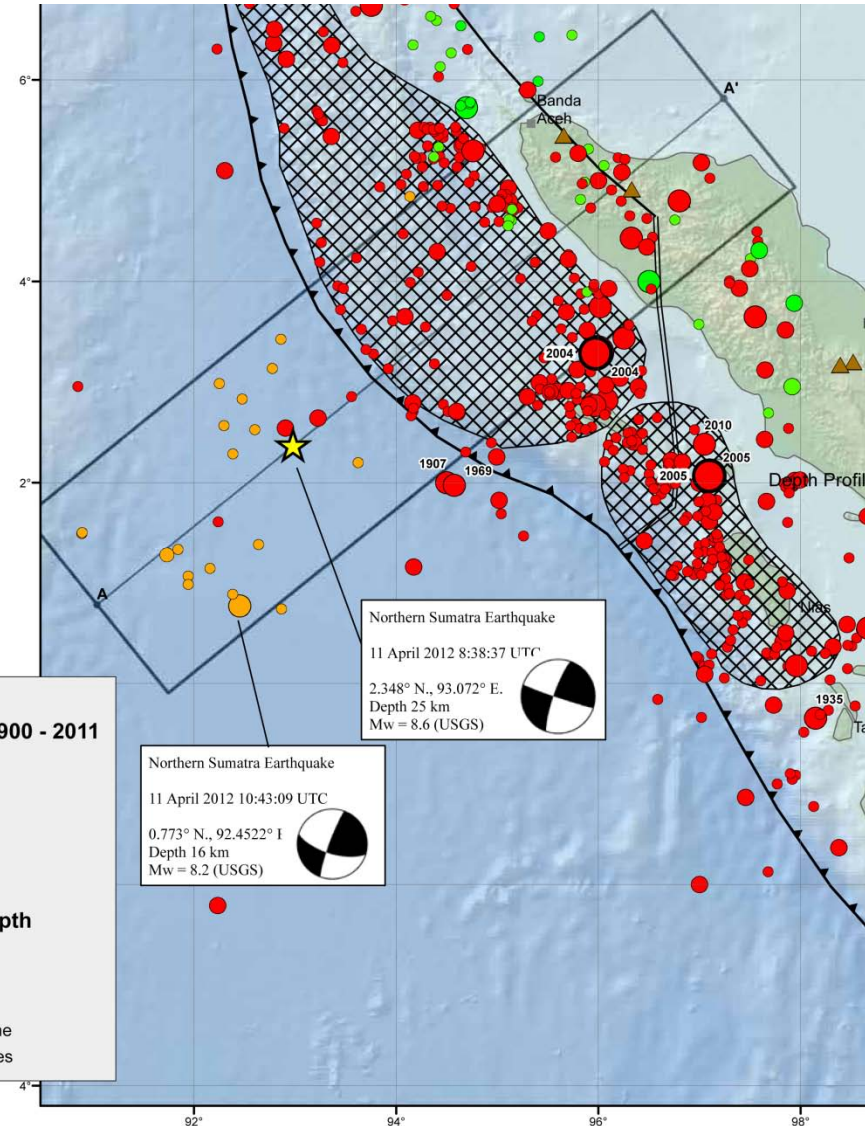
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Large strike-slip earthquakes, while rare, are not unprecedented in this region of the Indo-Australian plate. Since the massive M 9.1 earthquake that ruptured a 1300 km long segment of the Sumatran megathrust plate boundary in December of 2004, three large strike-slip events have occurred within 50 km of this event. These events align approximately with fabric of the sea floor in the diffuse boundary zone between the Indian and Australian plates.



Seismicity Cross Section across the subduction zone (M 8.6 yellow star)



Earthquakes locations are from the Centennial Catalog (1900-2003) and from NEIC (2003-present)



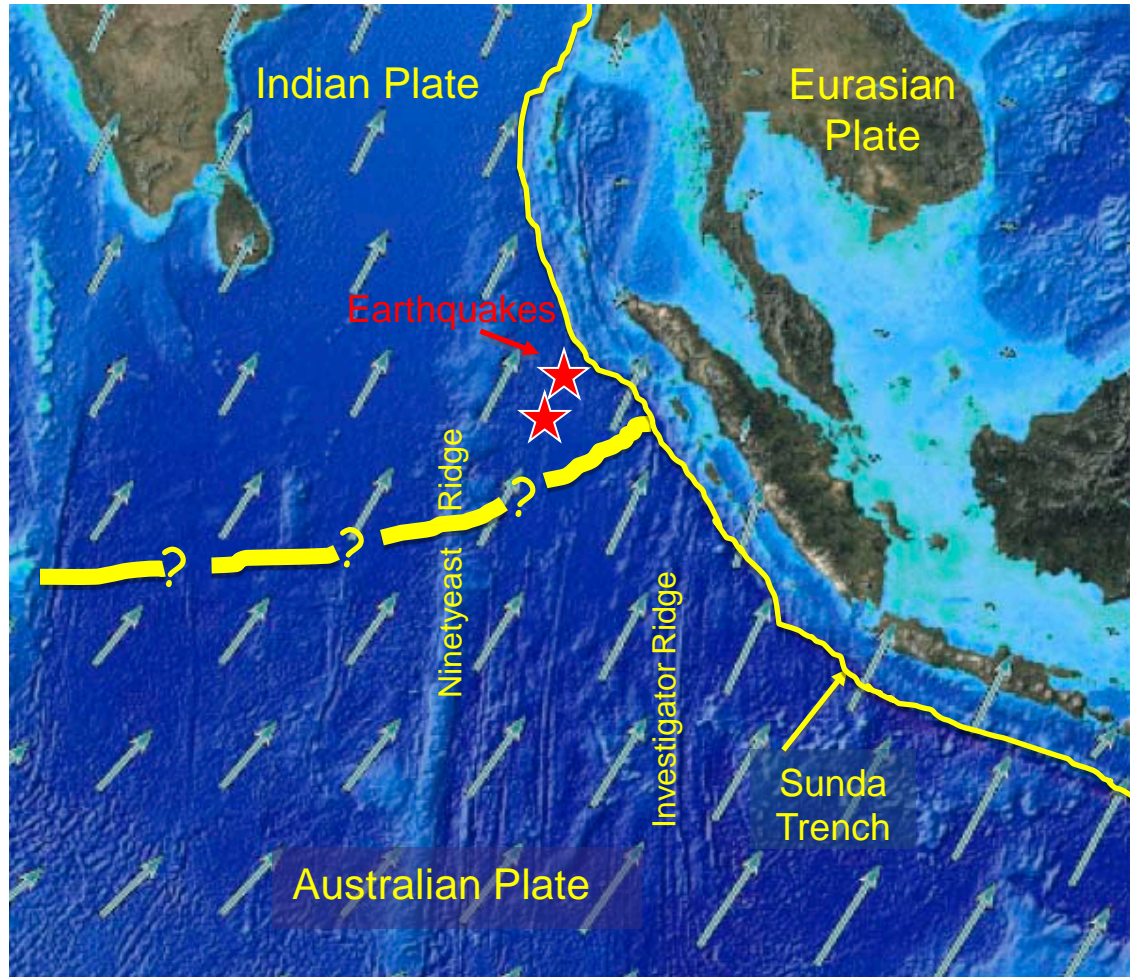
The tectonics of the northeast Indian Ocean and southeast Asia are complex. While the Australian and Indian plates both subduct into the Sunda Trench at about 5 to 6 cm/yr, these plates slowly converge at a boundary that is diffuse and poorly understood.

Arrows show the motion of the Australian and Indian plates with respect to the Eurasian Plate.

Epicenters of the April 11 great earthquakes are shown by the red stars.

The E – W oriented dashed line with question marks is the approximate location of the boundary between the Australian and Indian plates.

The Ninetyeast Ridge is likely a hotspot track formed 40 – 80 million years ago while the Investigator Ridge is one example of many N – S oriented fracture zones on the Indian Ocean floor southwest of Sumatra.



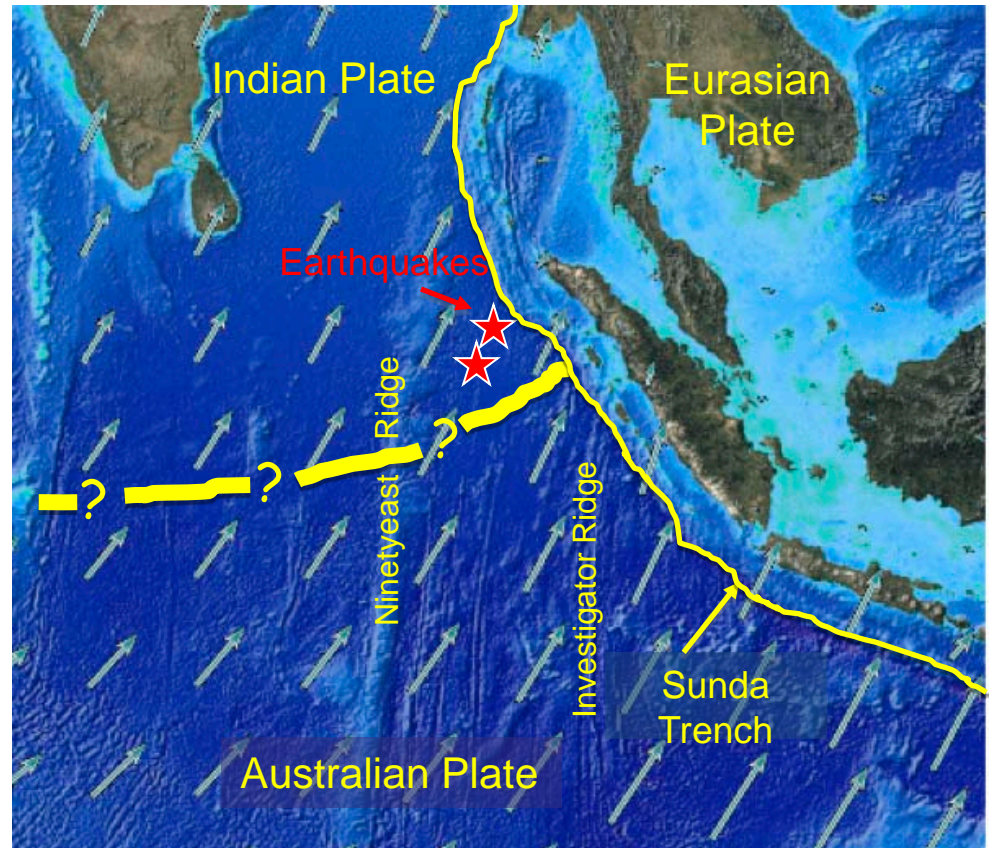
The April 11 and January 10 intraplate earthquakes occurred within Indian Plate oceanic lithosphere north of the Australian – Indian plate boundary and west of the Sunda Trench. In this region and to the south, there are many N – S oriented fracture zones like the Investigator Ridge. These fracture zones are related to seafloor spreading of the Southeast Indian Ridge that produced the ocean floor south and west of the Sunda Trench.

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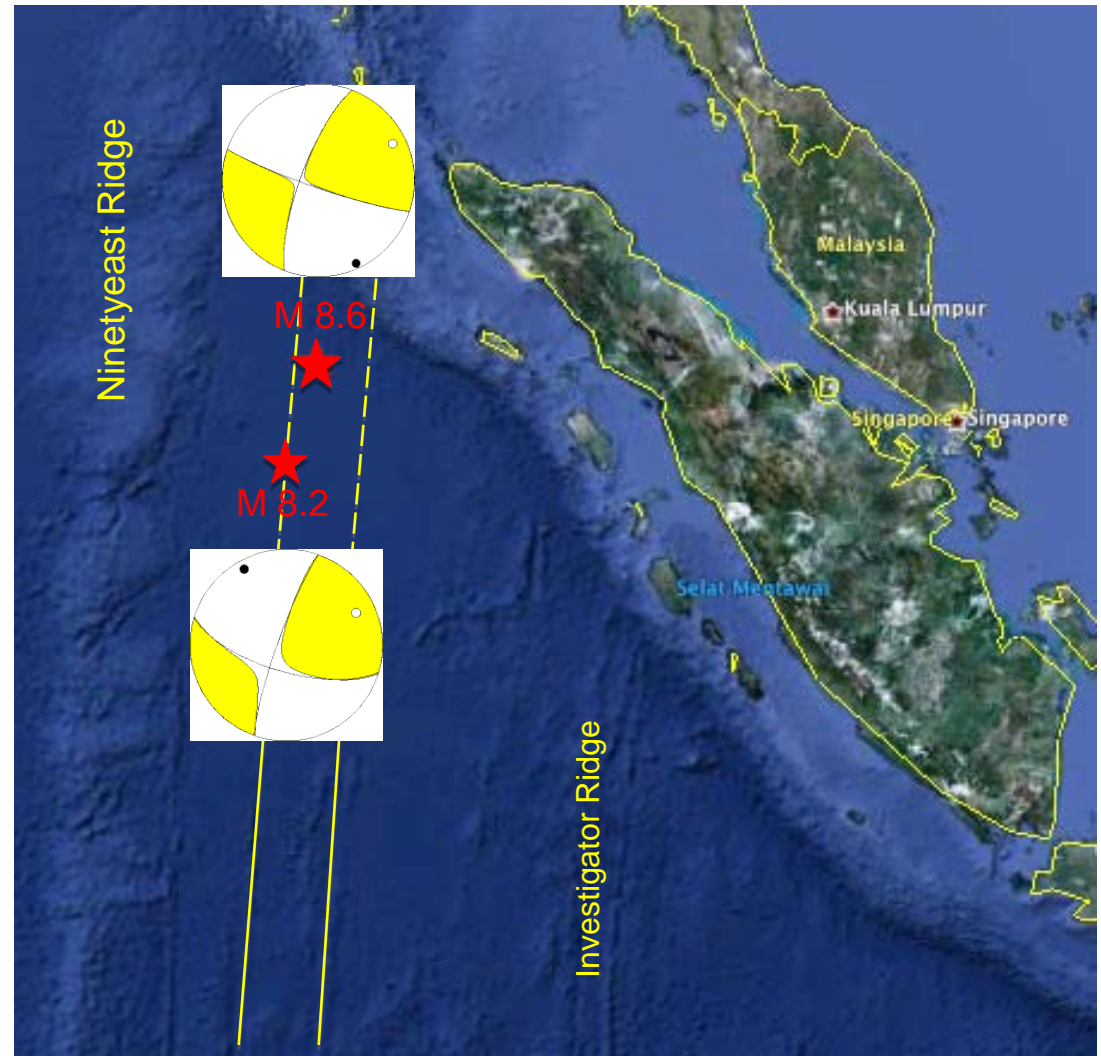
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These intraplate earthquakes were caused by strike-slip faulting within Indian Plate oceanic lithosphere. N – S oriented fracture zones project into the area of the earthquakes and are the likely faults offset during these events.

On the inset focal mechanisms, the yellow quadrants indicate P-wave first motions away from the source while white quadrants indicate P-wave first motions toward the source. Black dot represents the axis of maximum compression (the "P-axis") and open dot represents the axis of maximum extension (the "T-axis").



Focal mechanisms are USGS Centroid Moment Tensor Solutions. Background image is from Google Earth.

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Explore an animation of the generalized regional tectonics and the relationship between these earthquakes and the M 9.1 earthquake in 2004.

Sumatra_M8.6_120411

File Edit View Window Help

Magnitudes 8.6 & 8.2 earthquakes, Sumatra

April 11, 2012

Indian Plate

Sunda Plate

Australian Plate

SUMATRA

Tectonic setting:
Intra-plate earthquake
near subduction zone
& the diffuse boundary
between the
Indian and
Australian plates

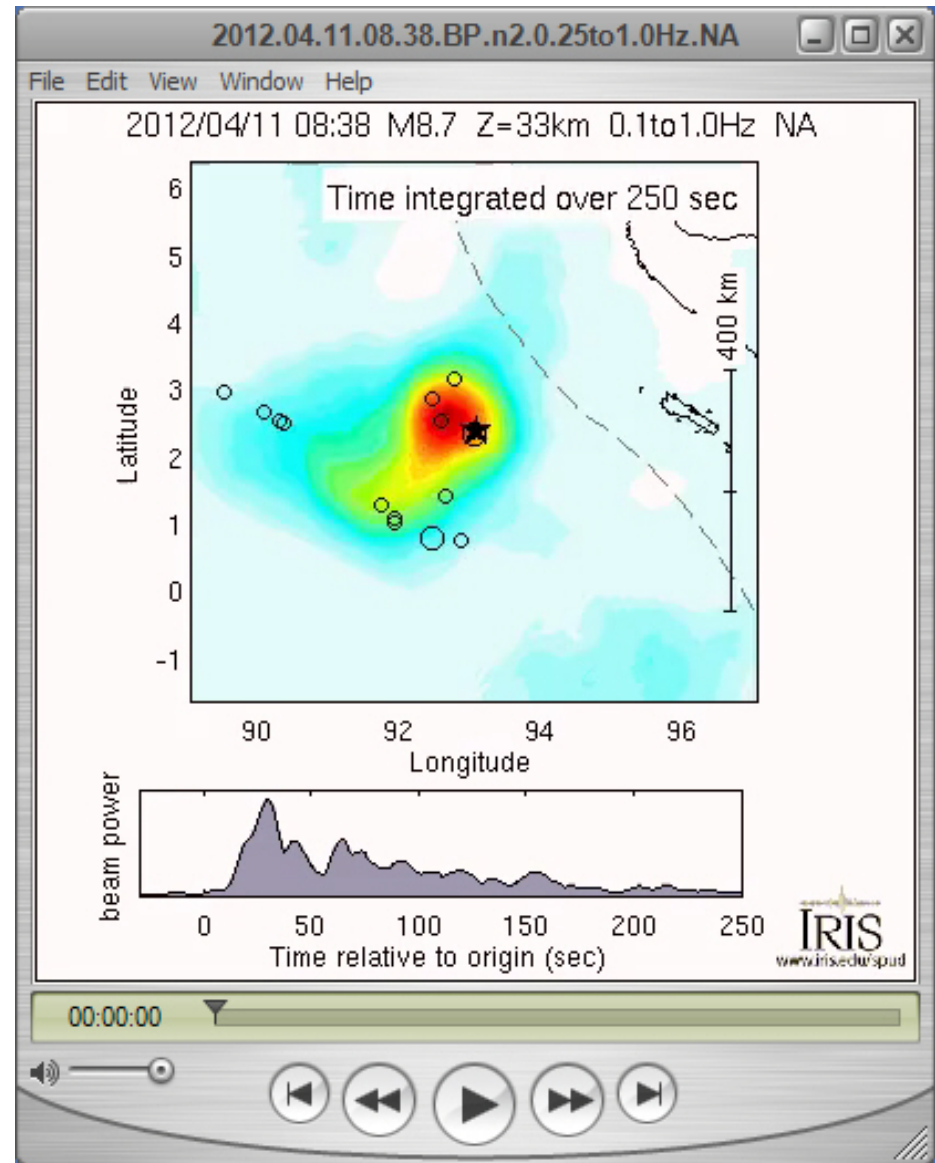
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IRIS

Back Projections are movies created from an automated data processing sequence that stacks up P wave energy recorded on many seismometers on a flat grid around the source region. This grid approximates the fault surface and creates a time and space history of the earthquake.

Warmer colors indicate greater beam power. In the movies, a red circle shows the location of the peak beam power when absolute beam powers are low.

Duration of rupture along the fault can be seen in the graph.



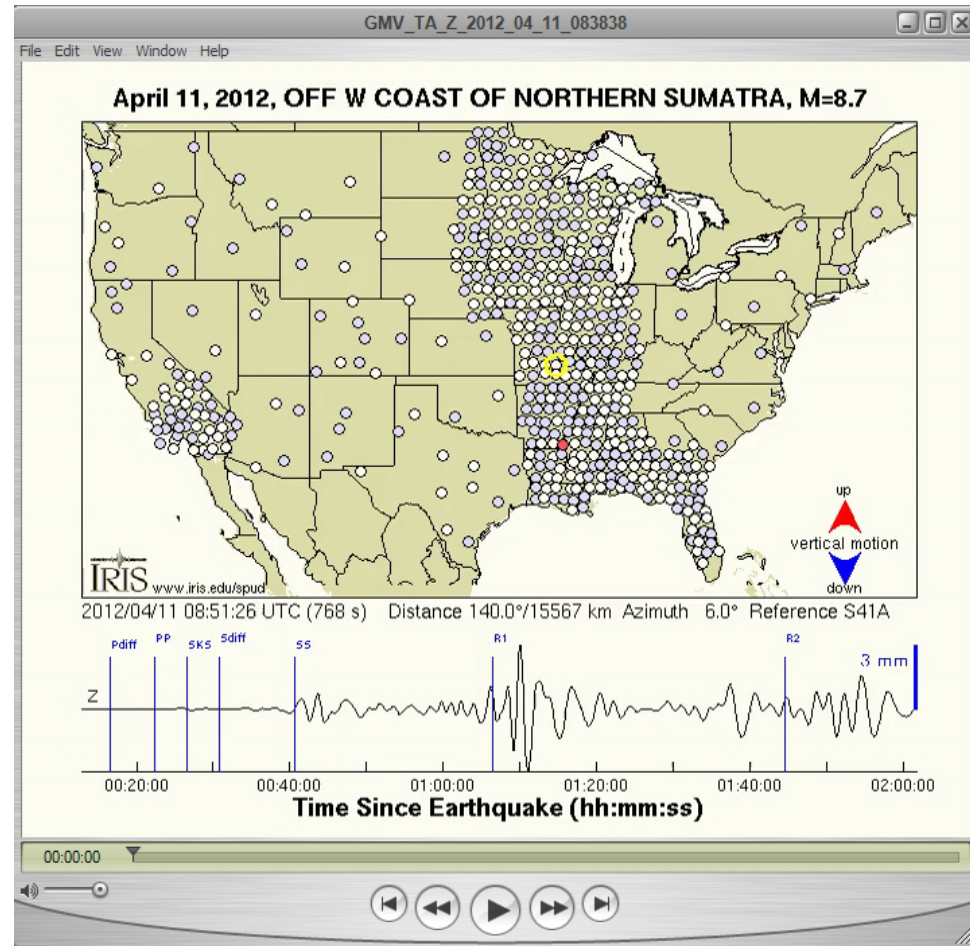
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As earthquake waves travel along the surface of the Earth, they cause the ground to move. With the 400 earthquake recording stations in EarthScope's Transportable Array, the ground motions can be captured and displayed as a movie, using the actual data recorded from the earthquake.

The circles in the movie represent earthquake recording stations and the color of each circle represents the amplitude, or height, of the earthquake wave detected by the station's seismometer.

A random representative trace is displayed on the lower part of the animation with its horizontal axis representing the time (in seconds) after the event. Location of the representative station is marked on the map by a yellow circle.



Seismic waves crossing the US recorded by the USArray.

Aftershock sequences follow predictable patterns as a group, although the individual earthquakes are themselves not predictable. The graph below shows how the number of aftershocks and the magnitude of aftershocks decay with increasing time since the main shock. The number of aftershocks also decreases with distance from the main shock.

Aftershocks usually occur geographically near the main shock. The stress on the main shock's fault changes drastically during the main shock and that fault produces most of the aftershocks. Sometimes the change in stress caused by the main shock is great enough to trigger aftershocks on other, nearby faults.

