JEM446

ŞEHİR PLANLAMASINDA JEOLOJİ

Ders Notları 10.Hafta
Depremsellik

Dr. Koray ULAMIŞ

Ankara

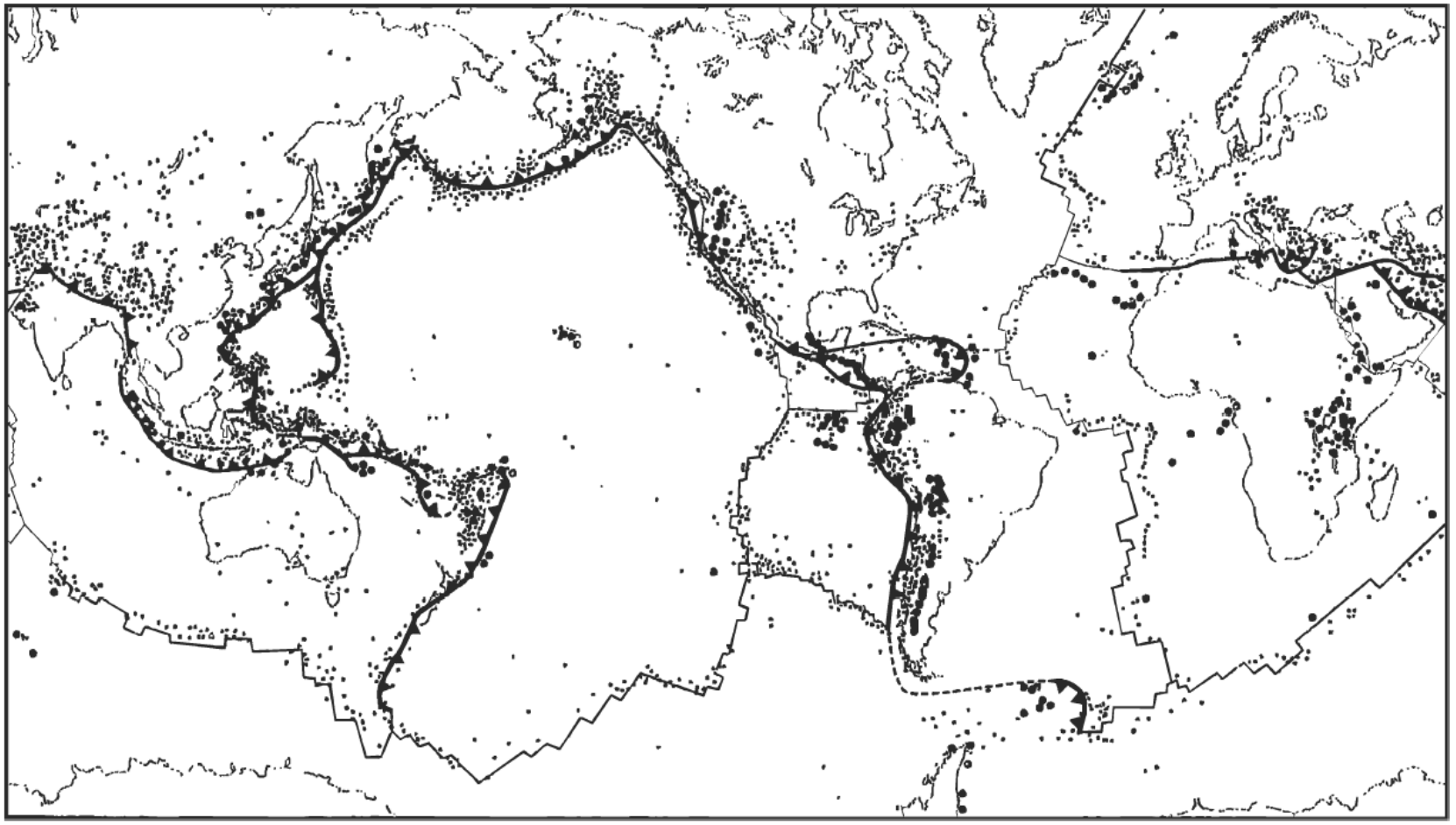
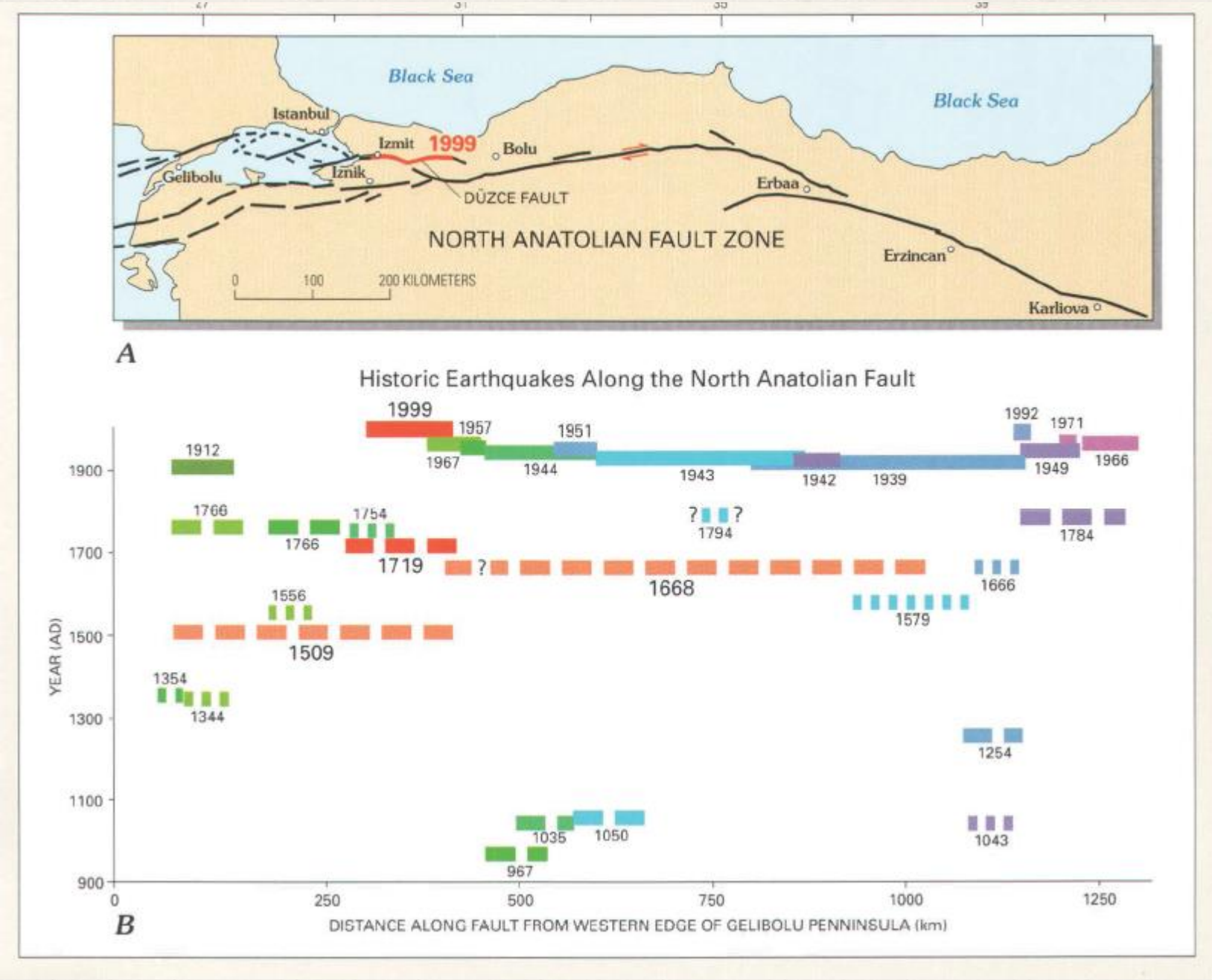


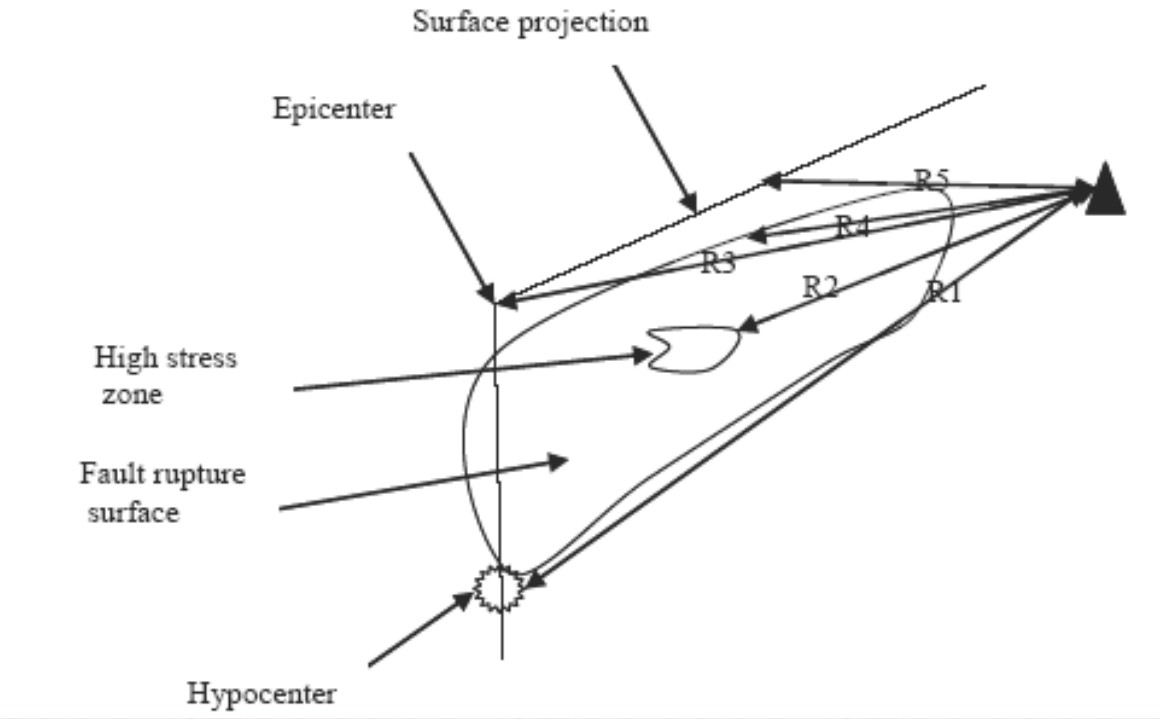
FIGURE 2.2 The major tectonic plate margins (heavy lines) and sample of most active seismic areas (heavy and light dots). Subduction zones marked with triangles (down dip).

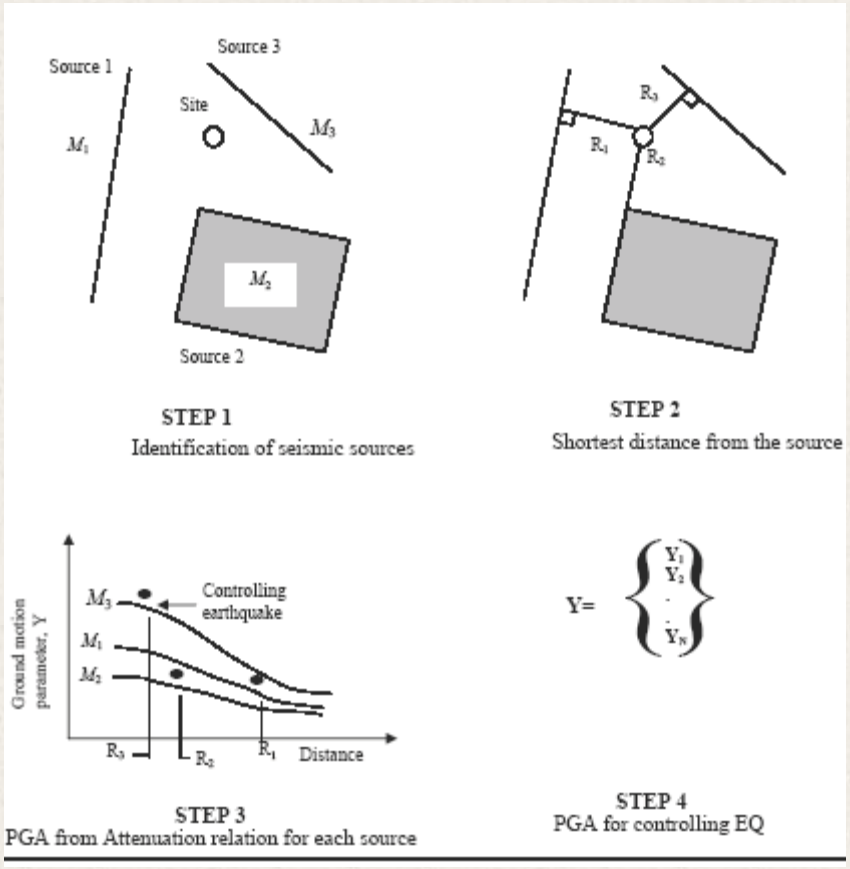
Kuzey Anadolu Fay Zonu



Deprem ve Fay Karakteristikleri

- Fay kırılma geometrisi
- Segmentli veya tekil fayın kırılması (Farklı enerji miktarı oluşması)
- Kırılan fayın etki alanı ve sakınım bandı genişliği
- Fay doğrultusu
- Fay türü
- Proje alanının fay odak noktasına uzaklığı
- Yüzey projeksiyonu
- Lokal jeoloji





Deterministik Sismik Tehlike Analizi

Proje alanı yakınındaki sismik kaynakların belirlenmesi
Alan en yakın mesafe
Her kaynaktaki pik ivmenin azalım ilişkileri ile ilgili alana uygulanması

Deprem Büyüklük Ölçekleri

Lokal Manyitüd (M_L)

Richter ölçeği olarak da adlandırılan ölçek sığ ve yerel depremler için 1935'de önerilmiştir.

$M_L = \log A - \log A_0 = \log A/A_0$
En büyük genlik (mm). Genliğin ölçüldüğü sismografta doğal salınım periyodu 0.8 s, sönüm oranı %80 ve standard ölçekleme 2800'dür.
A_0: 0.001 mm.

Yüzey Dalgası Manyitüdü (M_s)

Yüzeyde hareket eden ve periyou 20s olan dalga genliği için önerilmiştir (Gutenberg, Richter 1956).Lokal manyitüde göre avantajı, en büyük deplasmana göre hesaplanmasıdır.

$M_S = \log A' + 1.66 \log \Delta + 2.0$

A': En büyük deplasman, μm
Δ: Sismograf ile episantr arası mesafe

Moment Manyitüdü (M_w)

Büyük depremlerin büyüklüklerinin belirlenmesinde tercih edilen büyüklüktür.

En önemli avantajı, tüm deprem kaydının hesaba katılabilmesidir.

İlk olarak sismik manyitüd (M0) hesaplanmalıdır (Idriss, 1985).

$M_0=\mu A_f D$

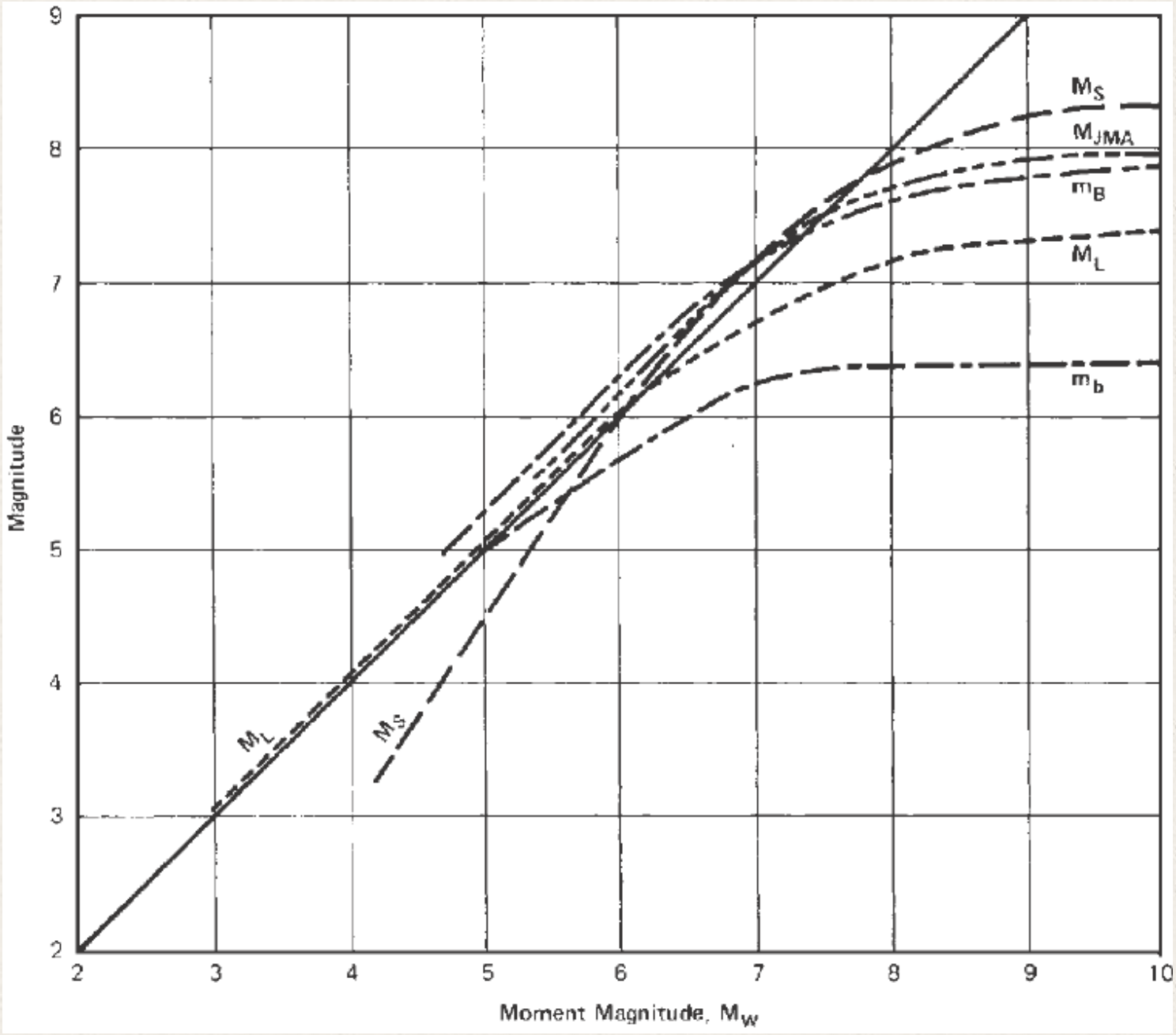
M_0: Sismik moment (N.m)

M: Fay düzlemindeki malzemenin makaslama modülü (N/m^2). Kabuk için ortalama $3x101^0$ N/m^2, manto için $7x10^{12}$ N/m^2.

A_f: Hareket eden fayın alanı (m^2).

D: Fayın tamamı veya kırılan segment üzerindeki deplasman (m)

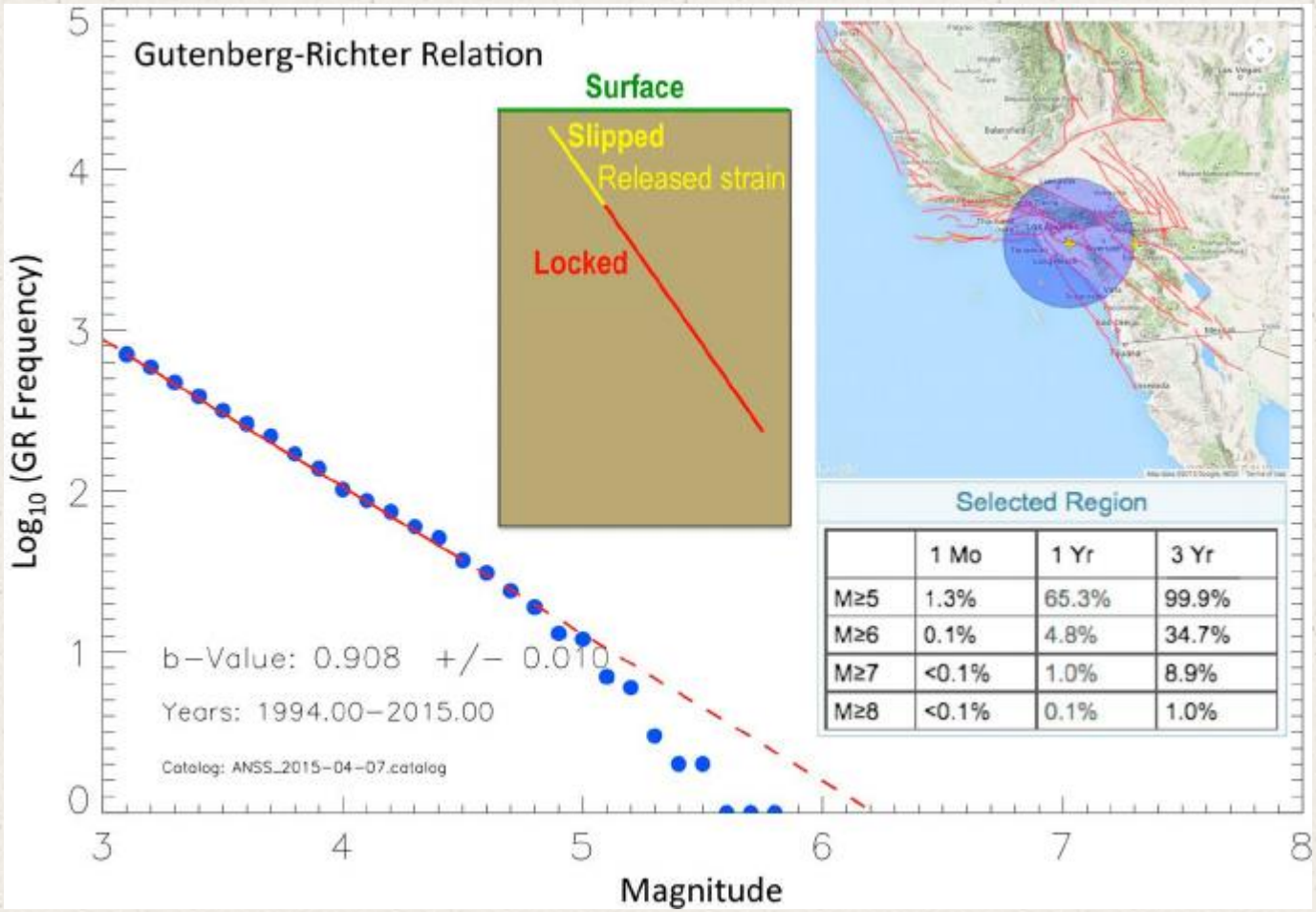
$M_w=-6.0+0.67\log M_0$ (Hanks and Kanamori, 1979; Kanamori, 1977)


Magnitude
Moment Magnitude, M_W
M_S
M_{JMA}
m_B
M_L
m_b
M_L
M_S
9
8
7
6
5
4
3
2
2
3
4
5
6
7
8
9
10

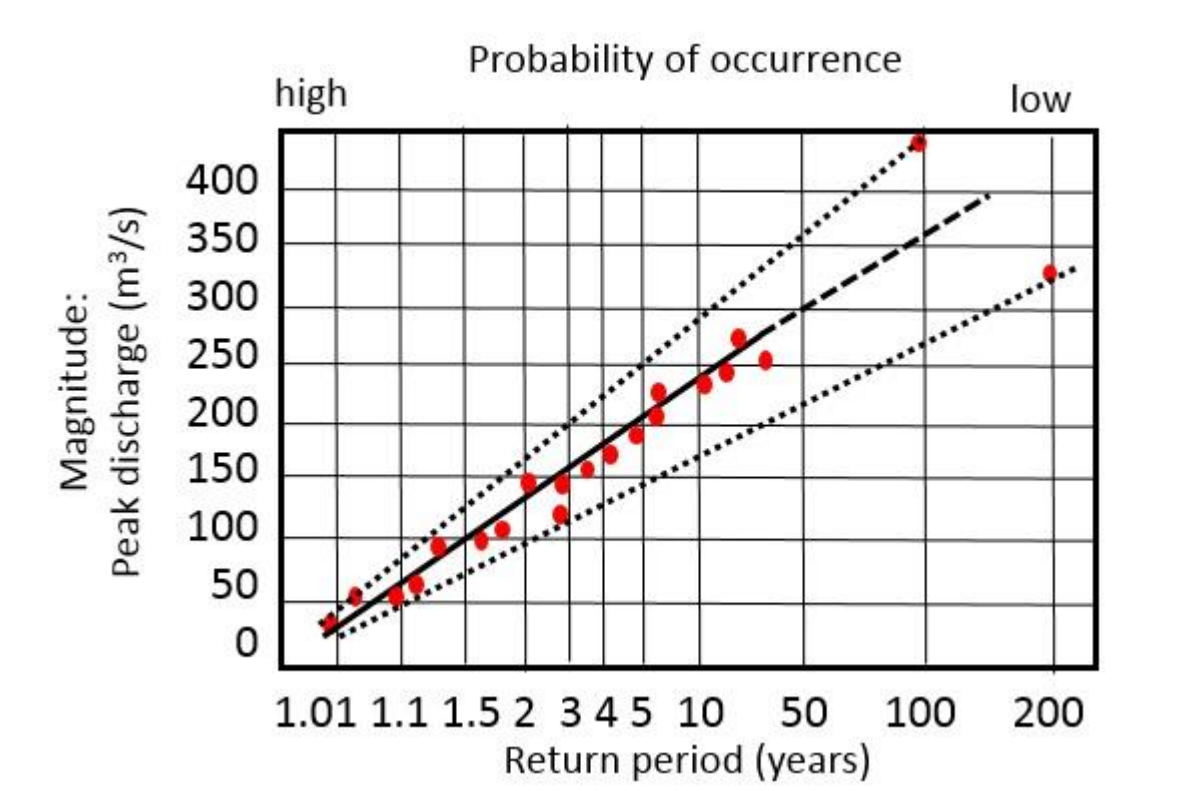
Deprem büyüklüğü ile belirlenen parametreler

1. Gutenberg-Richter İlişkisi

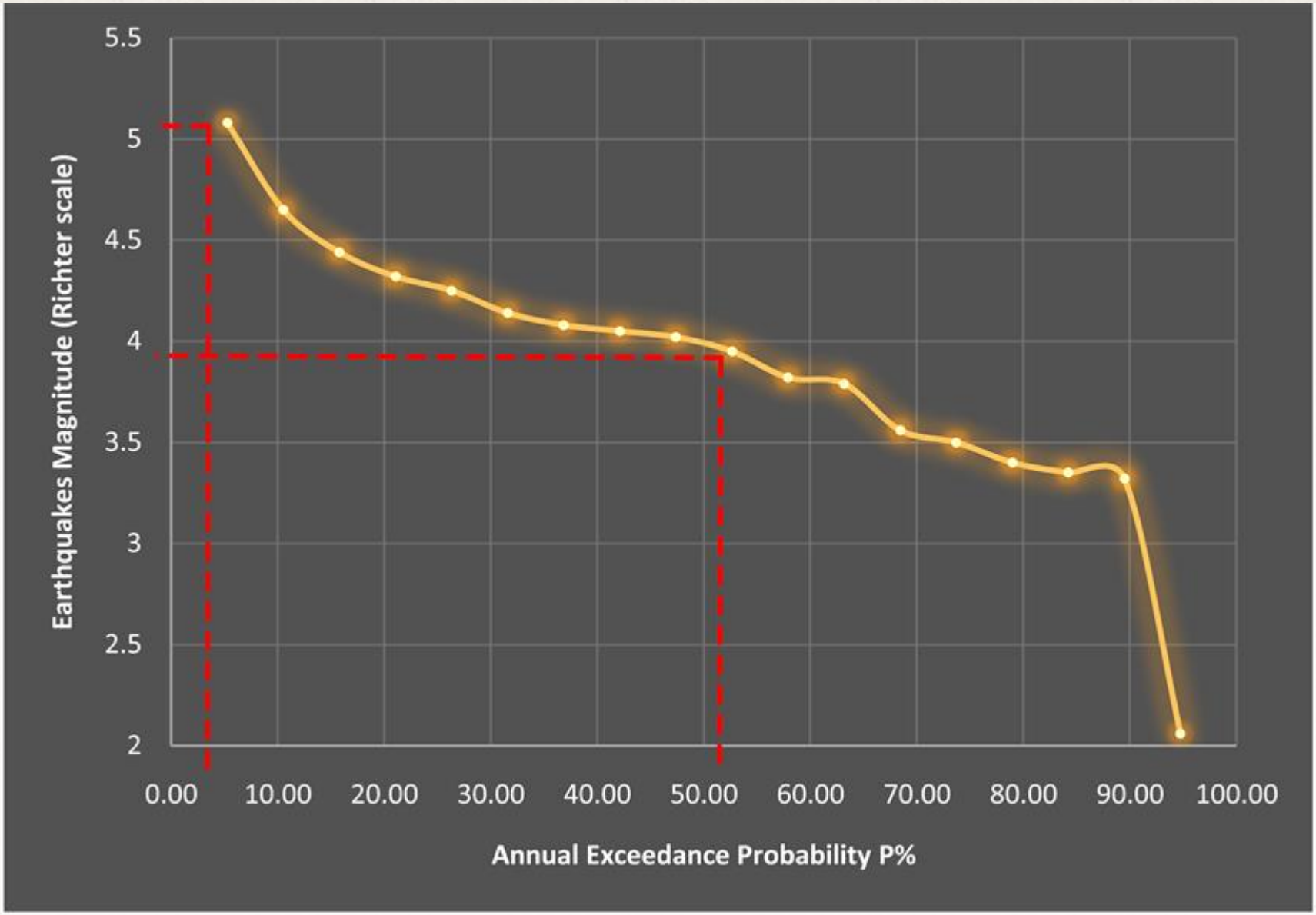
logN=a-bM



2. Belli büyüklükteki depremin tekrarlanma aralığı (Return Period)



3. Limit değerlerin aşılma olasılığı (Probability of Exceedance)



Jeolojik ve Jeoteknik İnceleme Esasları

- Jeolojik haritalama
- Yüzey ve yeraltı araştırmaları
- Laboratuvar deneyleri
- Jeolojik ve mühendislik analizleri
- Rapor

- Proje türü
- Topoğrafik durum
- Jeolojik malzeme karakterizasyonu
- Jeolojik ve sismik afet
- Sahaya ulaşım
- Yerel idare ve özel koşullar

Rank	Date	Location	Event	Magnitude
1	May 22, 1960	Valdivia, Chile	1960 Valdivia earthquake	9.4–9.6
2	March 27, 1964	Prince William Sound, Alaska, United States	1964 Alaska earthquake	9.2
3	December 26, 2004	Indian Ocean, Sumatra, Indonesia	2004 Indian Ocean earthquake	9.1–9.3
4	March 11, 2011	Pacific Ocean, Tōhoku region, Japan	2011 Tōhoku earthquake	9.1[3]
5	November 4, 1952	Kamchatka, Russian SFSR, Soviet Union	1952 Kamchatka earthquakes	9.0[4]
6	August 13, 1868	Arica, Chile (then Peru)	1868 Arica earthquake	8.5–9.0 (est.)
7	January 26, 1700	Pacific Ocean, USA and Canada (then claimed by the Spanish Empire and the British Empire)	1700 Cascadia earthquake	8.7–9.2 (est.)
8	April 2, 1762	Chittagong, Bangladesh (then Kingdom of Mrauk U)	1762 Arakan earthquake	8.8 (est.)
9	November 25, 1833	Sumatra, Indonesia (then part of the Dutch East Indies)	1833 Sumatra earthquake	8.8 (est.)
10	January 31, 1906	Ecuador – Colombia	1906 Ecuador–Colombia earthquake	8.8[5]
11	February 27, 2010	Offshore Maule, Chile	2010 Chile earthquake	8.8[5]
12	August 15, 1950	Assam, India – Tibet, China	1950 Assam–Tibet earthquake	8.7
13	October 28, 1707	Pacific Ocean, Shikoku region, Japan	1707 Hōei earthquake	8.7–9.3 (est.)
14	July 8, 1730	Valparaiso, Chile (then part of the Spanish Empire)	1730 Valparaiso earthquake	8.7 (est.)[6]
15	November 1, 1755	Atlantic Ocean, Lisbon, Portugal	1755 Lisbon earthquake	8.5–9.0
16	February 4, 1965	Rat Islands, Alaska, United States	1965 Rat Islands earthquake	8.7
17	October 28, 1746	Lima, Peru (then part of the Spanish Empire)	1746 Lima–Callao earthquake	8.6 (est.)
18	March 28, 1787	Oaxaca, Mexico (then part of the Spanish Empire)	1787 Mexico earthquake	8.6 (est.)
19	March 9, 1957	Andreanof Islands, Alaska, United States	1957 Andreanof Islands earthquake	8.6[5]
20	March 28, 2005	Sumatra, Indonesia	2005 Nias–Simeulue earthquake	8.6[5]
21	April 11, 2012	Indian Ocean, Sumatra, Indonesia	2012 Aceh earthquake	8.6
22	December 16, 1575	Valdivia, Chile (then part of the Spanish Empire)	1575 Valdivia earthquake	8.5 (est.)
23	November 24, 1604	Arica, Chile (then part of the Spanish Empire)	1604 Arica earthquake	8.5 (est.)
24	May 13, 1647	Santiago, Chile (then part of the Spanish Empire)	1647 Santiago earthquake	8.5 (est.)
25	May 24, 1751	Concepción, Chile (then part of the Spanish Empire)	1751 Concepción earthquake	8.5 (est.)
26	November 19, 1822	Valparaíso, Chile	1822 Valparaíso earthquake	8.5 (est.)
27	February 20, 1835	Concepción, Chile	1835 Concepción earthquake	8.5 (est.)
28	February 16, 1861	Sumatra, Indonesia	1861 Sumatra earthquake	8.5
29	May 9, 1877	Iquique, Chile (then Peru)	1877 Iquique earthquake	8.5 (est.)
30	November 10, 1922	Atacama Region, Chile Catamarca Province, Argentina	1922 Vallenar earthquake	8.5[7]
31	February 1, 1938	Banda Sea, Indonesia (then part of the Dutch East Indies)	1938 Banda Sea earthquake	8.5[5]
32	October 13, 1963	Kuril Islands, Russia (USSR)	1963 Kuril Islands earthquake	8.5[5]
33	October 20, 1687	Lima, Peru (then part of the Spanish Empire)	1687 Peru earthquake	8.5 (est.)
34	October 17, 1737	Kamchatka, Russia	1737 Kamchatka earthquakes	8.5 (est.)
35	June 15, 1896	Pacific Ocean, Tōhoku region, Japan	1896 Sanriku earthquake	8.5 (est.)

Tipik Yapısal Hasarlar

Loma Prieta earthquake damage in San Francisco. The soft first story is due to construction of garages in the first story and resultant reduction in shear strength. (Photo from: http://earthquake.usgs.gov/bytopic/photos.html)

Yumuşak kat ve makaslama deformasyonu

Mid-story collapse, Kobe earthquake. (Photo from: The January 17, 1995 Kobe Earthquake: An EQE Summary Report. April 1995, http://www.eqe.com/publications/kobe/kobe.htm)

Zayıf kat/kolon Makaslaması

Kolon Yenilmesi, Kolonlara Aşırı Yük Bindirilmesi

Collapsed section of I–10 (Santa Monica freeway), West Los Angeles.The freeway had been built across relatively soft soils (drained wetlands), the probable reason for the structural failure. This section of freeway was repaired and made serviceable in three months time. Photograph by Kerry Sieh.

Column failure on interstate highway overpass, Northridge earthquake. (Photo from: http://earthquake.usgs.gov/bytopic/photos.html)

1995 Kobe Depremi, Taşıyıcı Kolonlarda Makaslama/Burulma Yenilmesi

Kolon Yenilmesi Yakın Plan Görüntüsü