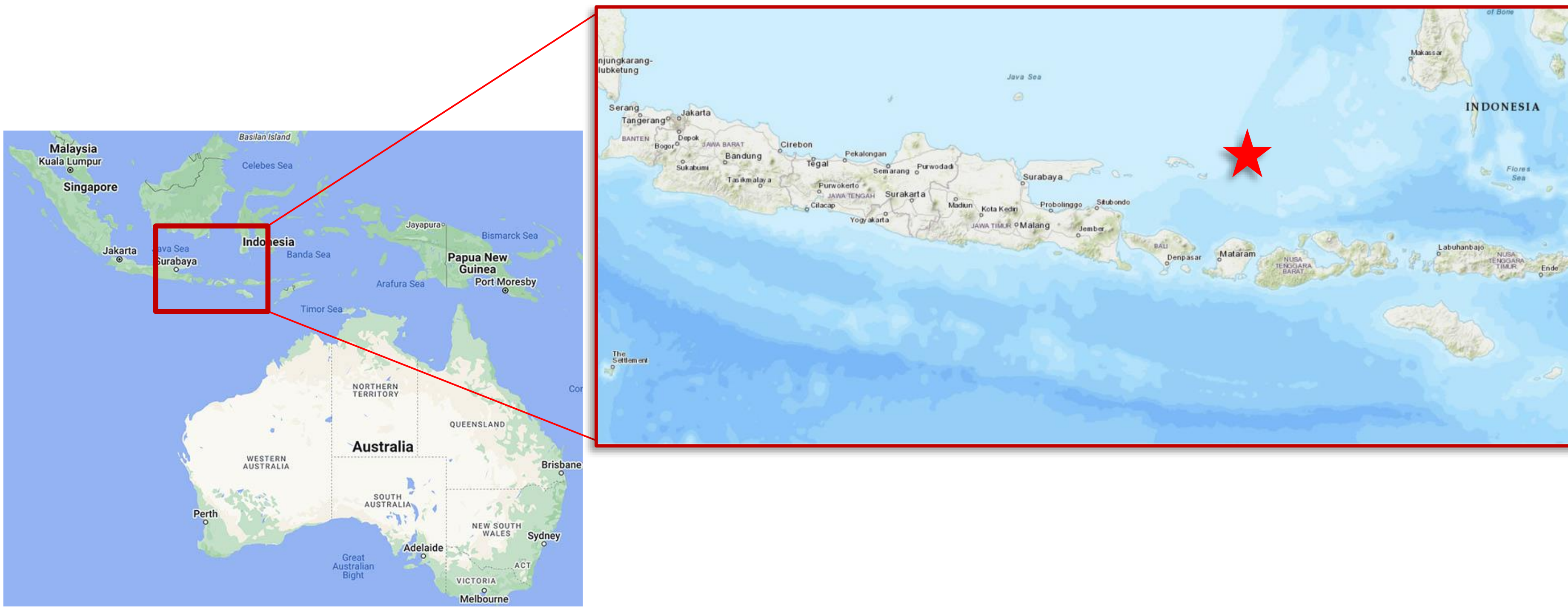
Magnitude 7.1 INDONESIA

Monday, August 28, 2023 at 19:55:32 UTC

Latitude 6.777° S
Longitude 116.568° E
Depth 513.5 km

A magnitude 7.1 earthquake occurred north of the Bali and Mataram islands, Indonesia at a depth of 513.5 km (319 mi) beneath the Java Sea. There are no reports of damage or injuries.

Deep earthquakes cause less damage on the ground surface above their foci than similar-magnitude shallow earthquakes. Still, large deep earthquakes may be felt at great distances from their epicenters.



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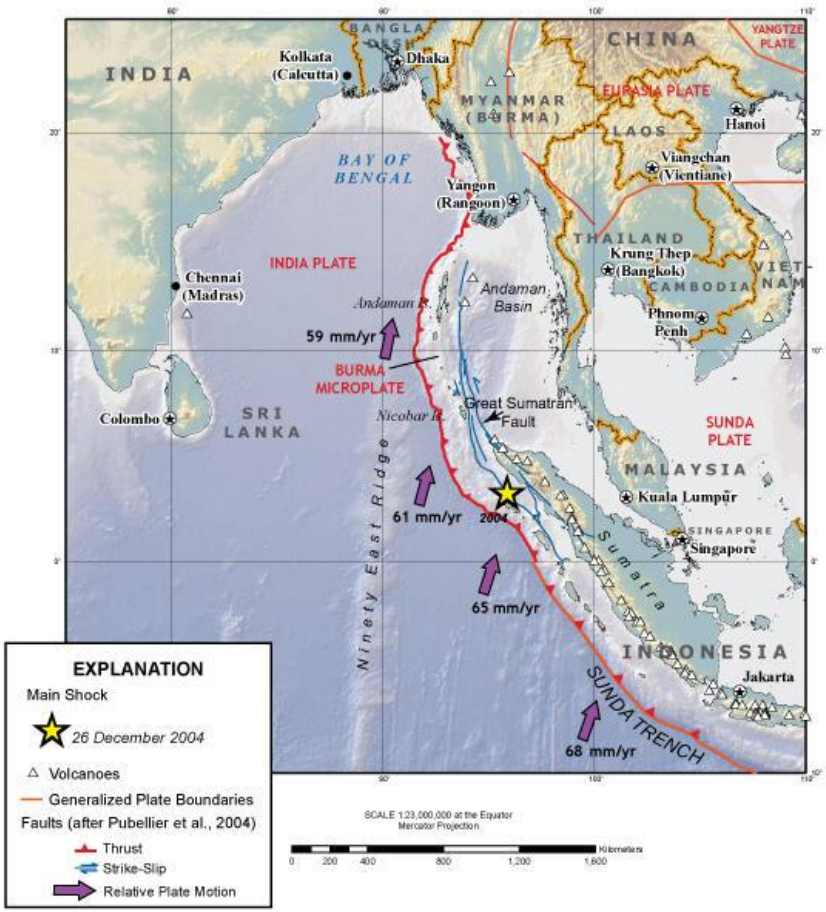
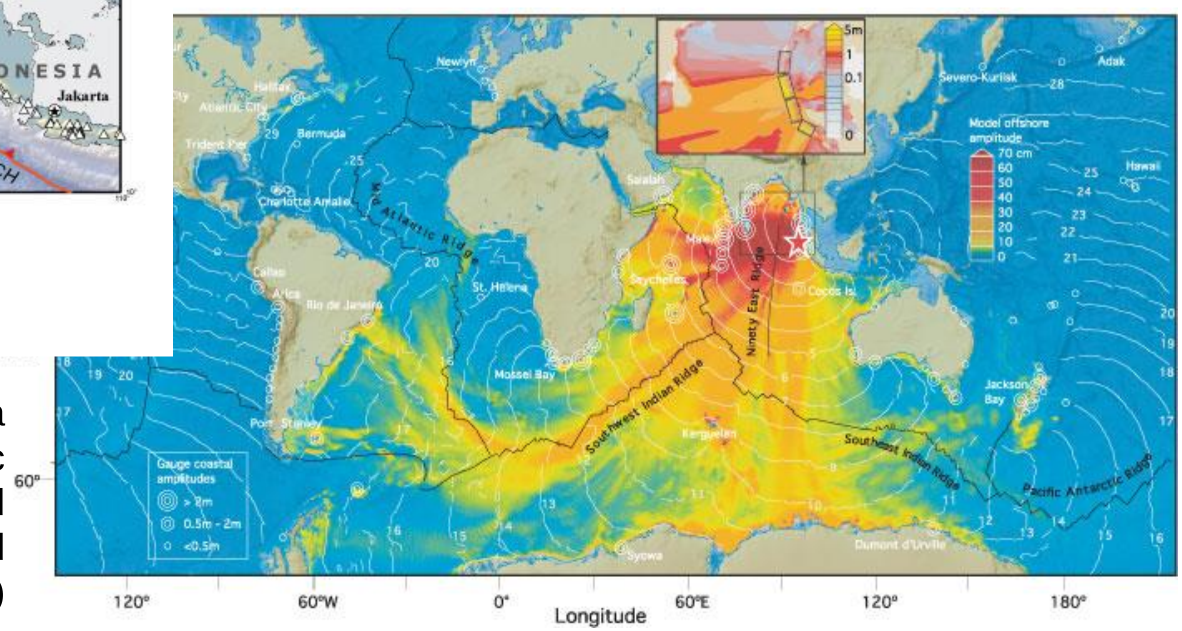
Farther northwest, along this same subduction zone, in 2004 a magnitude 9.1 shallow earthquake (30 km; 18.6 mi) ruptured the seafloor causing a massive tsunami that took over 225,000 lives.

The Sumatra–Andaman Islands earthquake was the third largest earthquake and the most deadly tsunami ever recorded.

The August 28, 2023 earthquake was deep (513.5 km; 319 mi) thus no tsunami was generated.





Propagation of the 2004 Sumatra tsunami showing the catastrophic regional impact of this event. Filled colors show maximum computed tsunami heights. (NOAA)

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The Modified-Mercalli Intensity (MMI) scale is a ten-stage scale, from I to X, that indicates the severity of ground shaking. Intensity is based on observed effects and is variable over the area affected by an earthquake. Intensity is dependent on earthquake size, depth, distance, and local conditions.

MMI	Perceived Shaking
X	Extreme
IX	Violent
VIII	Severe
VII	Very Strong
VI	Strong
V	Moderate
IV	Light
II-III	Weak
I	Not Felt

USGS estimated shaking intensity from M 7.1 Earthquake

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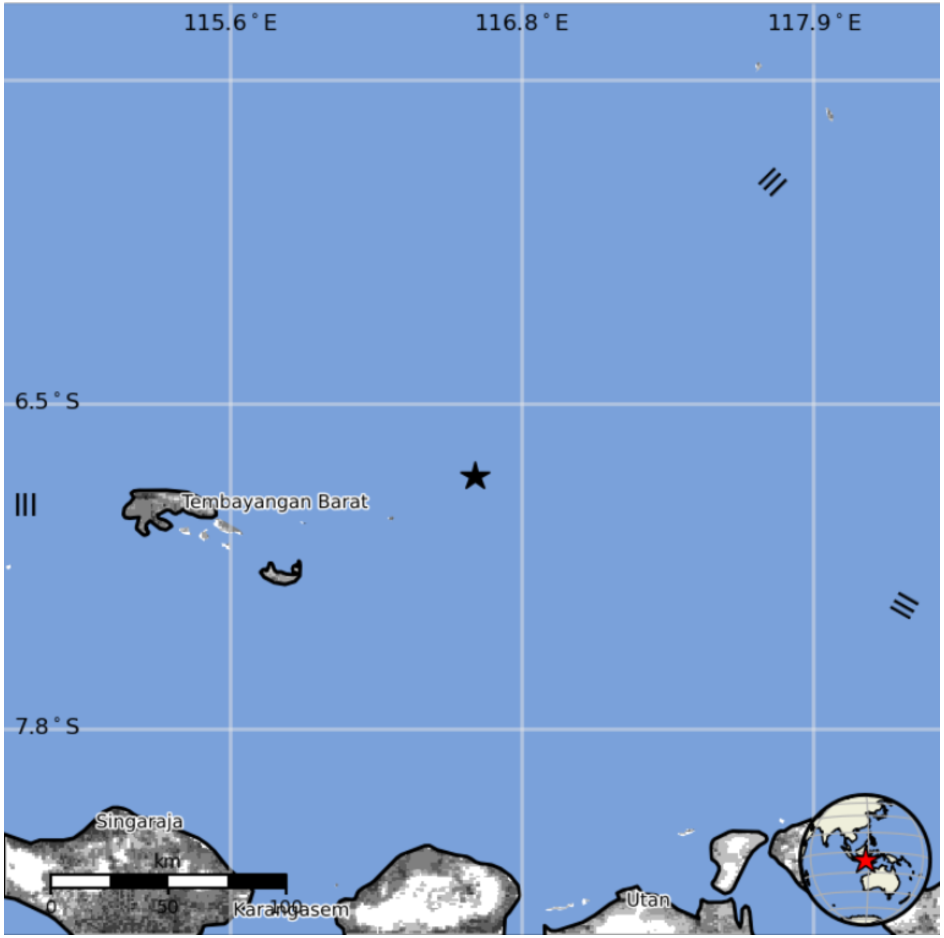
The USGS PAGER map shows the population exposed to different Modified Mercalli Intensity (MMI) levels.
The USGS estimates that 3 million people felt weak shaking from this earthquake.

I	Not Felt	0 k*
II-III	Weak	3,750 k*
IV	Light	0 k
V	Moderate	0 k
VI	Strong	0 k
VII	Very Strong	0 k
VIII	Severe	0 k
IX	Violent	0 k
X	Extreme	0 k



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.

Image courtesy of the US Geological Survey

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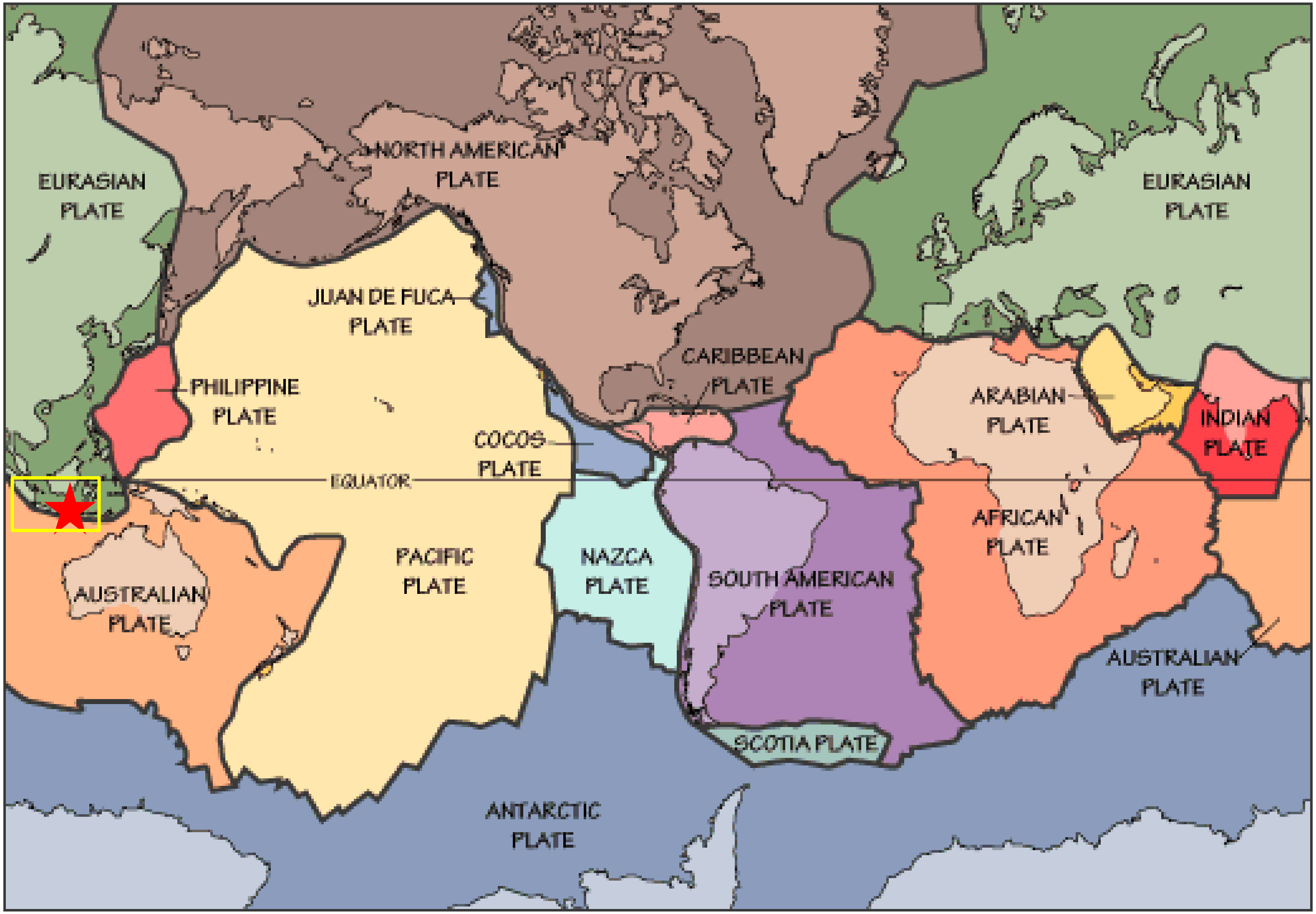

The Sunda–Java Trench is the convergent plate boundary where the Australia Plate subducts beneath the Sunda Plate, the southeastern part on the Eurasian Plate. The tectonics and seismicity of the area within the yellow rectangle are shown on the next slide.

Image courtesy OSU; simplified from Hamilton (1979)

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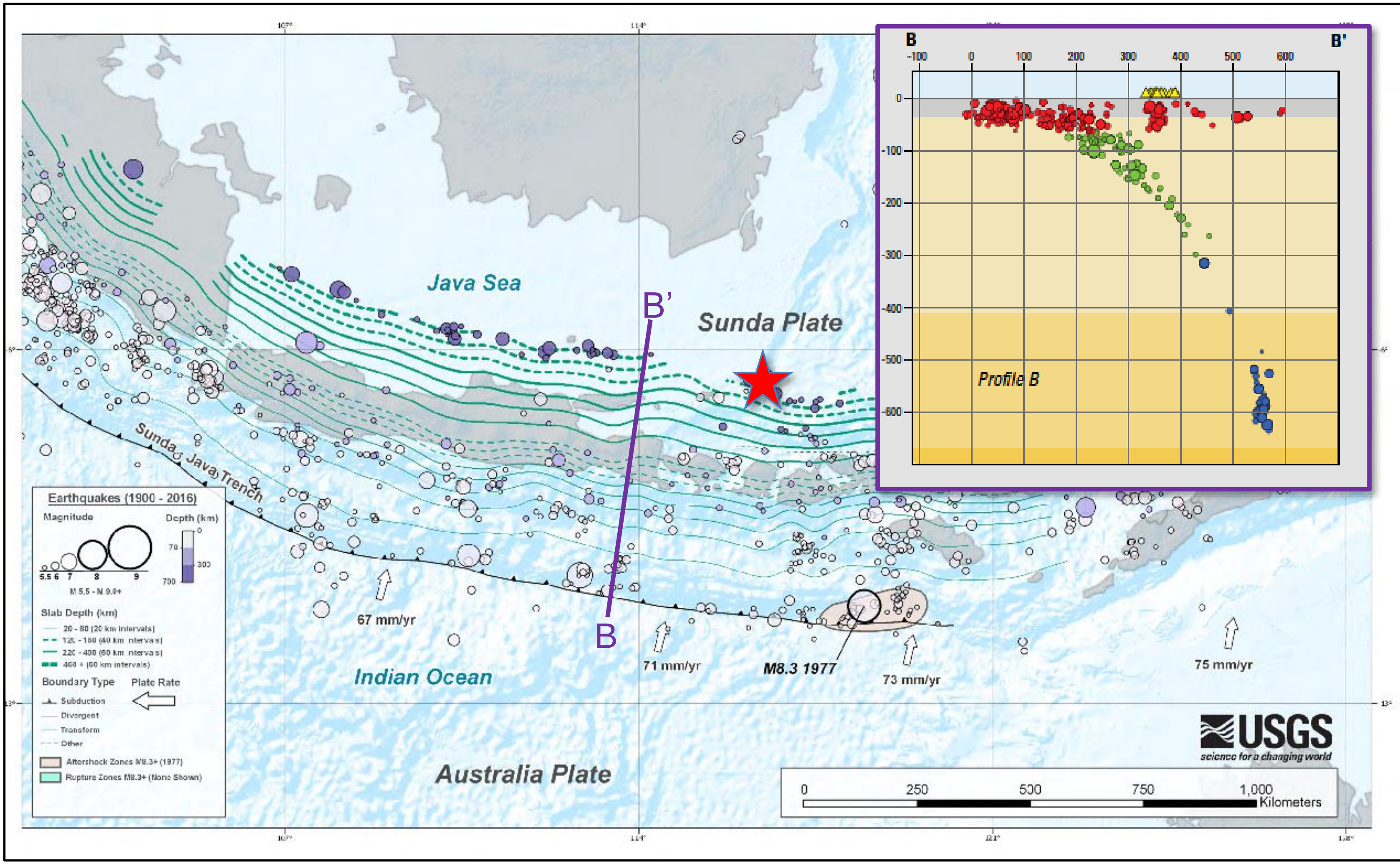

On this map, rates of subduction of the Australia Plate beneath the Sunda Plate are shown with earthquake history from 1900 to 2016 along the Sunda – Java subduction zone. The red star shows the epicenter of the August 23^{rd} earthquake. At the location of this earthquake, the rate of subduction is about 72 mm/yr. A south-to-north cross section of the subduction zone from B to B' is shown in the upper right. With a depth of 513.5 km, the August 23^{rd} earthquake occurred within the subducting Australia Plate.

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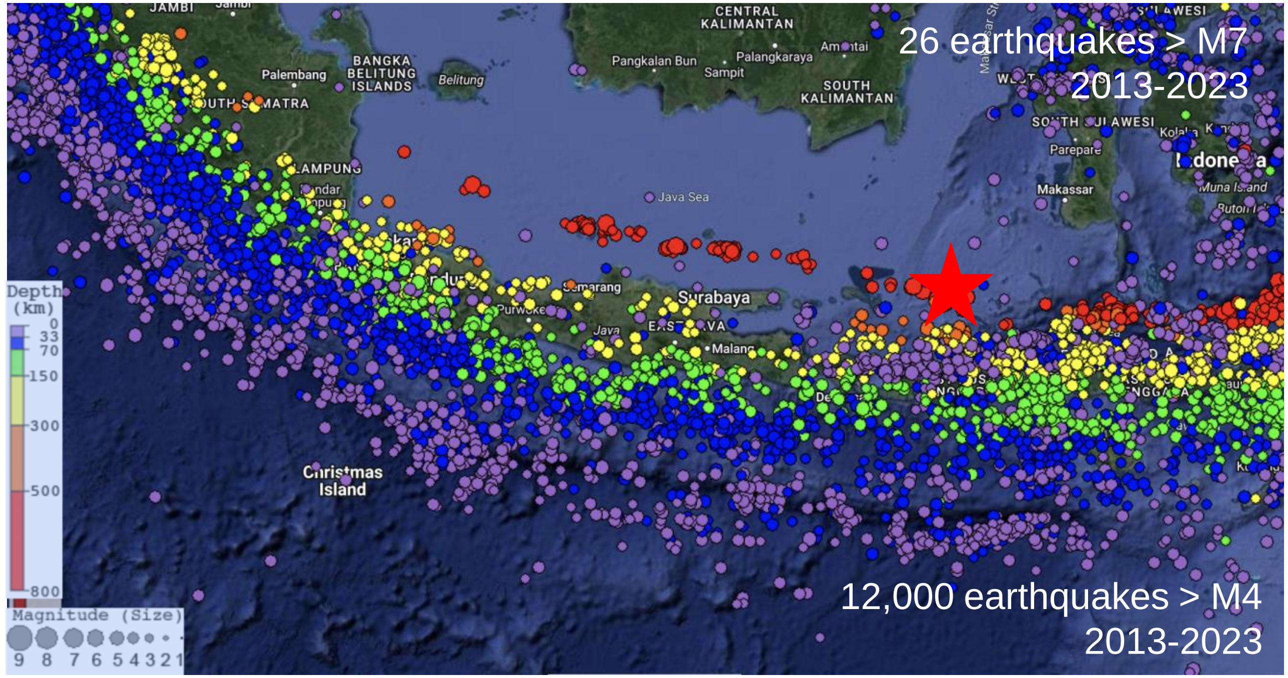
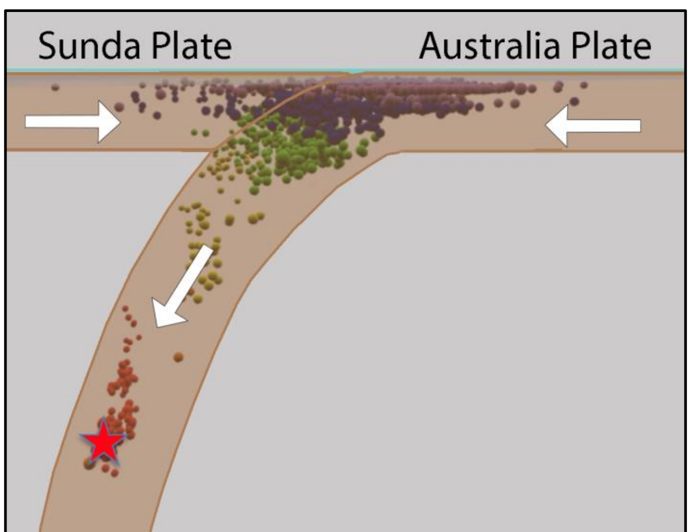
Regional historic seismicity >M4 in this region (2003-2023) is shown with earthquakes color coded by depth.

The red star indicates the epicenter of the August 28th earthquake.





Map and cross section generated from the Interactive Earthquake Browser (www.iris.edu/ieb)

Left: North-northeast trending cross sectional view through the earthquake. A similar nearby earthquake can be seen animated on the next slide.

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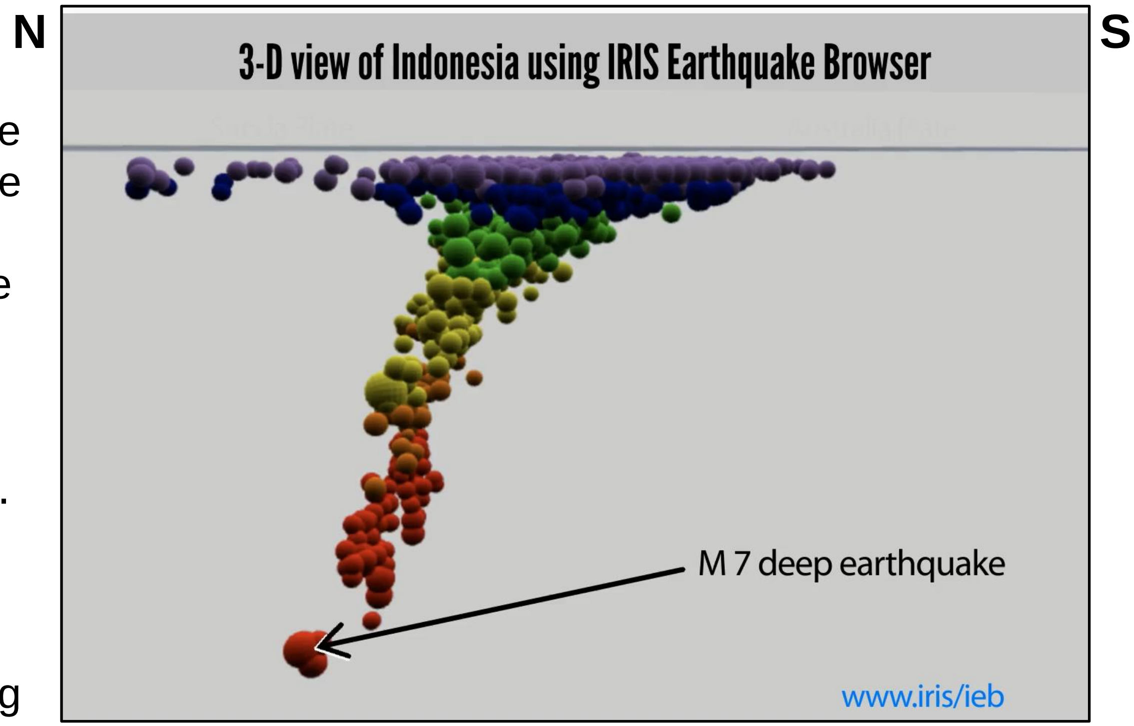
Animation of the cross-section view looking East through subduction zone using the IEB 3-D function. Plates are briefly highlighted to emphasize the structure indicated by the earthquake hypocenters.

A deep-focus earthquake has a hypocenter depth exceeding 300 km. Deep earthquakes occur exclusively within subducting oceanic lithosphere, especially within old oceanic lithosphere that is subducting rapidly.



To produce earthquakes rocks must be brittle. Brittle rock accumulates elastic energy as they bend then rapidly releases that energy during earthquake rupture.

With the exception of subducting oceanic plates, rock in Earth's mantle below about 100 km depth is viscoelastic and cannot rupture to produce earthquakes. Rocks are brittle at low temperatures but become viscoelastic when they reach temperatures of about 600° C. Rapidly subducting cool oceanic plates, however, can remain brittle up to about 700 km depth in the hot mantle.

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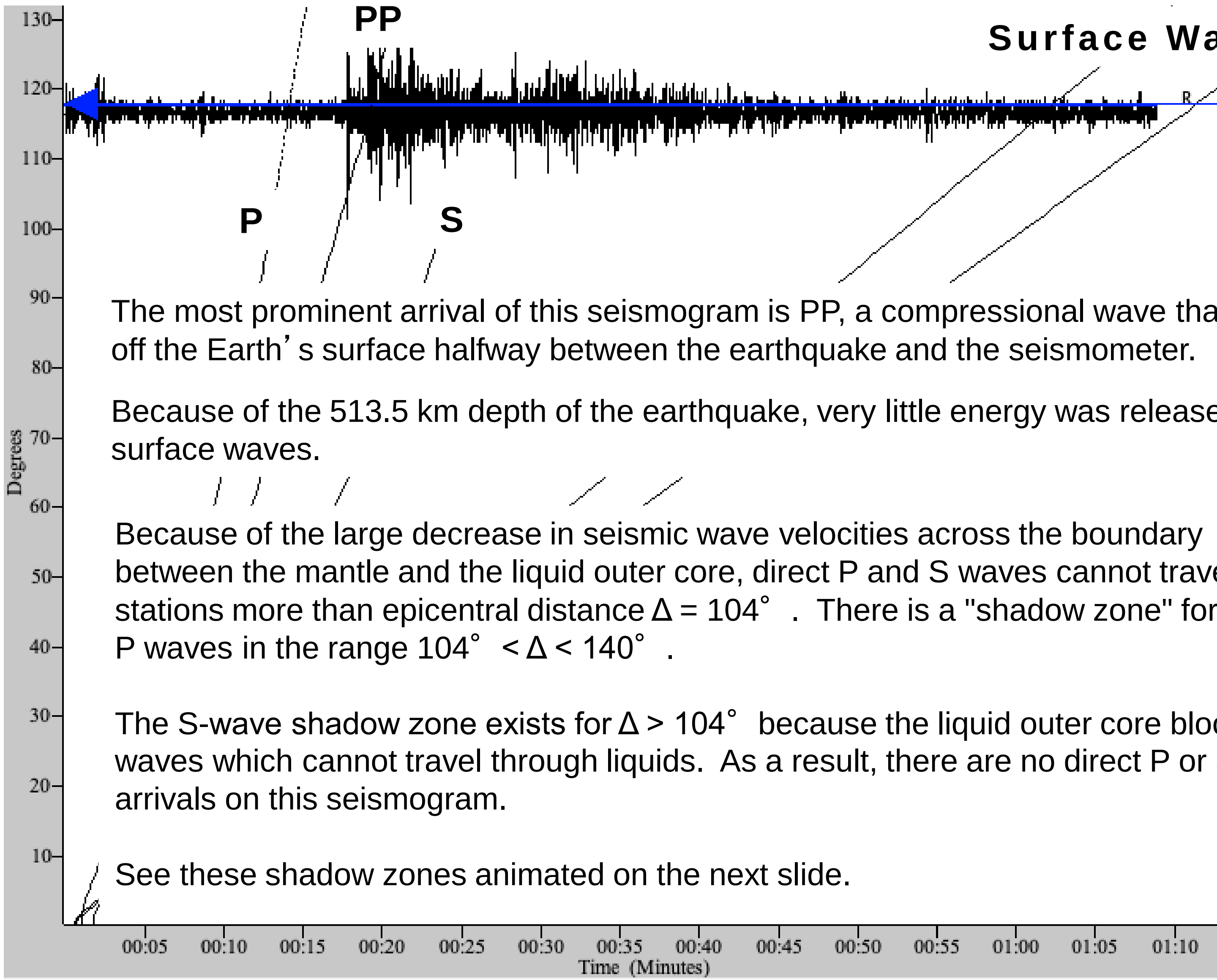
The record of the earthquake in Bend, Oregon (BNOR) is illustrated below. Bend is 13,063 km (8117 miles, 117.7°) from the location of this earthquake.



The most prominent arrival of this seismogram is PP, a compressional wave that bounced off the Earth's surface halfway between the earthquake and the seismometer.

Because of the 513.5 km depth of the earthquake, very little energy was released as surface waves.

Because of the large decrease in seismic wave velocities across the boundary between the mantle and the liquid outer core, direct P and S waves cannot travel to stations more than epicentral distance $\Delta = 104°$. There is a "shadow zone" for direct P waves in the range $104° < \Delta < 140°$.

The S-wave shadow zone exists for $\Delta > 104°$ because the liquid outer core blocks S waves which cannot travel through liquids. As a result, there are no direct P or S arrivals on this seismogram.

See these shadow zones animated on the next slide.

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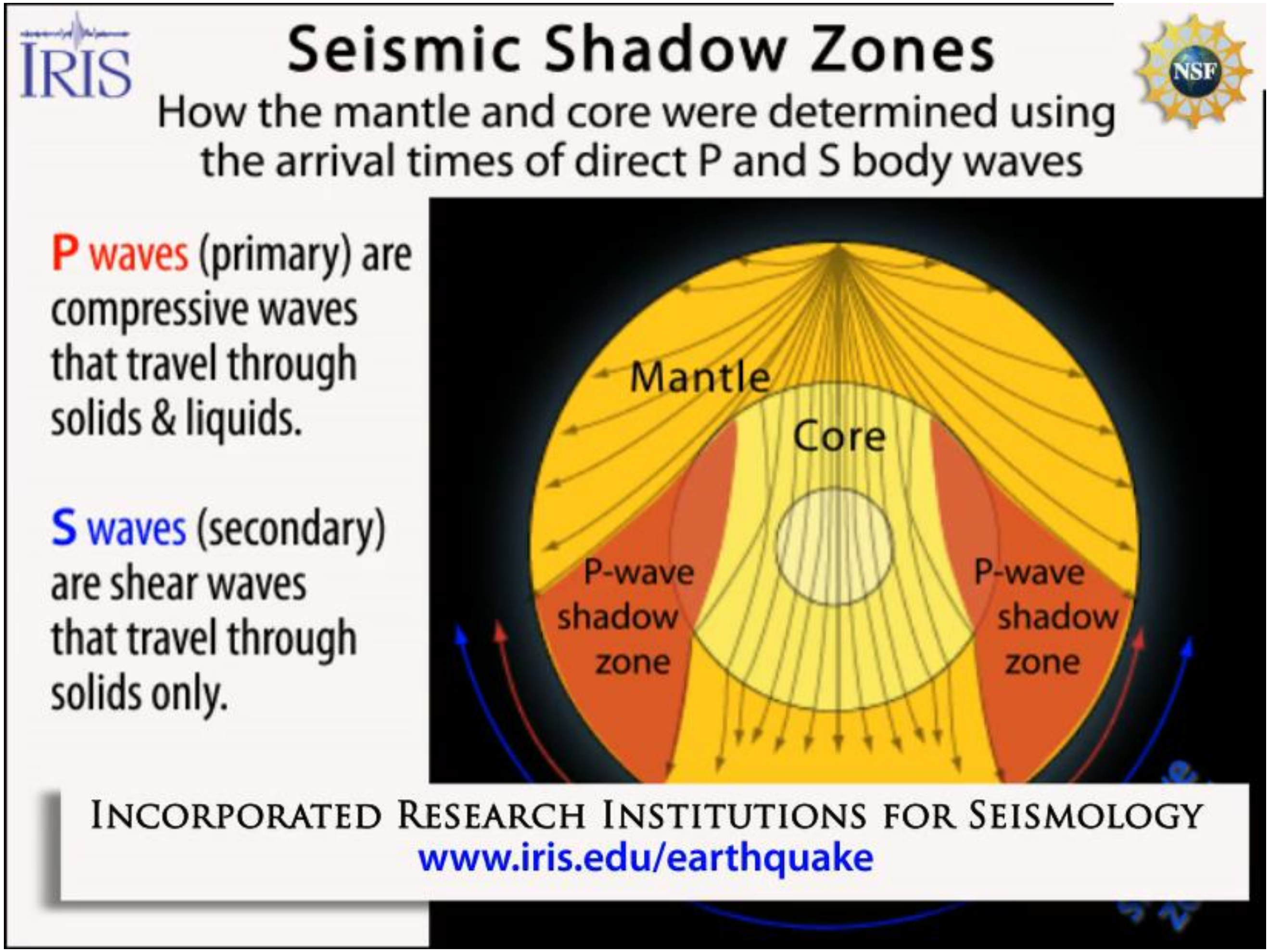
This animation explores the P-wave shadow zone resulting from refraction of compressional seismic waves at the core – mantle boundary. Shear (S) waves are blocked at the core – mantle boundary because they cannot travel through the liquid outer core.



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