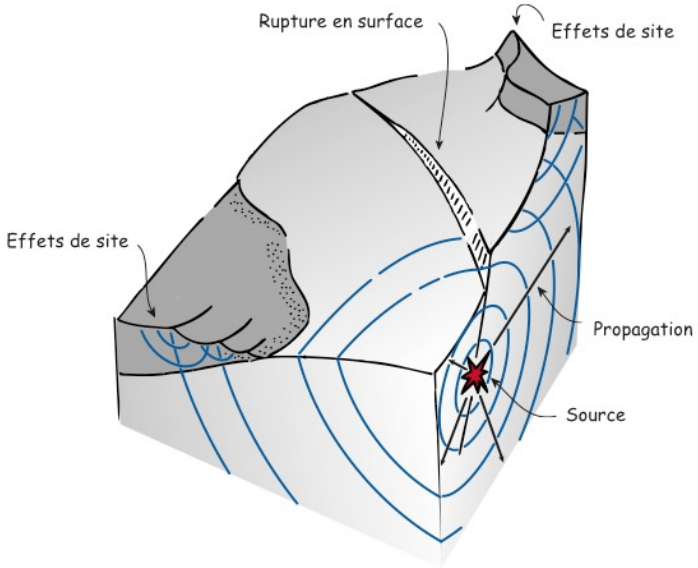
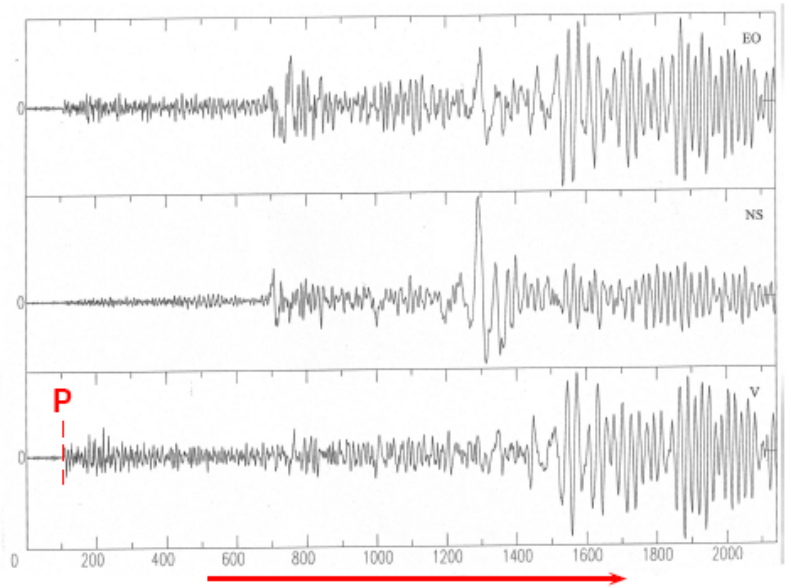
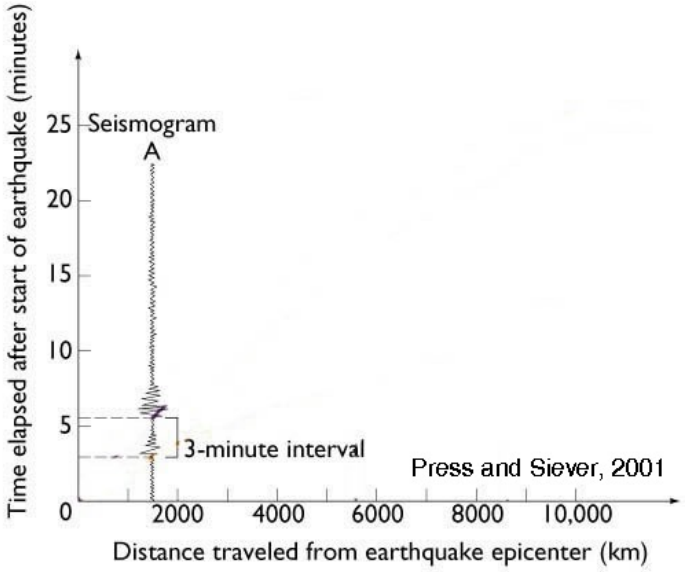
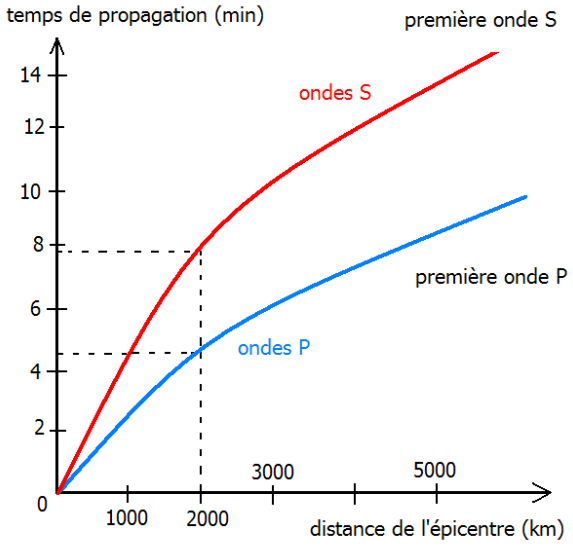
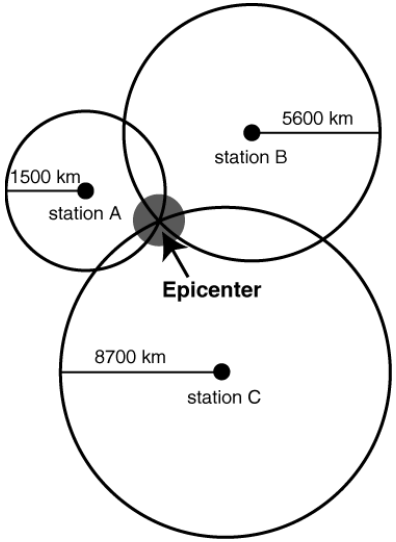
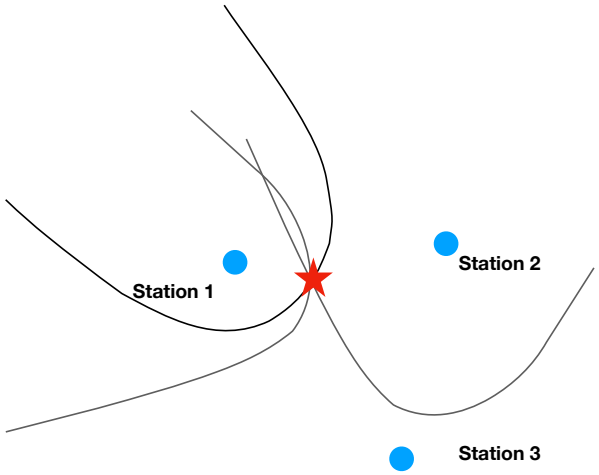

Rupture en surface
Effets de site
Effets de site
Propagation
Source

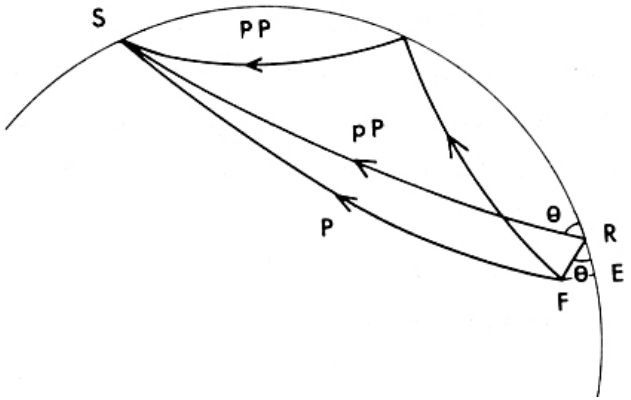

EO
NS
V
P
0
200
400
600
800
1000
1200
1400
1600
1800
2000
Temps en secondes

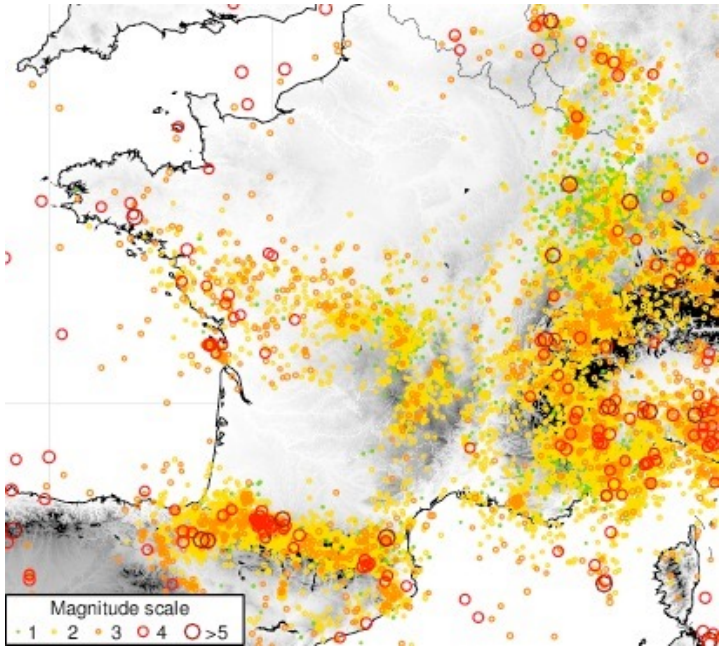

Time elapsed after start of earthquake (minutes)
25
20
15
10
5
0
Seismogram
A
3-minute interval
Press and Siever, 2001
2000
4000
6000
8000
10,000
Distance traveled from earthquake epicenter (km)

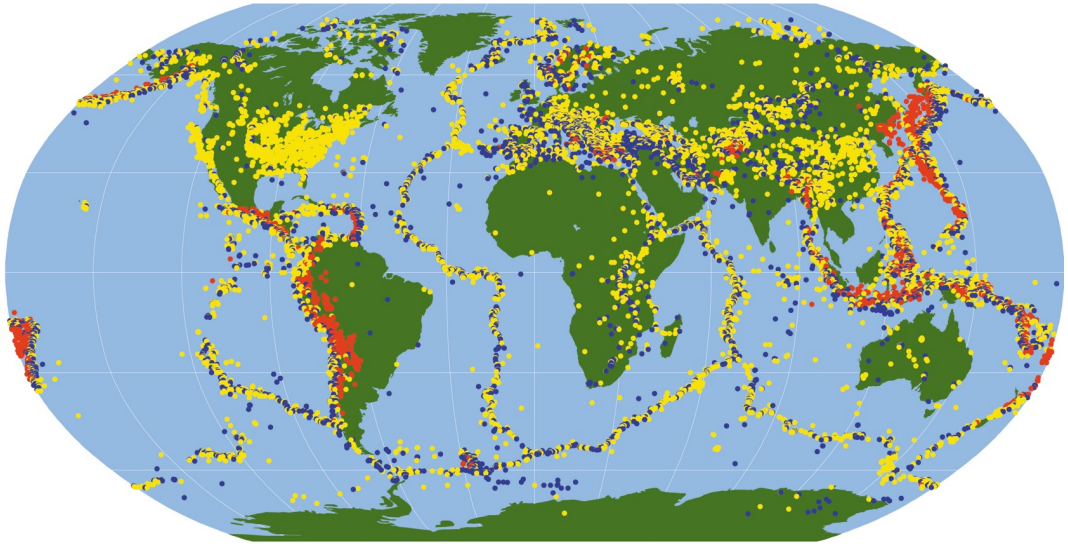

temps de propagation (min)
première onde S
ondes S
première onde P
ondes P
14
12
10
8
6
4
2
0
1000
2000
3000
5000
distance de l'épicentre (km)

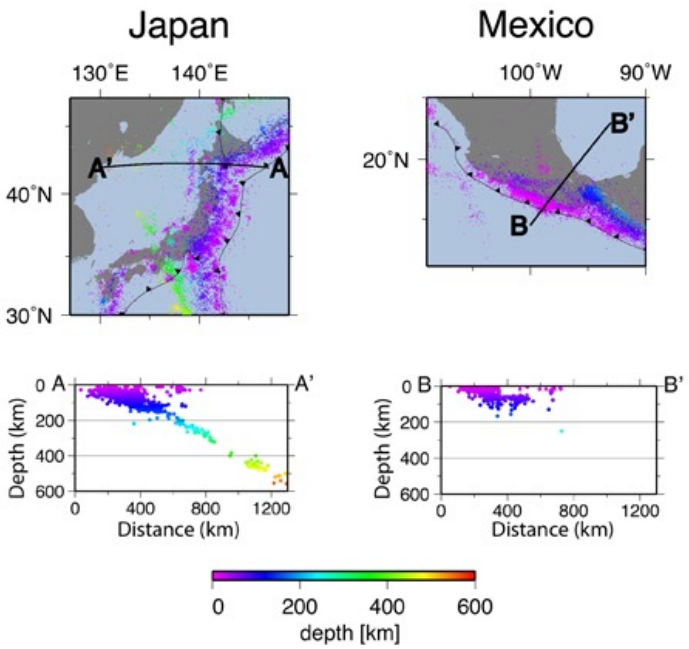

5600 km
station B
1500 km
station A
Epicenter
8700 km
station C

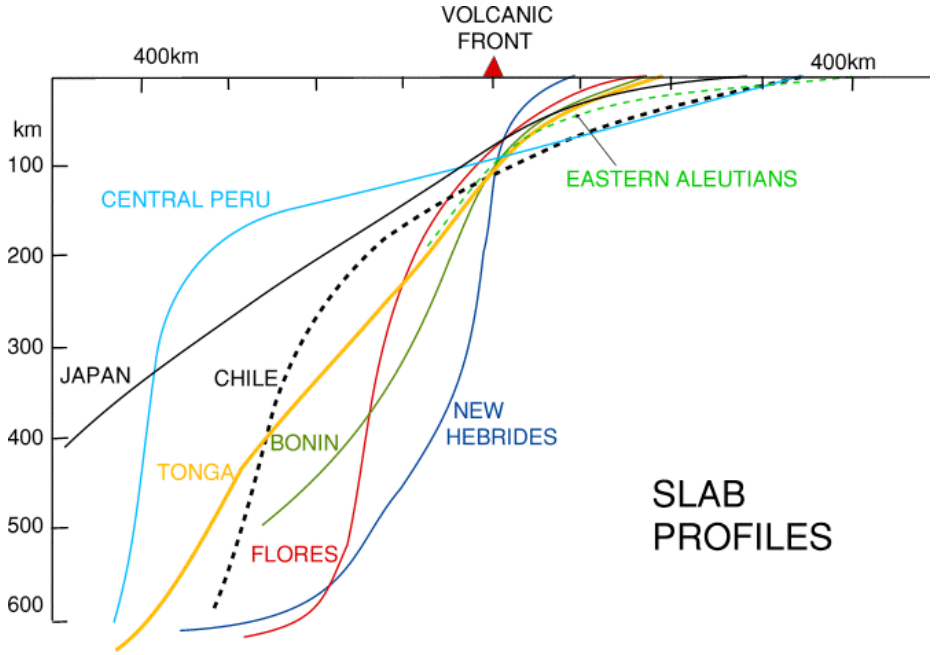

Station 1
Station 2
Station 3

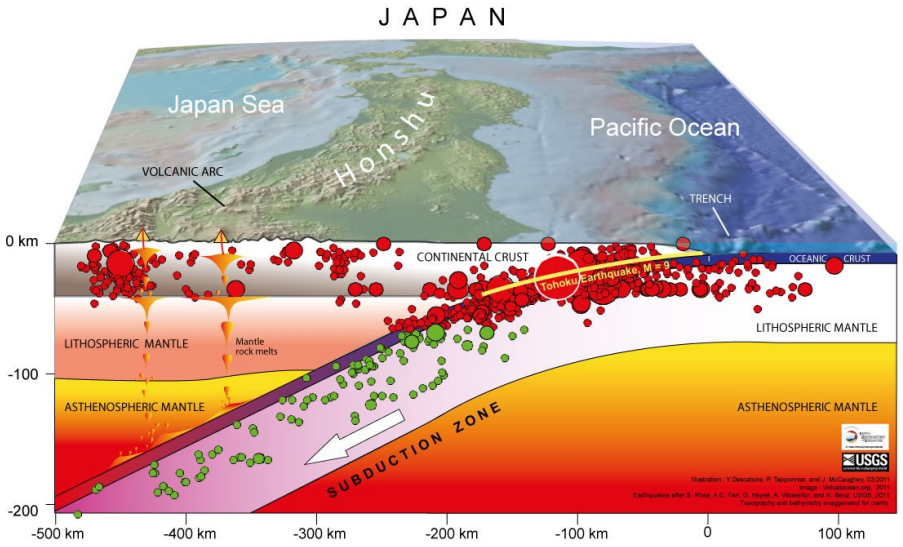

S
P P
P P
P
θ
R
θ
E
F

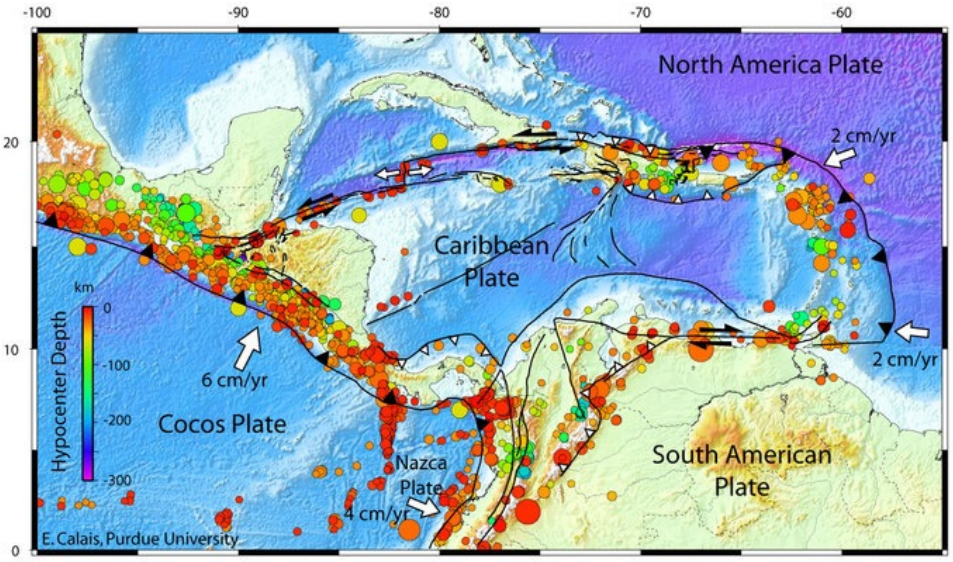

Magnitude scale
1 2 3 4 >5

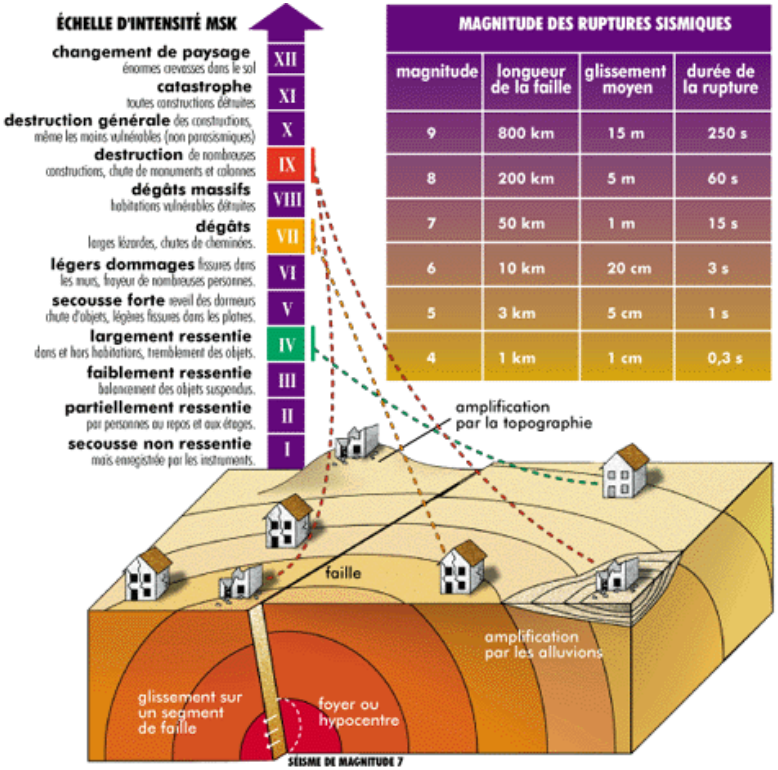


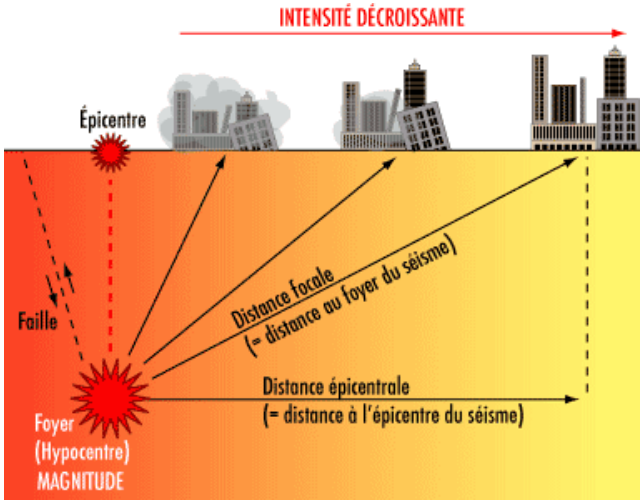

Japan
Mexico
130°E
140°E
100°W
90°W
40°N
30°N
20°N
A
A'
B
B'
Depth (km)
Distance (km)
0
200
400
600
800
1200
depth [km]


VOLCANIC FRONT
400km
km
100
200
300
400
500
600
CENTRAL PERU
EASTERN ALEUTIANS
JAPAN
CHILE
BONIN
TONGA
NEW HEBRIDES
FLORES
SLAB PROFILES


J A P A N
Japan Sea
Honshu
Pacific Ocean
VOLCANIC ARC
TRENCH
0 km
CONTINENTAL CRUST
OCEANIC CRUST
Tohoku Earthquake, M = 9
LITHOSPHERIC MANTLE
Mantle rock melts
ASTHENOSPHERIC MANTLE
SUBDUCTION ZONE
-100
-200
-500 km
-400 km
-300 km
-200 km
-100 km
0
100 km
USGS


-100
-90
-80
-70
-60
20
10
0
North America Plate
2 cm/yr
Caribbean Plate
6 cm/yr
Cocos Plate
Nazca Plate
4 cm/yr
South American Plate
2 cm/yr
Hypocenter Depth
km
0
-100
-200
-300
E. Calais, Purdue University





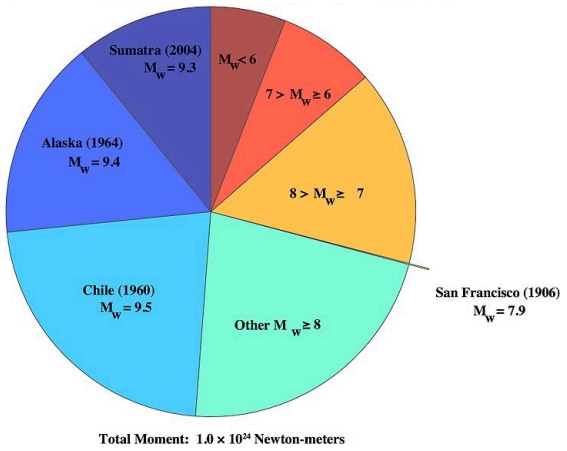
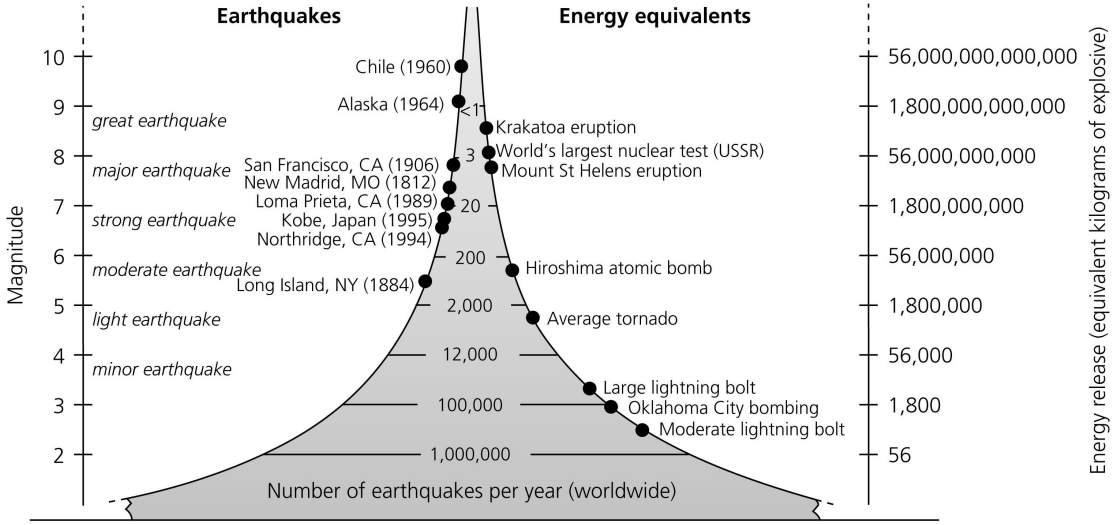
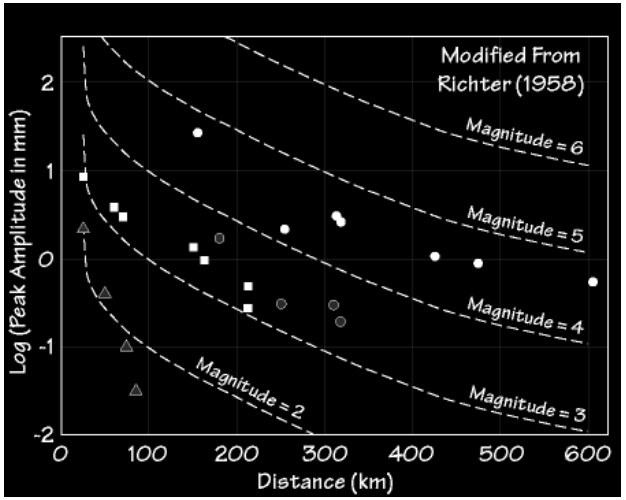
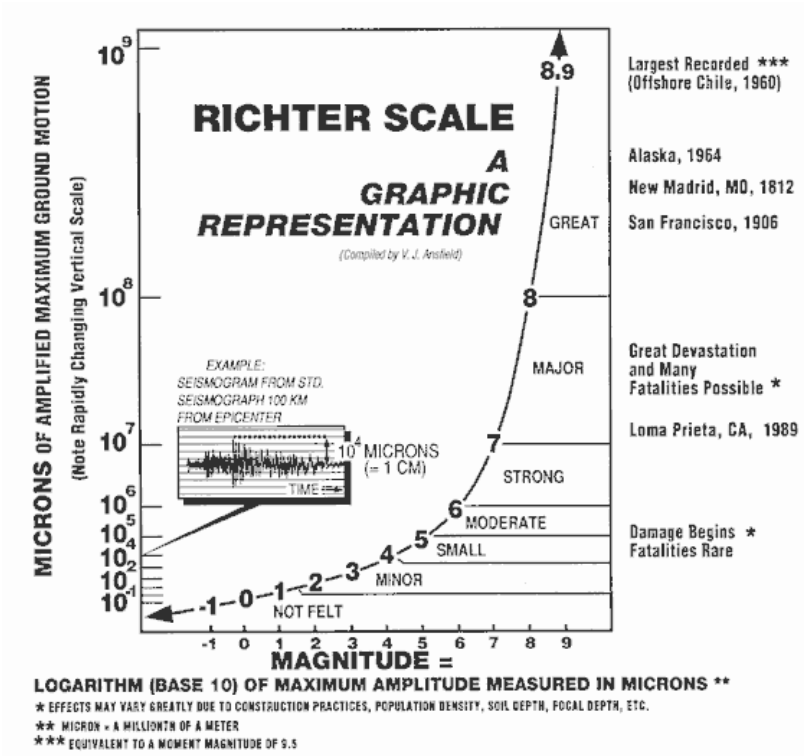
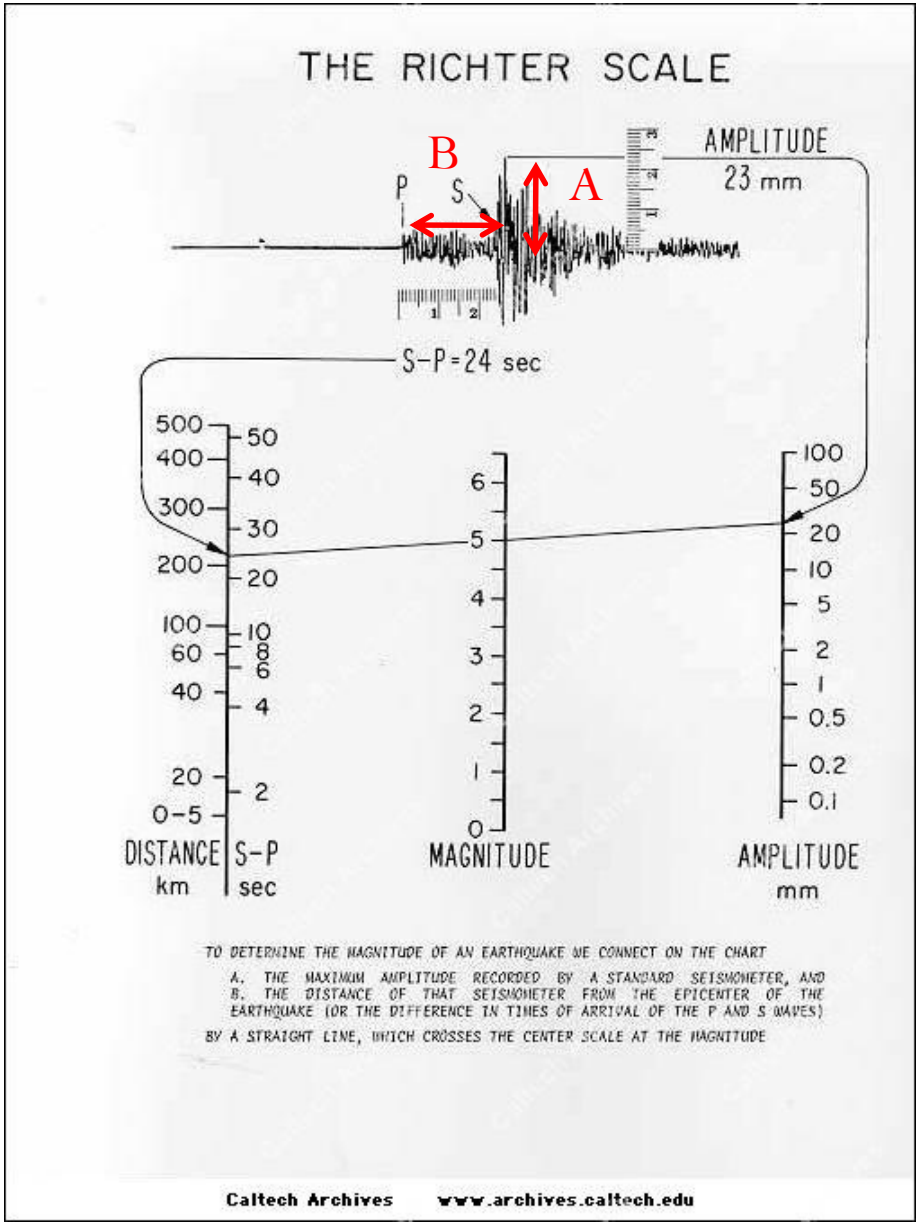


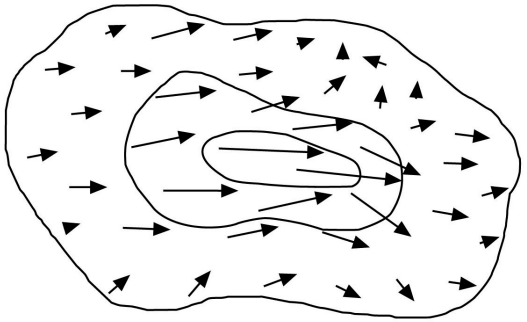
Figure 1.2-2: Comparison of frequency, magnitude, and energy release.




Modified From
Richter (1958)
Magnitude = 6
Magnitude = 5
Magnitude = 4
Magnitude = 3
Magnitude = 2
Log (Peak Amplitude in mm)
Distance (km)
2
1
0
-1
-2
0
100
200
300
400
500
600


RICHTER SCALE
A
GRAPHIC
REPRESENTATION
(Compiled by V. J. Ansfield)
MICRONS OF AMPLIFIED MAXIMUM GROUND MOTION
(Note Rapidly Changing Vertical Scale)
EXAMPLE:
SEISMOGRAM FROM STD.
SEISMOGRAPH 100 KM
FROM EPICENTER
10⁴ MICRONS
(= 1 CM)
TIME
GREAT
MAJOR
STRONG
MODERATE
SMALL
MINOR
NOT FELT
8.9
8
7
6
5
4
3
2
1
0
-1
MAGNITUDE =
Largest Recorded ***
(Offshore Chile, 1960)
Alaska, 1964
New Madrid, MO, 1812
San Francisco, 1906
Great Devastation
and Many
Fatalities Possible *
Loma Prieta, CA, 1989
Damage Begins *
Fatalities Rare
LOGARITHM (BASE 10) OF MAXIMUM AMPLITUDE MEASURED IN MICRONS **
* EFFECTS MAY VARY GREATLY DUE TO CONSTRUCTION PRACTICES, POPULATION DENSITY, SOIL DEPTH, FOCAL DEPTH, ETC.
** MICRON = A MILLIONTH OF A METER
*** EQUIVALENT TO A MOMENT MAGNITUDE OF 9.5


THE RICHTER SCALE
B
A
P
S
AMPLITUDE
23 mm
S-P = 24 sec
DISTANCE
km
S-P
sec
MAGNITUDE
AMPLITUDE
mm
TO DETERMINE THE MAGNITUDE OF AN EARTHQUAKE WE CONNECT ON THE CHART
A. THE MAXIMUM AMPLITUDE RECORDED BY A STANDARD SEISMOMETER, AND
B. THE DISTANCE OF THAT SEISMOMETER FROM THE EPICENTER OF THE
EARTHQUAKE (OR THE DIFFERENCE IN TIMES OF ARRIVAL OF THE P AND S WAVES)
BY A STRAIGHT LINE, WHICH CROSSES THE CENTER SCALE AT THE MAGNITUDE
Caltech Archives
www.archives.caltech.edu



$$M = \int_A \mu D(A) dA$$

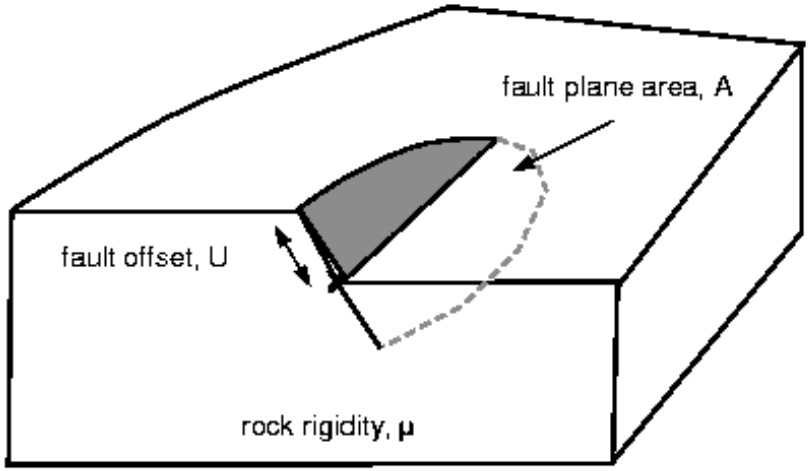
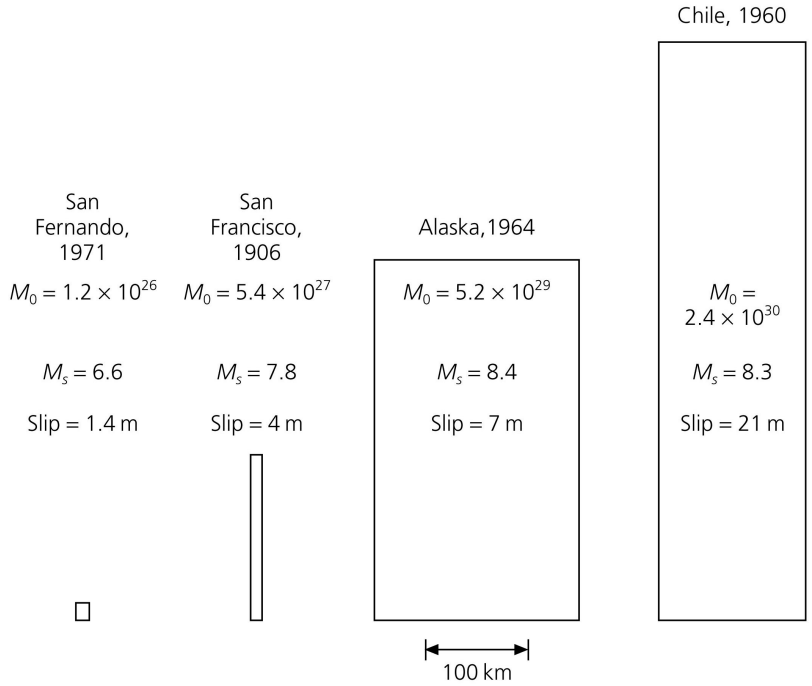


Figure 4.6-3: Comparison of the magnitudes of four earthquakes.



$$M_w = 2/3 \times \log(M_o) - 6$$
(M_o en N.m)

Earthquake	Body wave magnitude m_b	Surface wave magnitude M_s	Fault area (km^2) length × width	Average dislocation (m)	Moment (dyn-cm) M_0	Moment magnitude M_w
Truckee, 1966	5.4	5.9	10×10	0.3	8.3×10^{24}	5.8
San Fernando, 1971	6.2	6.6	20×14	1.4	1.2×10^{26}	6.7
Loma Prieta, 1989	6.2	7.1	40×15	1.7	3.0×10^{26}	6.9
San Francisco, 1906		8.2	320×15	4	6.0×10^{27}	7.8
Alaska, 1964	6.2	8.4	500×300	7	5.2×10^{29}	9.1
Chile, 1960		8.3	800×200	21	2.4×10^{30}	9.5