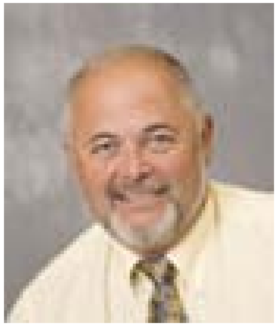
Week 3 Ch 6 PPT

EAPS 10000 Y01
Online Course
Planet Earth

Prof. Lawrence Braile

Welcome to the EAPS 10000 Y01 online course ***Planet Earth*** *(also known as EAPS 100)!*



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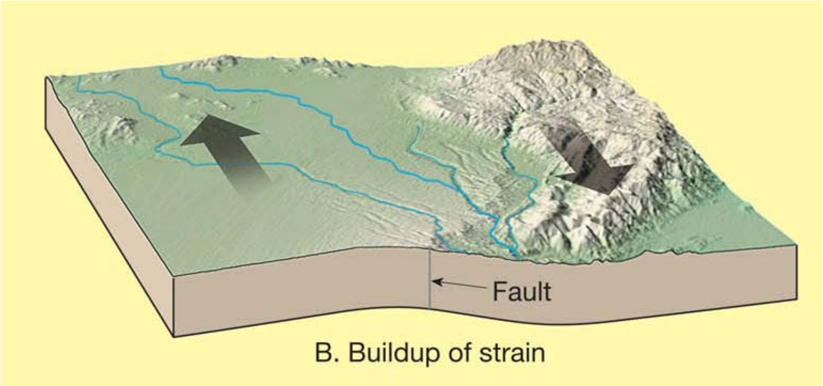
PURDUE UNIVERSITY

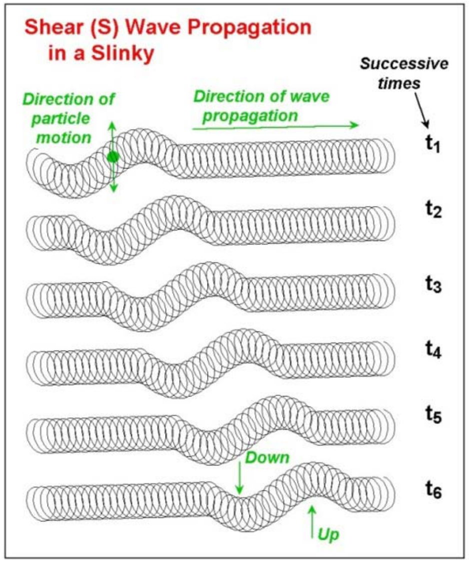
Earth Atmospheric Planetary Sciences

EAPS 10000 Y01 – *Planet Earth* (online course)
Week 3, Chapter 6 (pages 188-229, text)

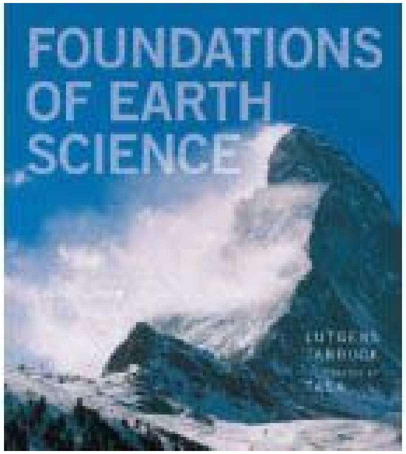
Week	Chapter	Assigned Pages	Major Concepts	Important Terms
3	**6 – Restless Earth**	188 – 229	Earthquakes, elastic rebound theory, seismic waves, earthquake hazards, Earth's interior structure, rock deformation, mountain building	Faults, magnitude, intensity, liquefaction, tsunami, crust, mantle, core, mountain belts



Elastic Rebound Theory



Seismic Waves



EAPS 10000 Y01 – Planet Earth (online course)
Week 3, Chapter 6 (pages 188-229)

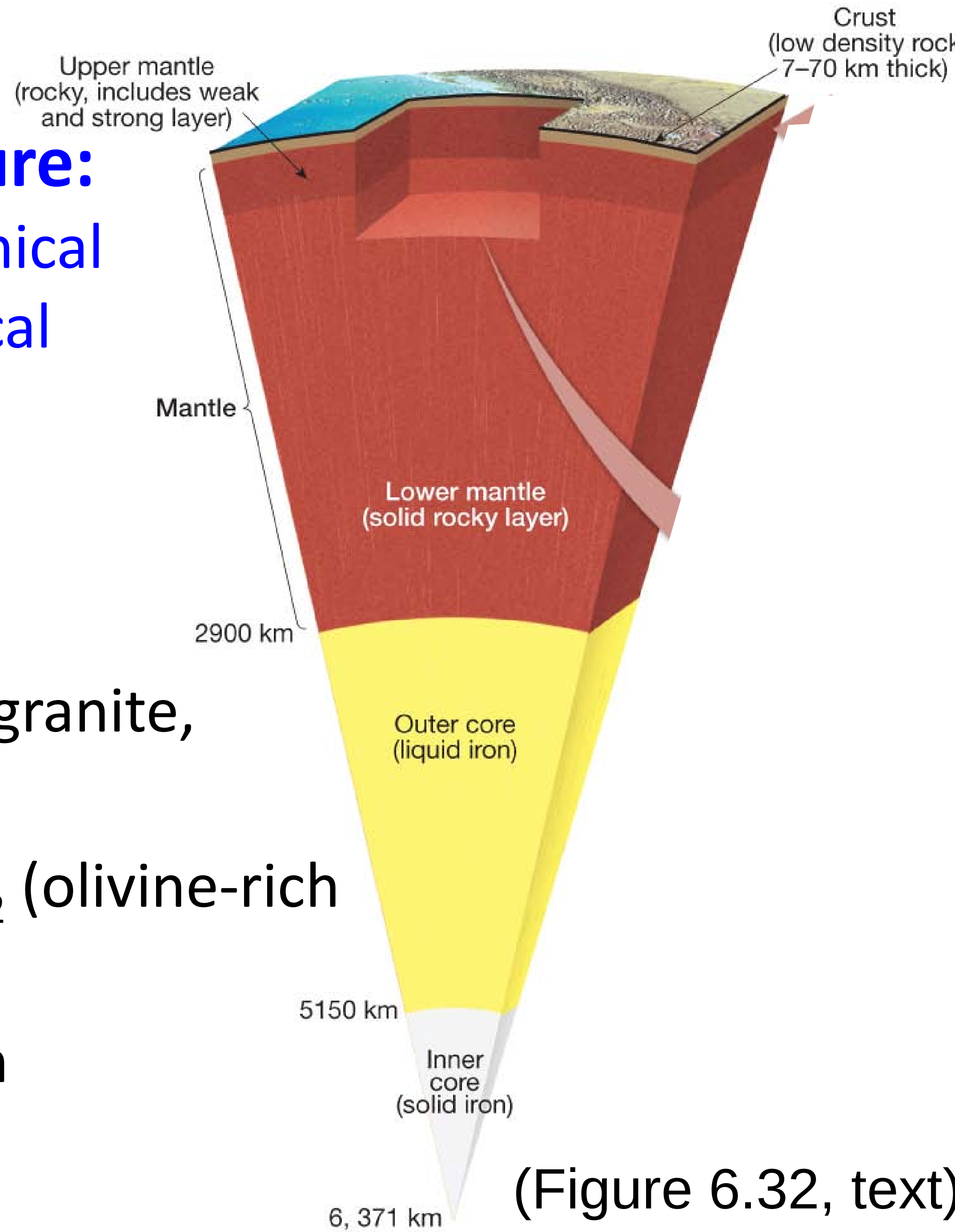
When you have finished reading Chapter 6 and viewing the PowerPoint file for Week 6, Chapter 6, take the quiz (Quiz5; be sure to read the Syllabus for more information on quizzes). You can use your book, notes, etc. during the quiz.

The PPT files (converted to PDF files) are best viewed with the Full Screen view in browsers.

The following slides illustrate some of the important concepts and topics of Chapter 6.

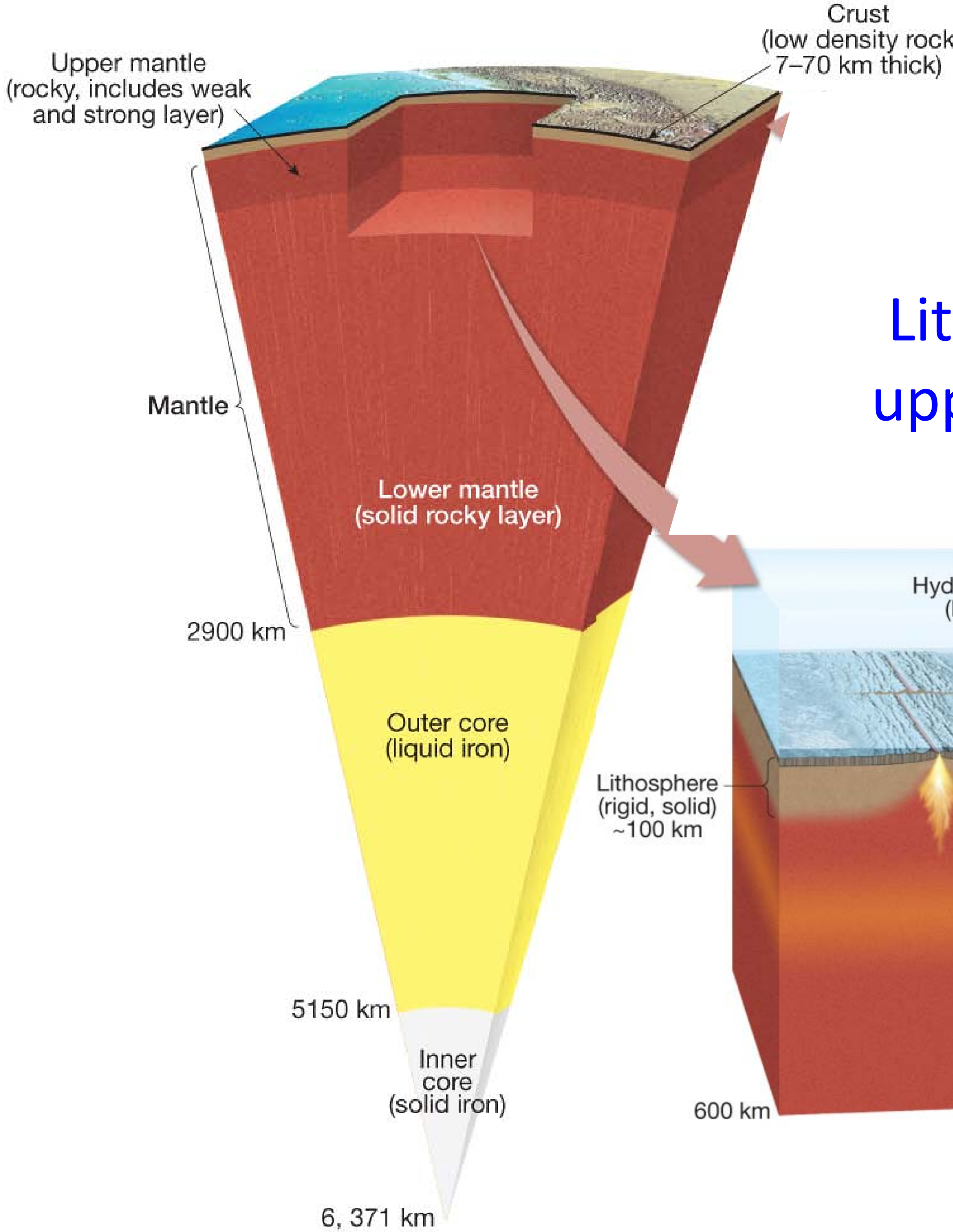
Earth's Interior Structure:

Earth is separated by chemical composition into spherical shells:

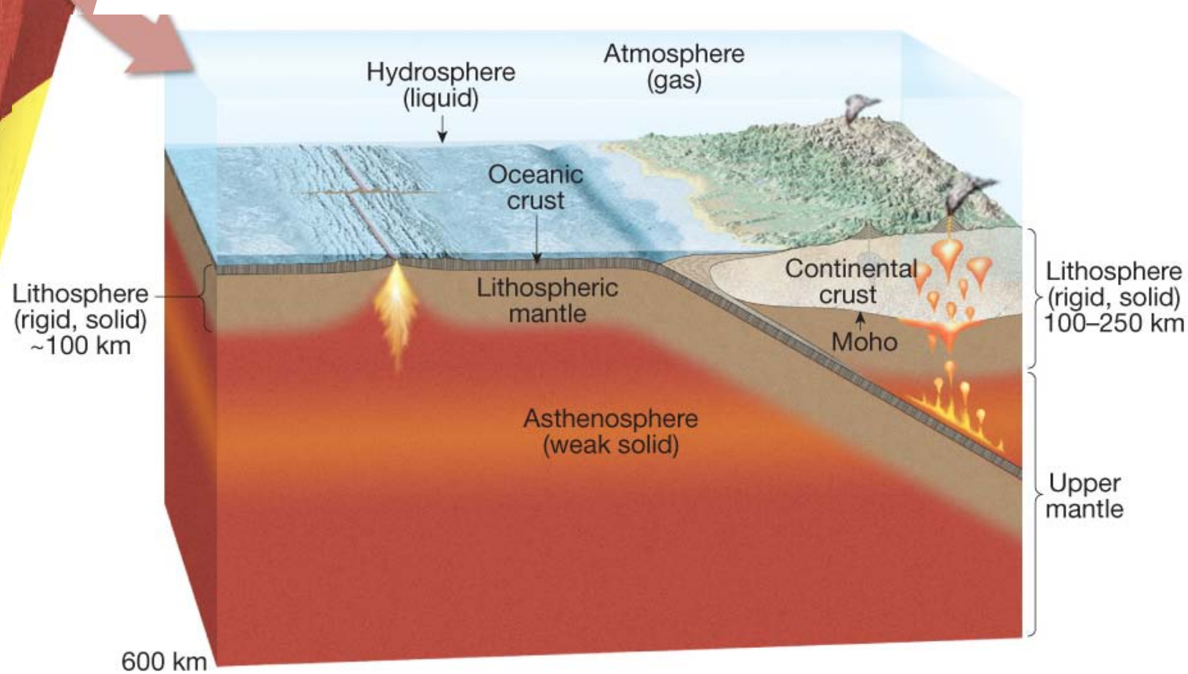


- **Crust** – high % of SiO_2 (granite, basalt, etc.)
- **Mantle** – low % of SiO_2 (olivine-rich silicate rocks)
- **Outer Core** – liquid iron
- **Inner Core** – solid iron

(Figure 6.32, text)



Lithosphere (crust and uppermost mantle) and Asthenosphere



(Figure 6.32, text)

Elastic Rebound Theory

Discovered by analysis of the fault motion and deformation before and during the 1906 San Francisco earthquake (before plate tectonics theory).

Theory is consistent with plate tectonics, in fact, it explains how the slow motions of the plates can result in the rapid slip along a fault to produce an earthquake.

B. Buildup of strain

Elastic Rebound Theory

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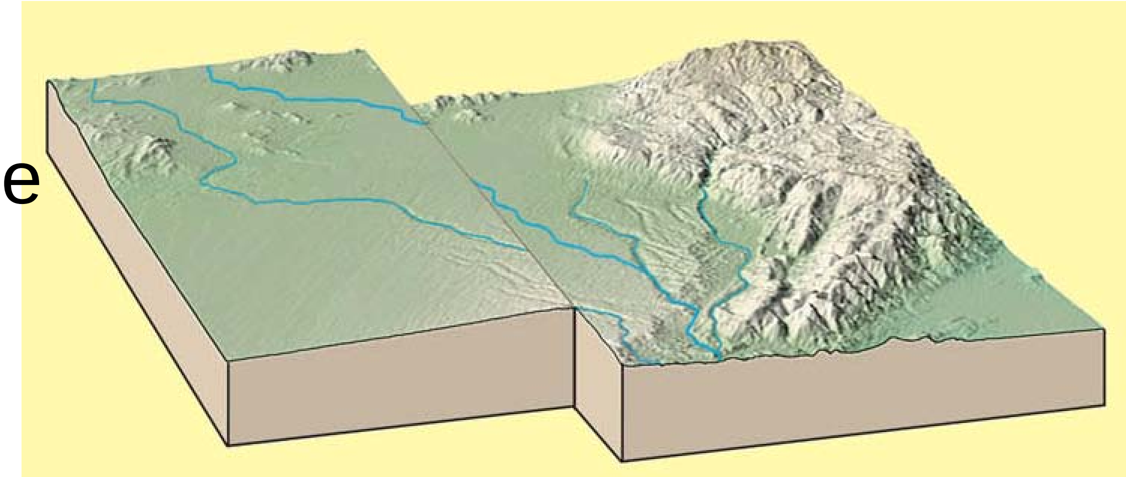
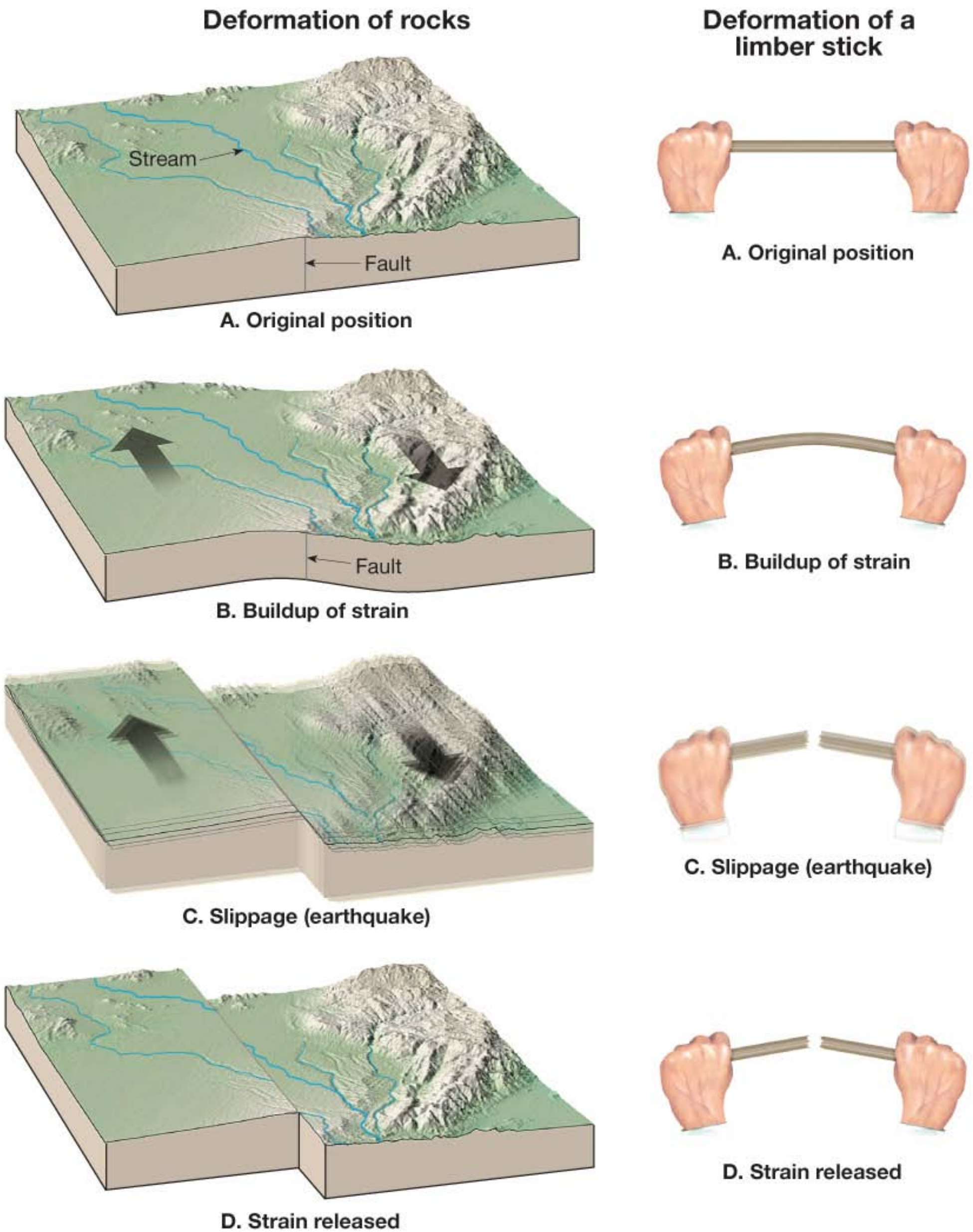

D. Strain released



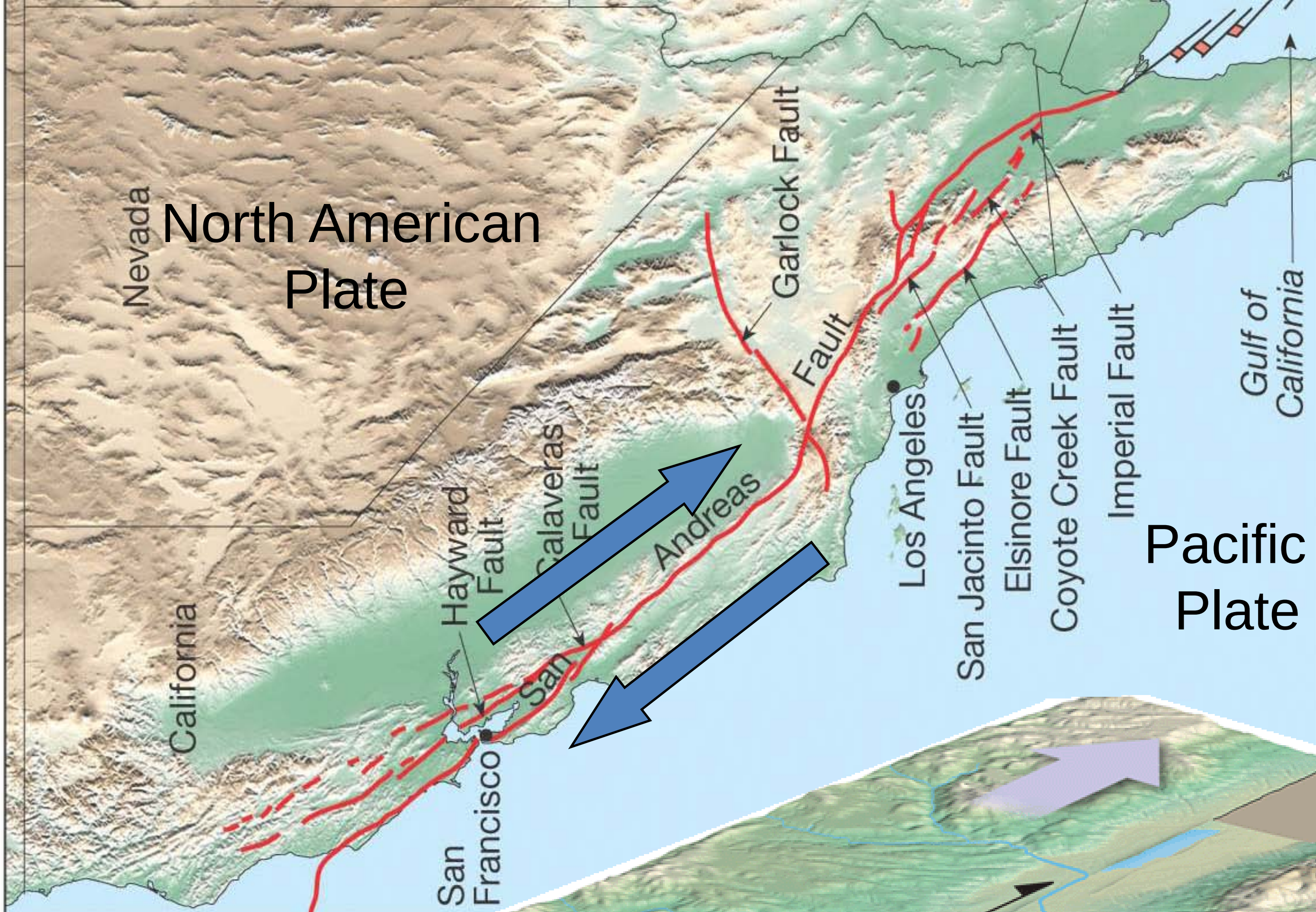
Elastic Rebound

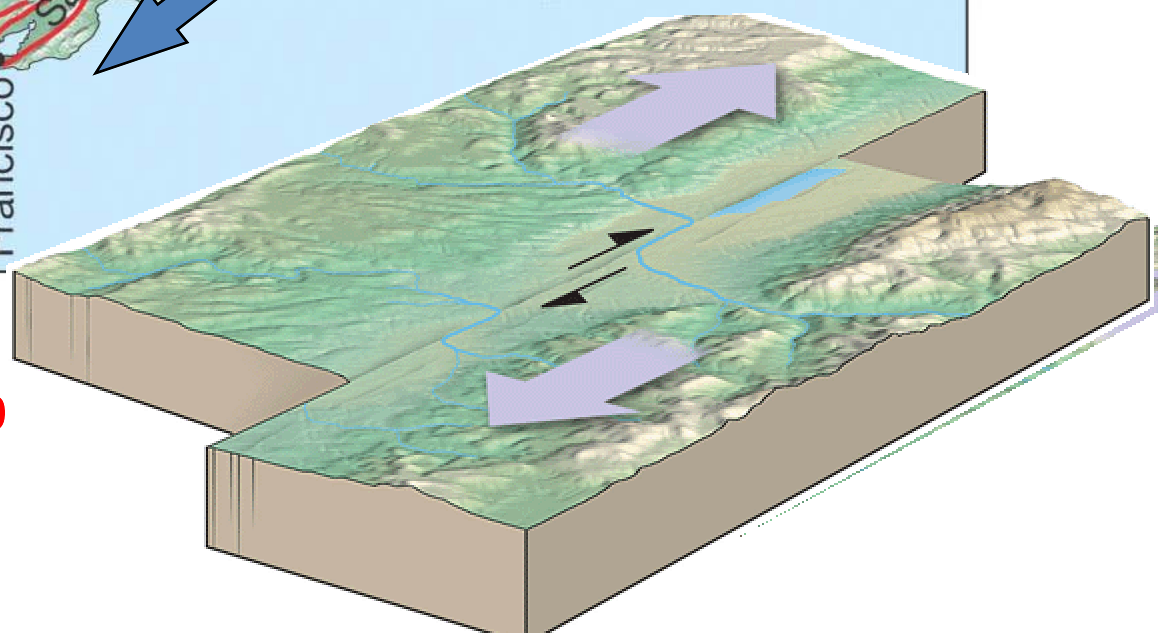
Slow build-up of deformation (strain, bending) in the rocks by plate motions. Strain (energy) is released (restoring force in elasticity) suddenly as fault slips (ruptures; earthquake).

Figure 6.5 text.

To better understand elastic rebound theory, see the **animation** (provided by the textbook company) in the Week 3 folder on BB Learn (after you open the animation, push “play”; there is narration and you can click on “show text” to read explanations):

ElasticRebound_GL.swf



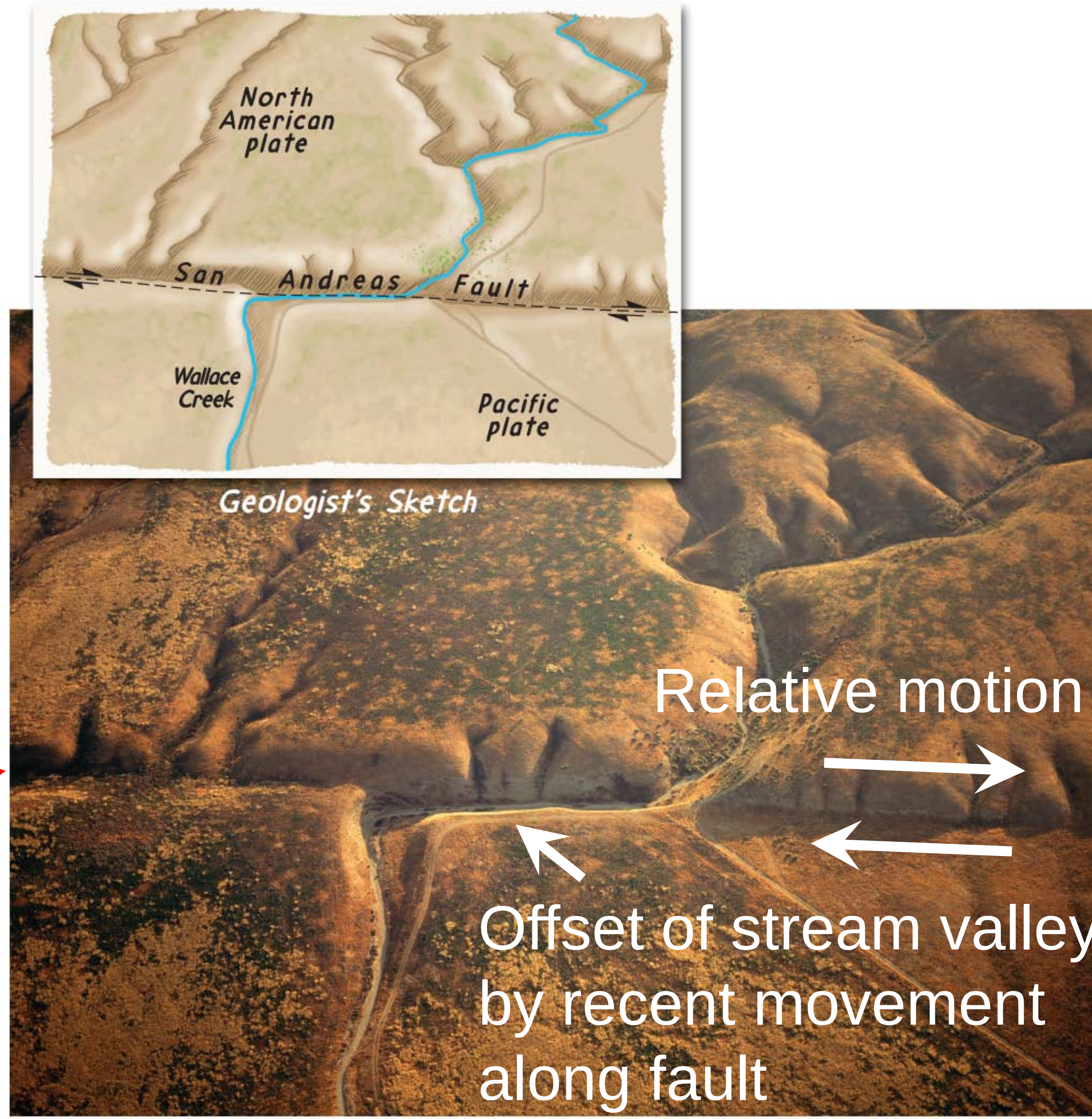


Transform or horizontal slip fault; occasional slip along the faults are earthquakes

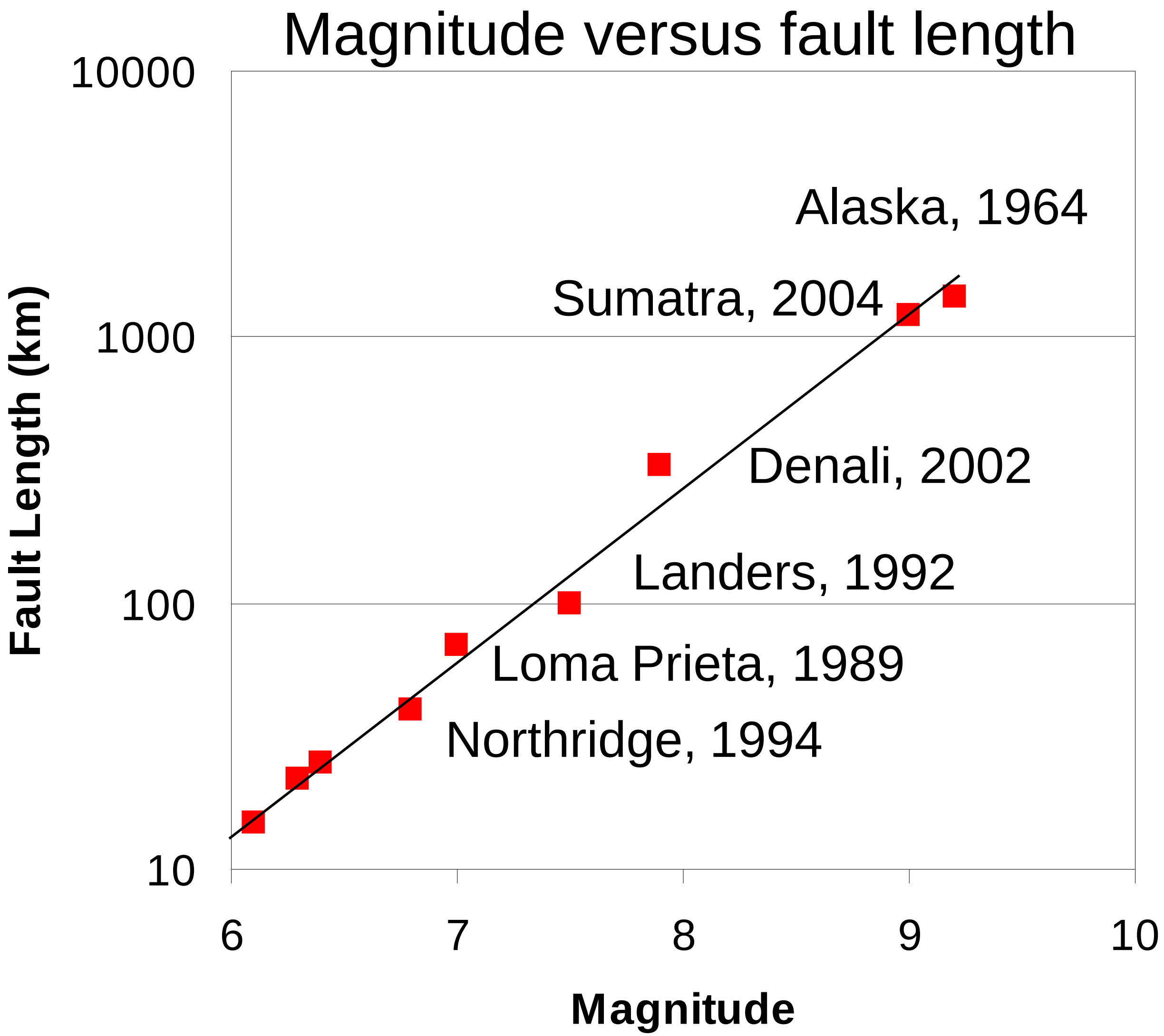
Plate Tectonics

Transform boundary;
(also called a strike-slip fault)
San Andreas fault,
Figure 5.24, text

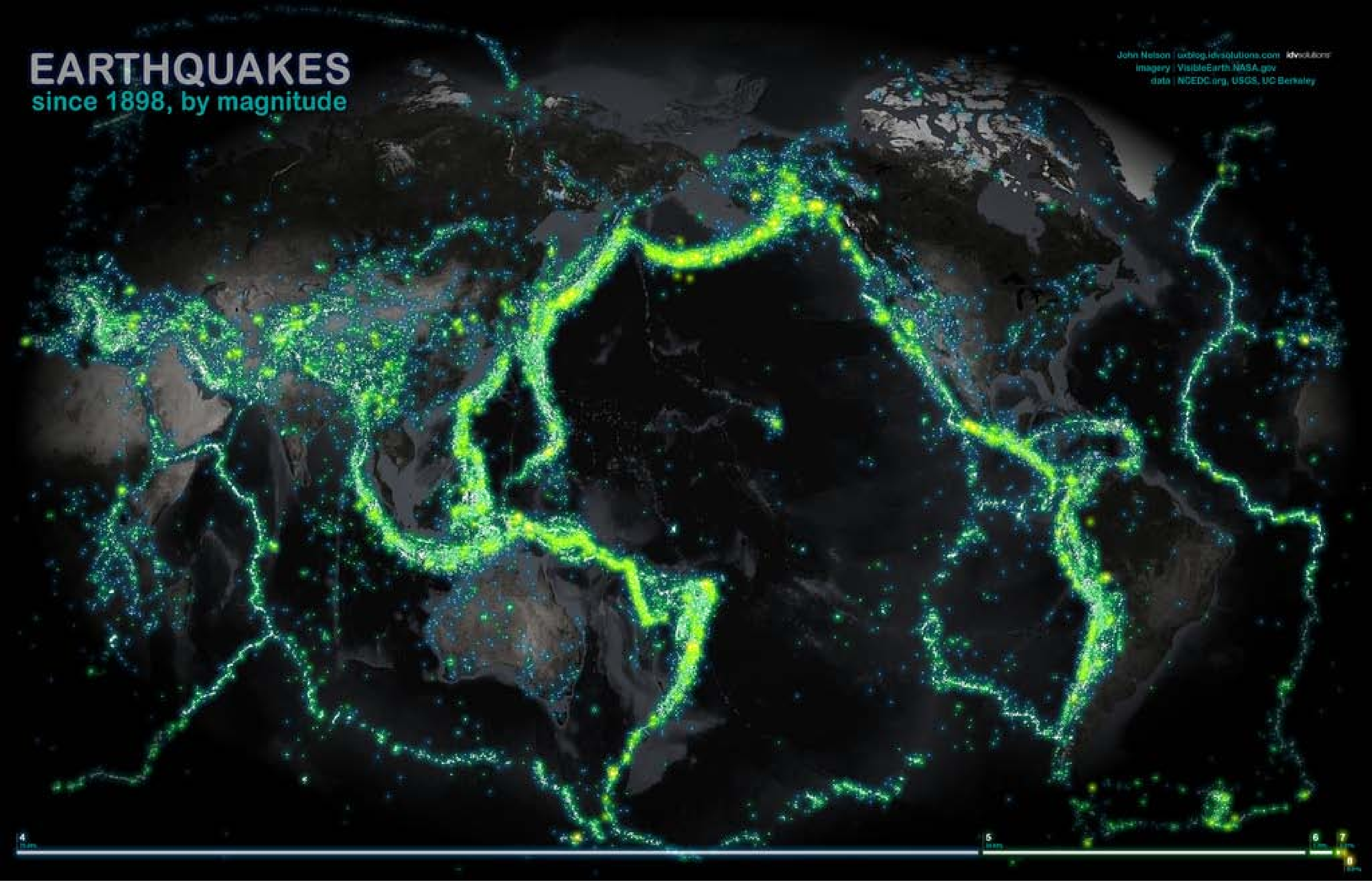
Fault



Magnitude of earthquake is controlled by fault length that ruptures (data for diagram generated using Seismic/Eruption program)

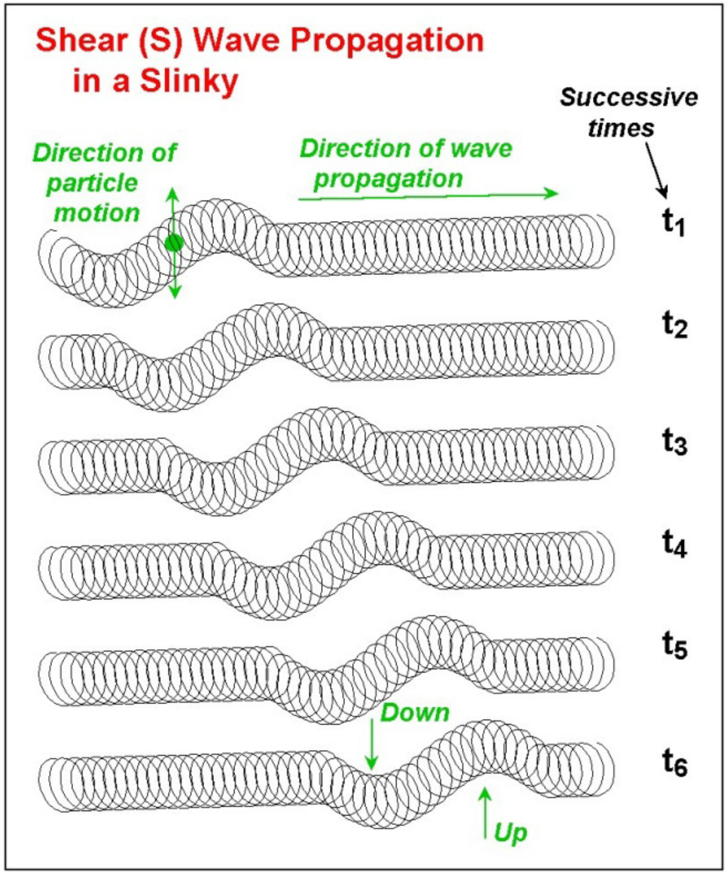


Magnitude versus fault length (determined from aftershock zone length) for various earthquakes (Alaska, 1964; Sumatra, 2004; Denali, 2002; Landers, 1992; Loma Prieta, 1989; Northridge, 1994, etc.). Results were quickly obtained using Seismic/Eruption views.



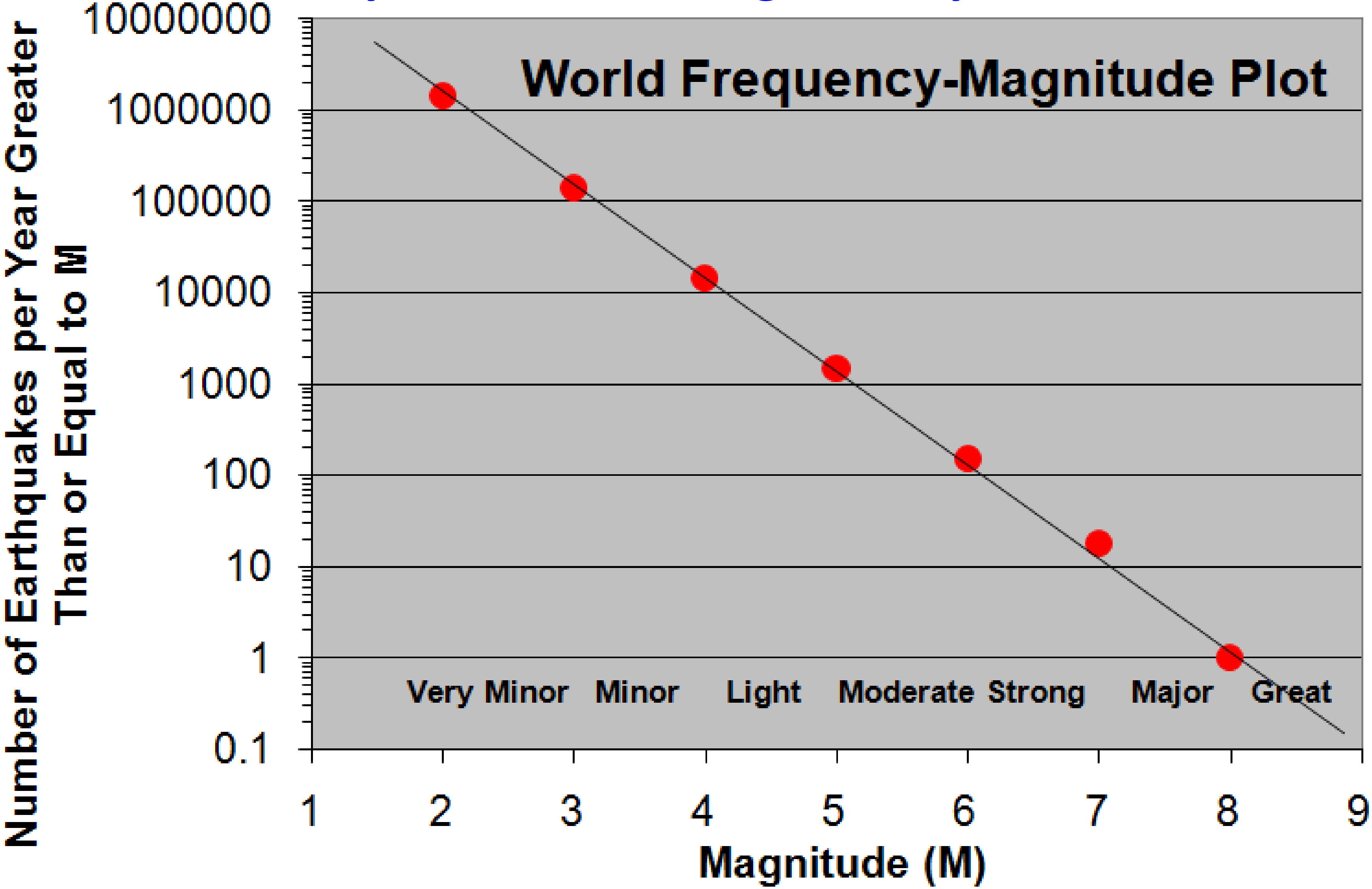
Brighter areas indicate higher total energy release (large magnitude eqs and large number of eqs)
http://www.ouramazingplanet.com/3114-world-earthquakes-map.html

Earthquakes generate P, S and Surface waves (different velocity of propagation and different vibration pattern for the three wave types). Seismic waves (P, S, Rayleigh, Love) can be demonstrated using the slinky.

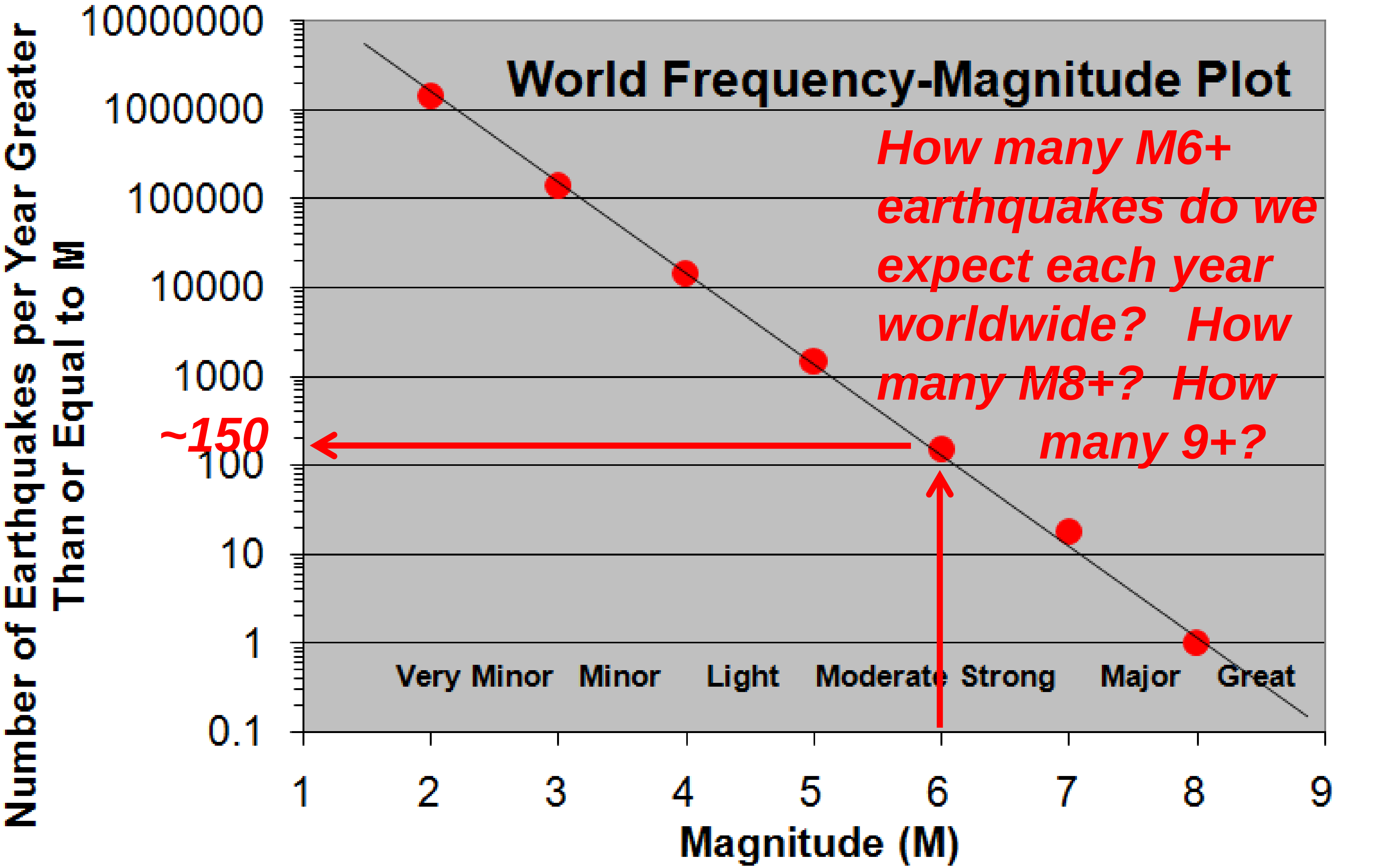


View animations of the P, S, Rayleigh and Love waves by going to: http://web.ics.purdue.edu/~braile/edumod/waves/WaveDemo.htm, then click on the animations in Section 4 (Figures 2, 3, 4, and 5)

Statistics of earthquakes: The number of earthquakes per year, worldwide, plotted versus the size of the earthquakes produces a straight line plot



Statistics of earthquakes: The frequency-magnitude plot can be used to forecast the number of earthquakes of M or larger earthquakes per time (in this case, per year)

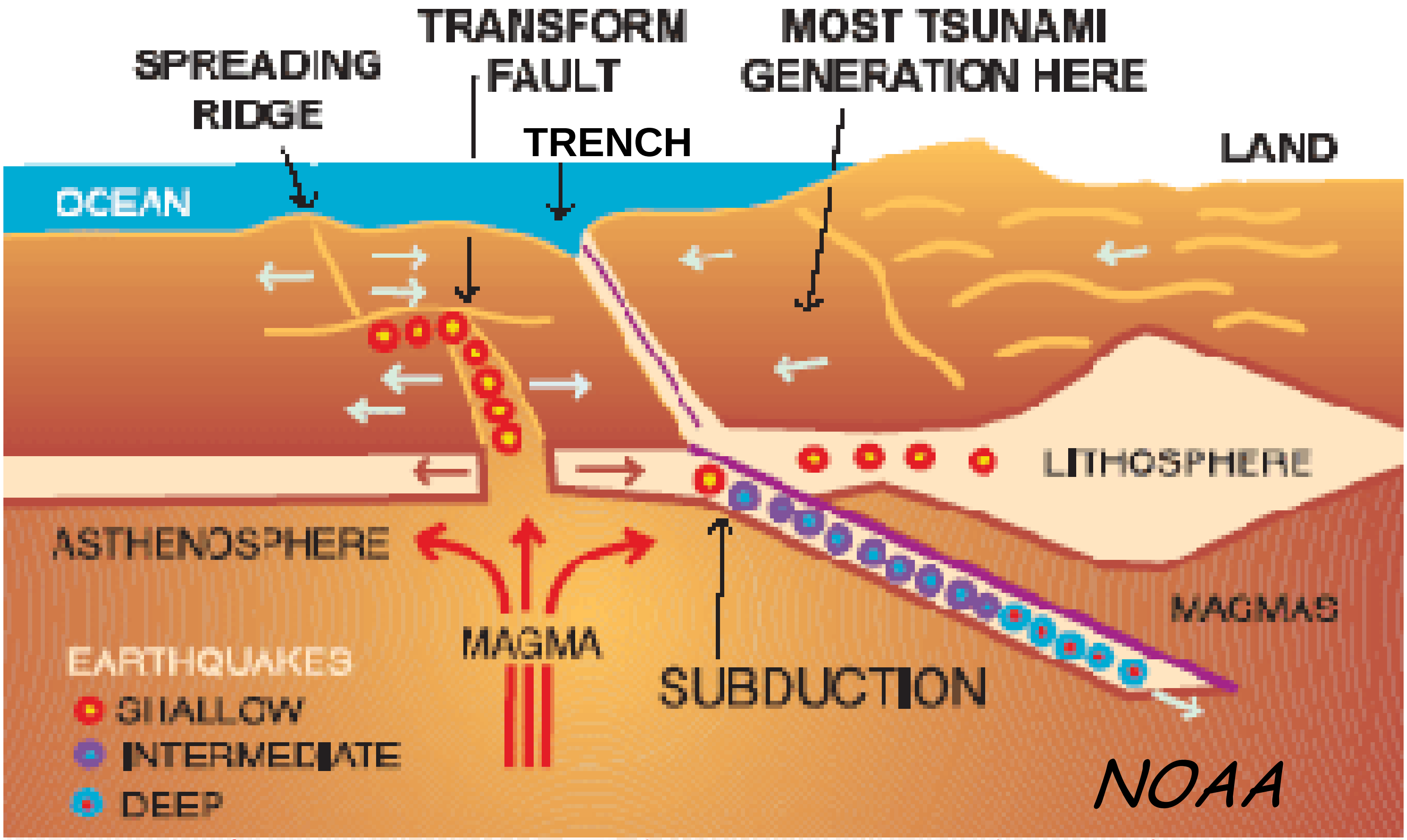


Tsunamis can be generated by:

1. Large Earthquakes (megathrust events such as Sumatra, Dec. 26, 2004, Japan, Mar. 11, 2011)
2. Underwater or coastal volcanic eruptions (Krakatoa, 1883)
3. Comet or asteroid impacts (evidence for tsunami deposits from the Chicxulub impact 65 mya)
4. Large landslides that extend into water (Lituya Bay, AK, 1958)
5. Large undersea landslides (evidence for prehistoric undersea landslides in Hawaii and off the east coast of North America)

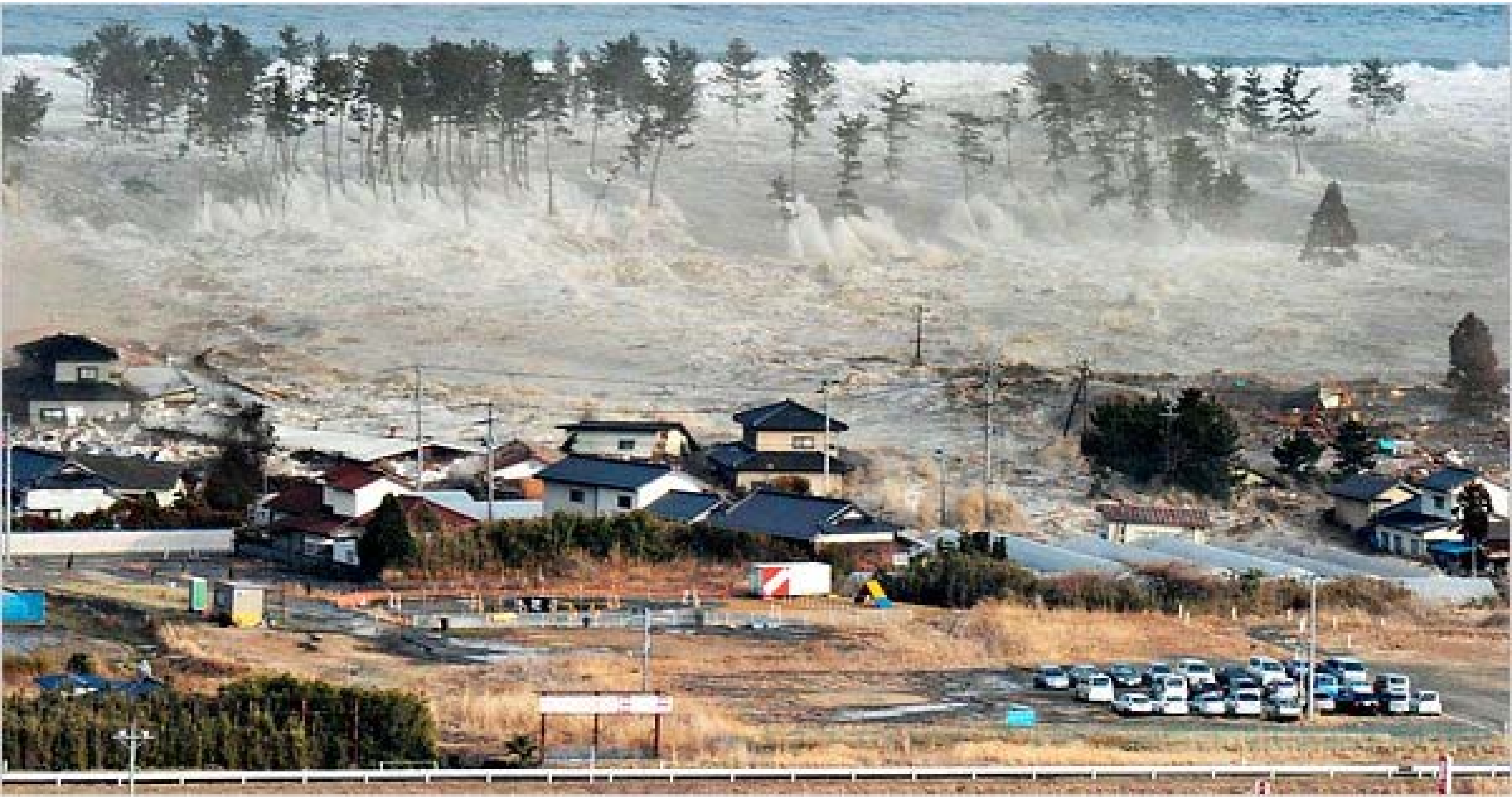
http://web.ics.purdue.edu/~braile/new/SumatraEQandTsunami122604New.ppt

Megathrust Earthquake - Schematic plate tectonic setting for tsunami generation – most tsunami are caused by large earthquakes

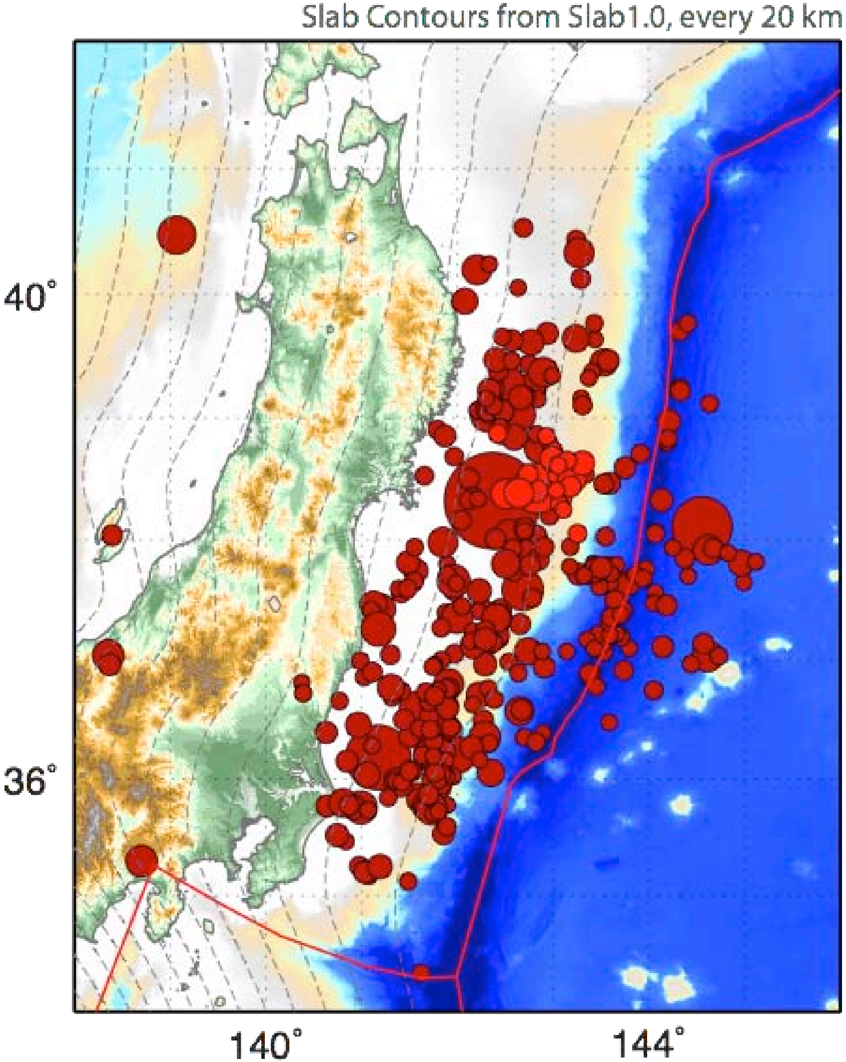


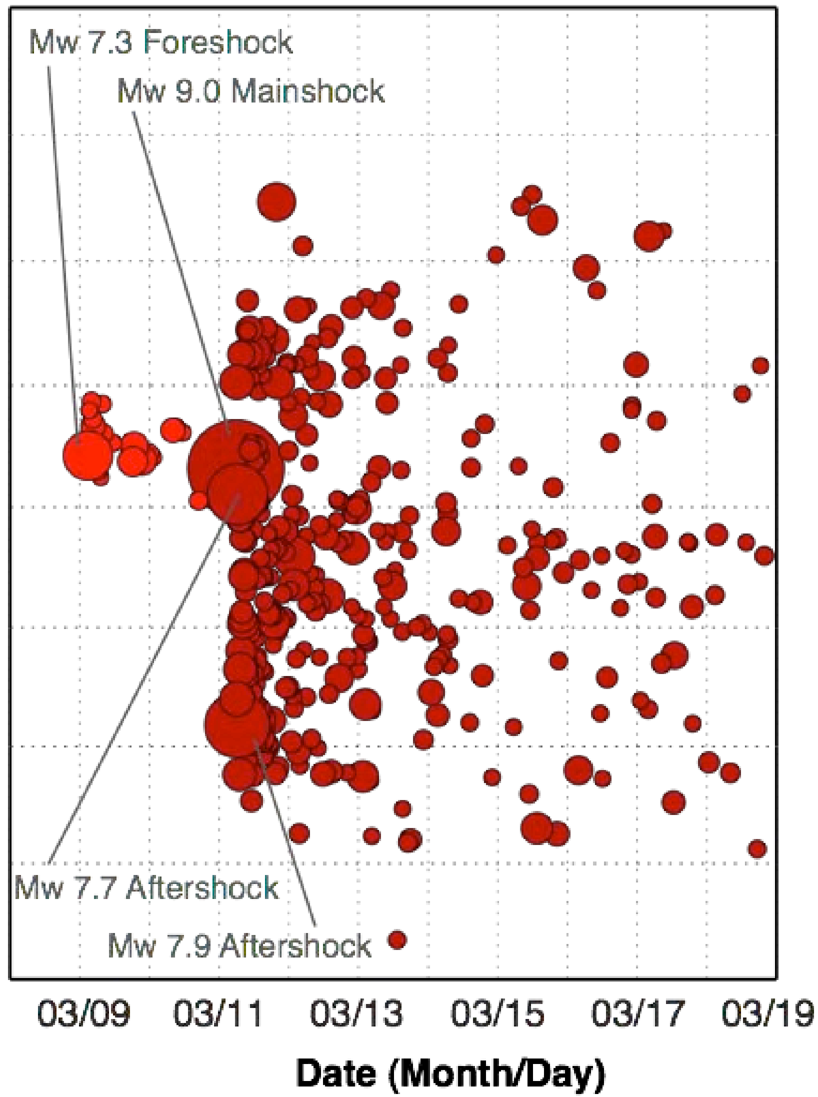
Commonly, in mega-thrust earthquakes, a very large area of the ocean floor is uplifted

Up to 10 m high tsunami waves hit coastal area near Sendai, in northern Honshu, Japan, March 11, 2011



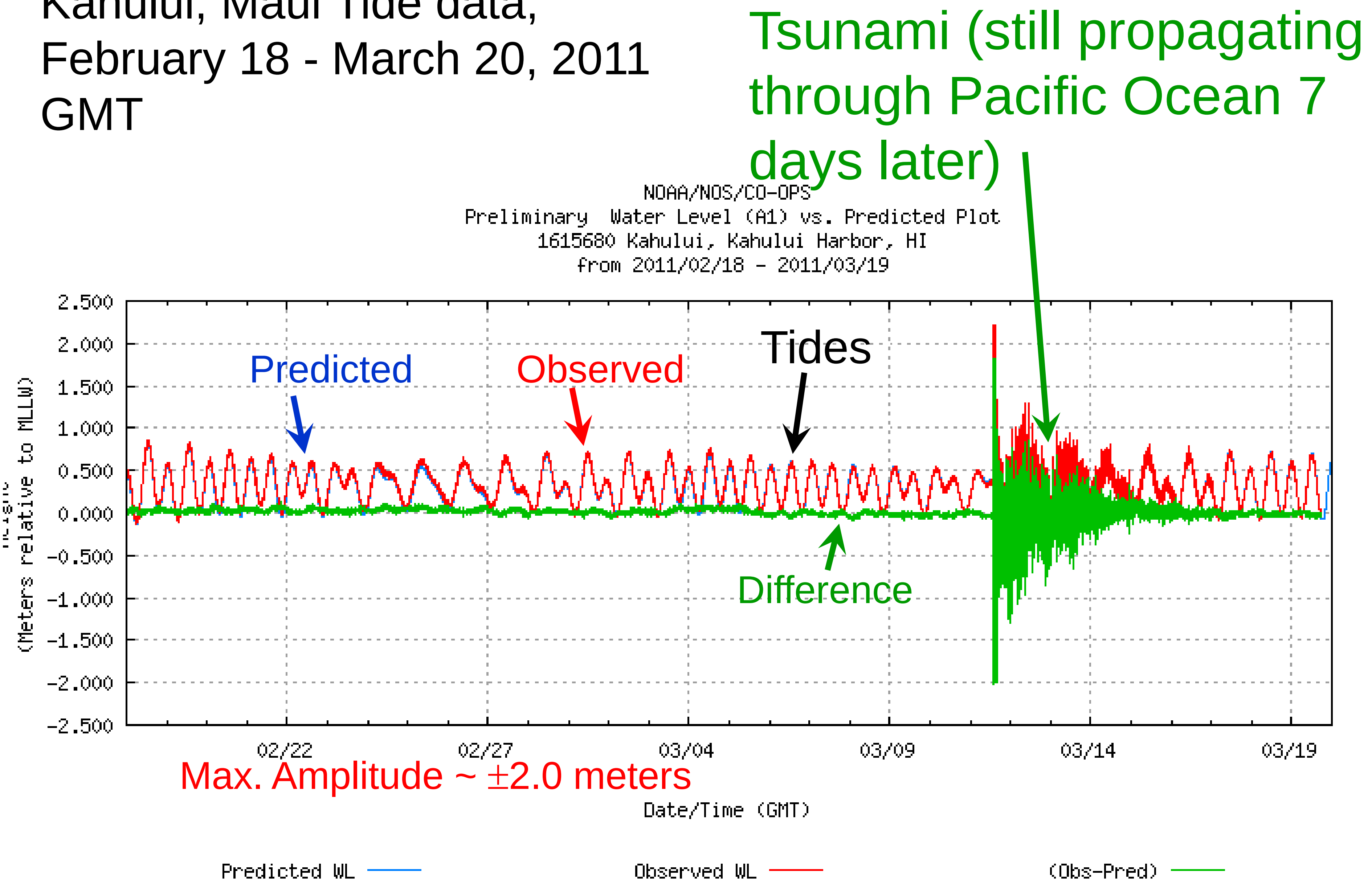
Tohoku, Japan Earthquake: Aftershock (and Foreshock) Sequence, 03/08/11 - 03/16/11





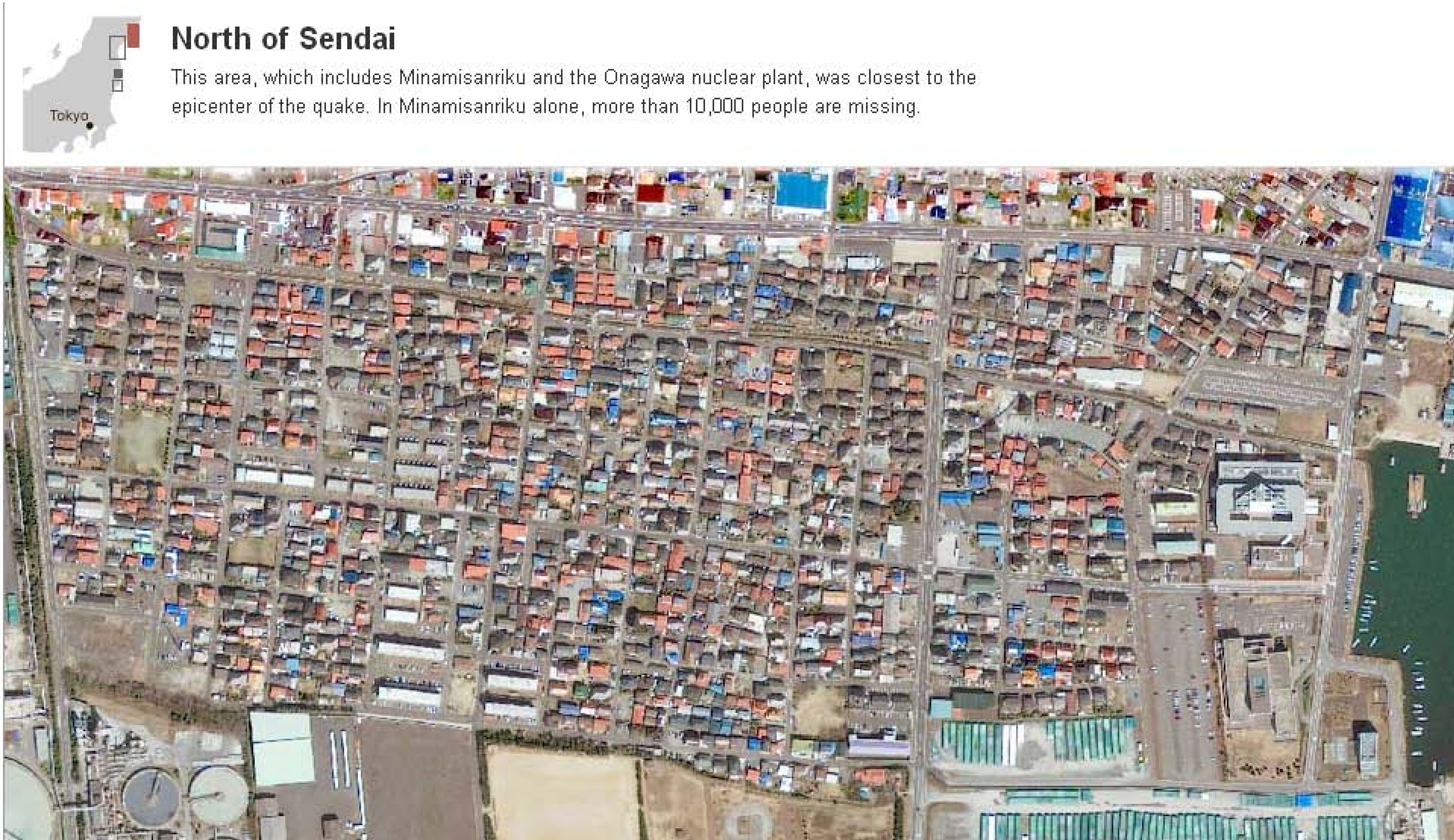
Note that the magnitudes of the 2011/03/11 06:15 (Mw 7.9) and 2011/03/11 06:25 (Mw 7.7) aftershocks were updated from earlier, lower estimates. Updates occurred on 03/16 and 03/18, respectively.

Kahului, Maui Tide data, February 18 - March 20, 2011 GMT



Tsunami Damage from the Tohoku [Northern Honshu, Japan] M9.0 Earthquake of March 11 – Satellite View before Tsunami

http://www.nytimes.com/interactive/2011/03/13/world/asia/satellite-photos-japan-before-and-after-tsunami.html



Tsunami Damage from the Tohoku [Northern Honshu, Japan] M9.0 Earthquake of March 11 – Satellite View after Tsunami

http://www.nytimes.com/interactive/2011/03/13/world/asia/satellite-photos-japan-before-and-after-tsunami.html

North of Sendai

This area, which includes Minamisanriku and the Onagawa nuclear plant, was closest to the epicenter of the quake. In Minamisanriku alone, more than 10,000 people are missing.