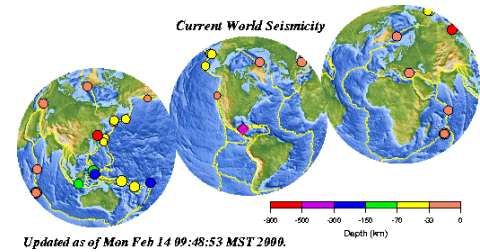


Try the URL: <http://www.trinet.org/> for information on Southern California Seismicity.

# Earthquakes

## Earthquakes

- are vibrations caused by motions and/or deformation of earth's rigid surface and can be therefore defined as the strains produced by accumulated stress; and
- result from sudden release of stored energy, with or without any visible extrusives, but can also result from landslides, nuclear blasts and bolide impacts.



Try <http://www.neic.cr.usgs.gov/> (USGS Earthquake homepage) and, for current California seismicity, try <http://pasadena.wr.usgs.gov/recenteqs/latest.htm>

## Seismic waves are of two kinds

- body waves**, comprising (a) the faster P (or primary) waves that move in alternate compressions and dilations and (b) the slower S (shear or secondary) waves in which particles move transverse to the direction of wave propagation, that have enabled mapping the earth's internal structure; and
- surface waves**, comprising (a) Love waves (transverse, on the horizontal plane) and (b) Rayleigh waves (the backward rotating and circularly moving rolling waves).



This USGS Online Publication: EARTHQUAKES by Kaye M. Shedlock & Louis C. Pakiser is available at the URL:

<http://pubs.usgs.gov/gip/earthq1/>

For earthquake related links on the web, try:

<http://www.whfreeman.com/bolt/>

<http://earthquake.usgs.gov/4kids/learning/exp.html>



The above digital fault and fold map for Southern California is available at the URL:

<http://pubs.usgs.gov/of/1996/ofr-96-0263/geoset.htm>

It highlights blind thrust systems and other principal faults that the Southern California seismicity is typically associated with.

## Individual earthquakes

- are described in terms of epicenter, focal depth and energy release;
- locating the epicenter requires the S and P-wave travel time difference from three stations;
- Richter magnitude, a logarithmic scale, is used to define the energy released by an earthquake (seismic moment\* scale is a variant of it);
- Earthquake-proof construction takes ground-acceleration into account.
- Mercalli scale qualitatively measures earthquake intensity or the damage caused.

	Focal depth	% of all energy released
Shallow focus	0-70 Km	85
Intermediate focus	70-350 Km	12
Deep focus	350-700 Km	3

## Earthquake occurrence, frequency and energy release

- Shallow focus earthquakes are most frequent and release most energy
- Minor earthquakes are ~1,000 times as common as the major ones but release ~10,000 times less energy
- Internally triggered seismicity and volcanic earthquakes:** (a) tectonic earthquakes occur: (i) at the present and past plate boundaries and (ii) in the plate interiors (i.e., Stable Continental Region or SCR seismicity), and (b) volcanic earthquakes include hot-spot and subduction-zone seismicity, in addition to that at the mid-ocean ridges.
- Externally triggered seismicity** includes collapse earthquakes, nuclear tests, and reservoir-induced seismicity.

	Minor	Major
Magnitude	4-5	7-8
Frequency	~10,000/yr	~10/yr
Energy released	~10 <sup>19</sup> ergs/yr	~10 <sup>23</sup> ergs/yr

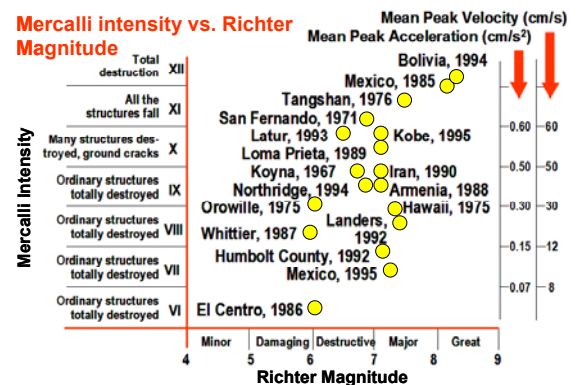
## Earthquake prediction:

- The precursor signatures or the geophysical approach;
- The "Gap" theory or the statistical approach

### How predictable are the earthquakes, really?

Read USGS Factsheet "Quake Forecasting" at the URL:

<http://quake.wr.usgs.gov/prepare/factsheets/QuakeForecasts/>



As Mercalli intensities show a wider spread over Richter magnitudes, a good disaster mitigation strategy for earthquakes would be to lower Mercalli intensity of an event.

\* $M_w = \log_{10}(M_0) - 10.7$ ; where  $M_0$  = shear strength of rock  $\times$  rupture area of fault  $\times$  average slip on the fault.