

EARTHQUAKE CASE HISTORIES II (08)

I Main Topics for next two lectures

A Recognition of earthquake hazards from case historiesB Consistent lessonsC Key questions regarding characterization of earthquakes and faultingII Case Histories (The historic record)

A Loma Prieta, 1989 (5:04 PM October 17, 1990; M=7.1)

http://wwwneic.cr.usgs.gov/neis/eqlists/USA/1989_10_18.html

- 1 The location and style of the ground response and ground water response could have been predicted in many areas based on what happened in 1906
- 2 Rupture was very similar to what had been mapped by Hall & Sarna
- 3 Resilience of wood-frame construction and flaws of unreinforced masonry demonstrated again
- 4 Tremendous increase in ability/ speed to determine the location, extent, and energy release (i.e. physical parameters) based on seismologic and geodetic information
- 5 Possible precursor identified after the fact - long wavelength radio waves (submarine communications)
- 6 No precursor recognized in advance
- 7 57 people killed (41 on Cypress structure). We were lucky.
- 8 ~\$6 billion damage. Just for comparison, the 1906 quake damage in 1987 dollars is estimated at ~\$20 billion.

B Parkfield "nonearthquake" and earthquake prediction 1992

- 1 Similar prior earthquakes of M~6: 1881, 1901, 1922, 1934, 1966
- 2 Mean interevent time of 21.8 ± 5.2 years
- 3 Strain buildup comparable to 1966
- 4 Earthquake forecast issued in 1985 for a 1988 (± 5 years) quake
- 5 No earthquake yet

- C Kalapana, Hawaii (4:48 AM November 29, 1975; M=7.12)
http://wwwneic.cr.usgs.gov/neis/eqlists/USA/1975_11_29.html
- 1 Surface rupture along Kilina fault system
 - 2 Magnitude 5.7 foreshock at 3:36
 - 3 Maximum tsunami height 12.2-14.6 m
 - 4 Maximum subsidence along coast: 3.5 m
 - 5 Small eruption at Kilauea triggered 45 after quake
 - 6 \$4.1 million in damage
 - 7 Earthquake caused by deep-seated failure of SE flank of Kilauea
 - 8 Earthquake similar to April 2, 1868 earthquake
http://wwwneic.cr.usgs.gov/neis/eqlists/USA/1868_04_03.html
- G Key Lessons (Common elements / recurring themes)
- a Earthquake effects are a function of the strength of the source, the path of the seismic waves, and the nature of the "receiver"
 - b Faults with prior Quaternary activity generate nearly all quakes
 - c Structural failures kill the most people. Securely tie houses to foundations in earthquake country!
 - d Shaking depends on surficial materials but generally decreases with distance from the epicenter
 - e Ground response can be consistent from quake to quake
 - f Ground rupture is devastating for structures but can be avoided
 - g Significant damage can occur for faults that don't rupture the surface (Coalinga, almost Loma Prieta).
 - h We get surprised
 - i We can't predict earthquakes in the short term yet
- H Some key characterization questions
- a What controls how large an earthquake will be?
 - b How do surficial deposits respond to seismic waves?
 - c How do buildings respond to seismic waves?
 - d How can we predict when and where an earthquake is likely to occur? What is the uncertainty associated with the predictions?