Earthquakes 101 (EQ101)

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Global Distribution of Earthquakes
Plate Tectonics
Plate Boundaries
Three Types of Faults

Strike-Slip

Thrust

Normal
Strike-slip Fault Example
Strike-slip Fault Example

1906 San Francisco Earthquake
Normal Fault Example

Dixie Valley-Fairview Peaks, Nevada earthquake
December 16, 1954
Thrust Fault Example
Thrust Fault Example
Rupture on a Fault

Total Slip in the M7.3 Landers Earthquake

SLIP (METERS)
Slip on an earthquake fault

Depth Into the earth

100 km (60 miles)
Distance along the fault plane

Surface of the earth
Slip on an earthquake fault
Second 2.0
Slip on an earthquake fault
Second 4.0
Slip on an earthquake fault
Second 6.0
Slip on an earthquake fault
Second 8.0
Slip on an earthquake fault
Second 10.0
Slip on an earthquake fault
Second 12.0
Slip on an earthquake fault
Second 14.0
Slip on an earthquake fault
Second 16.0
Slip on an earthquake fault
Second 18.0
Slip on an earthquake fault
Second 20.0
Slip on an earthquake fault
Second 22.0
Slip on an earthquake fault
Second 24.0
Bigger Faults Make Bigger Earthquakes

- Magnitude
- Kilometers

Graph showing the relationship between earthquake magnitude and the distance in kilometers, indicating that bigger faults result in larger earthquakes.
Bigger Earthquakes Last a Longer Time

![Graph showing the relationship between earthquake magnitude and duration. Larger magnitudes correspond to longer durations.](image-url)
What Controls the Level of Shaking?

- **Magnitude**
  - More energy released
- **Distance**
  - Shaking decays with distance
- **Local soils**
  - Amplify the shaking
Is there such a thing as “Earthquake Weather”???
Earthquake Effects - Ground Shaking

Northridge, CA 1994
Earthquake Effects - Ground Shaking

Northridge, CA 1994
Earthquake Effects - Ground Shaking

Loma Prieta, CA 1989
Earthquake Effects - Ground Shaking

Kobe, Japan 1995
Earthquake Effects - Ground Shaking

Kobe, Japan 1995
Earthquake Effects - Surface Faulting

Landers, CA 1992
Earthquake Effects - Liquefaction

Source: National Geophysical Data Center
Niigata, Japan 1964
Earthquake Effects - Landslides

Turnagain Heights, Alaska, 1964 (upper left inset);
Santa Cruz Mtns, California, 1989

Source: National Geophysical Data Center
Earthquake Effects - Fires

Loma Prieta, CA 1989
Earthquake Effects - Tsunamis

1957 Aleutian Tsunami

Photograph Credit: Henry Helbush. Source: National Geophysical Data Center
Seismic Waves

(a) Undisturbed material

(b) Primary wave

(c) Secondary wave

(d) Rayleigh wave

(e) Love wave
Earthquake Magnitude

M5
M6
M7
Earthquake Location
The San Andreas Fault
Pacific-North American Plate Boundary
Will California eventually fall into the ocean???

NO!
Faults of Southern California

Source: SCEC Data Center
Shaking Hazard in Southern California
Faults in Our Local Area - Arcadia

Sierra Madre Fault Zone

- THRUST fault
- 55 KM long
- Last ruptured in last 10,000 YEARS
- SLIP RATE: between 0.36 and 4 mm/yr
- PROBABLE MAGNITUDES: MW6.0 - 7.0 (?)
- Dips to the north
Faults in Our Local Area - Arcadia

Raymond Fault

STRIKE-SLIP fault
26 KM long
Last ruptured in last 10,000 YEARS
SLIP RATE: between 0.10 and 0.22 mm/yr
PROBABLE MAGNITUDES: MW6.0 - 7.0
Dips to the north

At least eight surface-rupturing events have occurred along this fault in the last 36,000 years
Faults in Our Local Area - Arcadia

18 KM long
Last ruptured in last 1.6 million YEARS
SLIP RATE: ???
PROBABLE MAGNITUDES: ???
Dips to the north

Clamshell-Sawpitt Canyon fault
THRUSt fault
18 KM long
Last ruptured in last 1.6 million YEARS
SLIP RATE: ???
PROBABLE MAGNITUDES: ???
Dips to the north
Real-time Earthquake Information

Index Map of Recent Earthquakes in California-Nevada

USGS•UCB•Caltech•UCSD•UNR

MAGNITUDE

7
6
5
4
3
2
1
?

LAST HOUR
LAST DAY
LAST WEEK

Thu May 17 11:00:04 PDT 2001
224 earthquakes on this map
Did You Feel It?

Community Internet Intensity Maps
Where to go for more information:

http://pasadena.wr.usgs.gov/
http://earthquake.usgs.gov/

The End
Faults in Our Local Area - La Canada

TYPE OF FAULTING: reverse

LENGTH: the zone is about 55 km long; total length of main fault segments is about 75 km, with each segment measuring roughly 15 km long

MOST RECENT SURFACE RUPTURE: Holocene, 10,000 years to present

SLIP RATE: between 0.36 and 4 mm/yr

INTERVAL BETWEEN SURFACE RUPTURES: several thousand years (?)

PROBABLE MAGNITUDES: MW6.0 - 7.0 (?)

OTHER NOTES: This fault zone dips to the north.