

ESS 8 Course Review



1979
Imperial
Valley

http://www.ngdc.noaa.gov/seg/hazard/slideset/8/8_slides.shtml

The Final Exam

- 11:30 am-2:30 PM, Thursday, June 16.
- **Tuesday Labs: [Here](#)**
- **Wednesday Labs: [CS 76 \(Young Hall – Court of Sciences\)](#)**
- The exam covers material from the entire quarter.
 - Both labs and lectures
- **Sections**
 - 60 multiple choice questions
 - 5 short calculations
 - 5 short answers
- No calculators or other aides allowed.
- Exam grades will be posted on MyUCLA by Friday June 24

What we have learned...

General Concepts & Skills

- Scientific method
 - Observations and interpretations
- Numbers
 - exponents, logs and log-log graphs

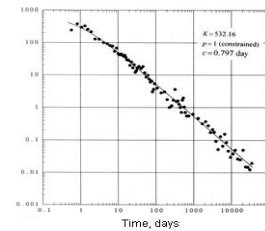


Plate Tectonics Part I

- Overview of the inside of the Earth
 - Crust, mantle, core
- Historical development of **Plate Tectonics**
 - Continental Drift
 - Matching fossils & coastlines
 - Mantle convection
 - Rocks flow over long timescales
 - Heat drives them
 - Magnetic stripes on the ocean floor
 - Record sea-floor spreading and reversals of the Earth's magnetic field
 - How the plates have moved over time
 - Pangea, Gondwanaland, Rodinia

Plate Tectonics Part II

- Three types of plate boundaries
 - Divergent, convergent, lateral motion
- Three types of faults
 - Normal, thrust, strike-slip
- Earthquakes off plate boundaries
- GPS velocities and the geological record
 - How often should we have earthquakes

To summarize: Where are earthquakes?

- Mostly near plate boundaries **Interplate**
 - Greatest number at subduction zones
 - But also plenty at ridges and transform zones
- Some in mid-plate **Intraplate**
 - Near hotspots - volcanoes
 - Failed rift - New Madrid
 - Unloading after ice age

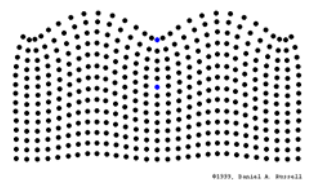
Faulting

- From plate motions to earthquakes
 - Aseismic faults
 - The creeping section of the San Andreas
 - Elastic rebound and the earthquake cycle
 - Stress, strain and elasticity
 - Friction and cracks
- What do faults look like?
 - Thin slip surface
 - Strike and dip
- Rupture propagation
 - From hypocenter to rest of fault plane

Waves

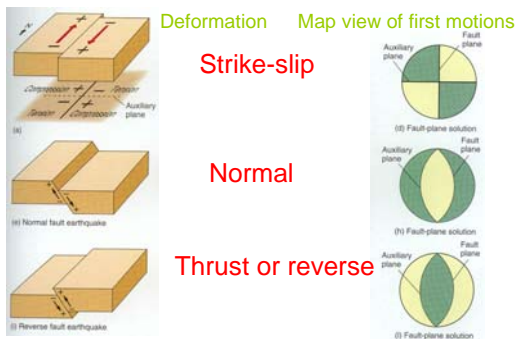
- Seismic Waves
 - Types of waves
 - P,S, Love and Rayleigh
 - Period, amplitude, frequency and wavelength
 - Moving waves and Doppler shift
 - Refraction, reflection and conversion
- First Motion and fault orientation
- Earthquake location

Which kind of wave is this?



D. Russell, Kettering Univ.

Three primary focal mechanisms



Instruments

- Measuring motion
 - Velocity, displacement and acceleration
- Seismometers
 - Mass-spring
 - Challenges
 - Frequency, stability, friction, timing, retrieving the data
 - Remote locations
 - Ocean-bottoms, other planets
- Geodesy
 - GPS and InSAR
- Earthscope

The Size of an Earthquake

- Intensity
 - Observational assessment of damage
 - Measures shaking at a spot
- Magnitude
 - Instrumental measurement of wave amplitude
 - M_L and M_w
- Moment
 - Measures source size
- Energy, duration, slip and rupture length all scale with magnitude

Where are the faults?

- Alaska
 - Subduction and Queen Charlotte fault zone
- British Columbia, Oregon, Washington
 - Subduction, Juan de Fuca,
- California
 - Mendocino, San Andreas, Big bend
- Utah, Idaho, Montana, Wyoming
 - Wasatch Fault Zone

Mainshocks, Aftershocks and Foreshocks

- Number of earthquakes
 - Gutenberg-Richter
 - Smallest earthquake?
- Mainshocks, foreshocks and aftershocks
 - Aftershock locations
 - Omori's Law
- Non-conventional sequences
 - Swarms, long-range triggering, jumping faults

Prediction I

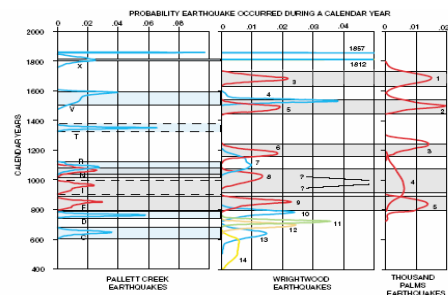
- Definition of prediction
 - where, when and how big
 - Classification of size of earthquakes
- Prediction myths
 - Earthquake weather, animals, mornings
- Precursors and post-dictions
 - Water chemistry, magnetic fields and radon
- Forward prediction
 - Parkfield, Foreshocks and seismic gaps
- Probability
 - confidence intervals
- Recurrence Inteverals

Prediction II

- Input to predictions and forecasts
 - Paleoseismology
 - Terraces, subsiding forests, trenching
 - Superposition
- Output of forecast
 - When, where and *how much shaking*
- Hazard and risk



SoCal Earthquake History



Grey bands are correlated events

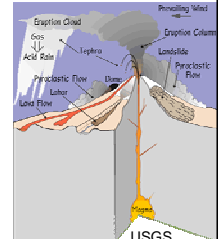
Fumal et al., BSSA, 2002

Landslide & Tsunamis

- Landslides
 - Angle of repose
 - Identifying landslides
 - Triggers - Rain, Earthquakes, Magma, Construction
 - Mitigation
- Tsunamis
 - Differences from water waves
 - Triggers – EQs, landslides, eruptions
 - Propagation
 - Velocity – Square Root of depth
 - Small amplitude at sea
 - Run-up – steepen and pile up
 - Damage by debris and waves
 - Seiches

Volcanoes

- Where are they
 - Ridges, subduction zones and hotspots
- Melting rocks
- Effusive and explosive eruptions
 - Viscosity and gas
- Hazards
 - Direct
 - Lava flows, pyroclastic flows, ejecta, ashflows, lahars, caldera collapse, gas
 - Indirect
 - Earthquakes, landslides, famine and climate



Volcanoes II

- Where are they
- Melting rocks
- Explosive and effusive eruptions
- Hazards
- Anatomy
 - Shields and stratovolcanoes
 - Domes and cones
 - Plutons
- Prediction and Mitigation
 - Deformation, EARTHQUAKES, etc.
 - Hazard mapping and public education works

Building for Earthquakes I

- Physical Principles of Earthquake Engineering
 - Fault zone damage
 - Site effects on foundation – crucial – If a foundation fails so does everything else
 - Soft soil amplification
 - Liquefaction
 - Settlement
 - Lateral bracing
 - Buildings are usually built for vertical loads

Summary of Earthquake Resistance of Buildings

- ★ Wood frame (without stucco or masonry veneer)
 - ★ Unreinforced brick, stone or adobe
 - Concrete block
 - Reinforced brick
 - ★ Steel frame
 - ★ Concrete frame
 - Concrete shear wall
 - Concrete tilt-up
- Residential
- Commercial

Induced Seismicity & EQ Safety

- Induced seismicity
 - Reservoirs
 - fluid extraction/injection
 - mines
 - bombs
- Earthquake preparedness
 - Indoor hazards – Falling heavy things
 - STAY AWAY FROM THE OUTER WALLS
- Earthquake risks

Thanks for a great quarter...

- And good luck!