

lectures 9, 10, and 11

## Earthquakes

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### **Sources**

**Chapter 3 - Plate Tectonics and Earthquakes** - p, 61-75

**Chapter 4 - Earthquake Seismology** - all

**Chapter 6 - Earthquakes in Western North America** - all

**Chapter 7 - New Madrid, Missouri Earthquakes** - p. 171-176

also <http://myweb.cwpost.liu.edu/vdivener/notes/earthquakes.htm>

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## Earthquakes

caused by sudden slippage of the Earth's crust along a fault due to stress built up, most commonly near tectonic plate boundaries

### ***Plate Boundaries***

divergent: midocean ridges plates are pulling apart; earthquakes on normal faults

convergent: subduction zones & continental collisions; earthquakes on thrust faults

transform: plate shearing sideways past one another; earthquakes on strike-slip faults

### ***Earthquake Seismology***

elastic rebound theory

seismic waves: P, S, Surface

epicenter, focus (hypocenter)

fault rupture

seismographs record arrival time and amplitude of seismic waves

S-P interval used to determine distance to epicenter

earthquake location method (need S-P interval from three seismic stations)

earthquake magnitude method (need S-P interval & amplitude)

Richter scale (powers of 10)

moment magnitude scale

modified Mercalli intensity scale

number of small vs. large earthquakes

largest earthquakes are typically at convergent (subduction) boundaries

## ***Earthquake Case Studies***

San Andreas Fault

San Francisco

Loma Prieta

Parkfield

southern California earthquakes

Northridge

Mexico City

Izmit, Turkey

Holy Land earthquakes and the Bible

Sichuan, China 2008

New Madrid 1811-1812

possibility of a New York metro earthquake?

## ***Monitoring***

monitoring of crustal strain buildup (warping of crust)

laser ranging - distance measurements across faults

GPS monitoring of positions

seismic gaps

seismic sequence (like Turkey)

## ***Hazards - Mitigation***

danger of building on soft sediments, especially saturated ones

liquefaction

soft first stories

wood vs. brick houses

building height

diagonal (triangular) bracing

isolation of foundation with "shock absorbers"

better reinforcement for steel-reinforced concrete bridge supports

earthquake prediction? Nope!

risk assessment - likelihood of damaging earthquake in certain number of years

great for insurance budgeting

good for planning for disaster response budgeting

not much help for saving people killed directly in an event

earthquake early warning

good for a few seconds or tens of seconds warning

time to stop trains, etc. and let people cover up

induced earthquakes: make little ones to prevent big ones?