Ev 200

1. Geohazards
2. Water, mineral and biological resources
3. Environmental Energy Resourses

Ev 200: Course outline

1. Geohazards
   - Earthquakes
   - Volcanics
   - Landslides
   - Atmospheric Geohazards
   - Floods and Droughts

2. Water, mineral and biological resources

3. Environmental **Energy Resourses**
   - Rewable source
   - Non- rewenable sources
   - Man's impact on the earth energy balance
   - Energy Sources Management

Introduction

Aspects of Geology:

Geology is the study of the Earth, focuses on describing our planet’s composition, behaviour and history.

Geology may be one of the most practical subjects your can learn, for geologic phenomenon and issues affecting our daily lives, sometimes in unexpected ways. Practical problems such as how to **prevent ground water contamination**, **how to find oil and minerals**, and **how to stabilize slopes** need a basic understanding of geology. To make decisions **concerning Earth- related issues** requires a basic understanding of geologic phenomena.

Your knowledge of geology may help you to avoid building your home on a hazardous floodplain or fault zone, on an unstable slope or along a rapidly eroding coast.

Textbooks

Marshak, S. 2004: Essentials of Geology. *W.W. Norton & Company*. 536 p.

Press, F. and Siever, R. 1996: Understanding EARTH. *W.H. Freeman and Company*. 3rd edition. 593 p.

Duff, P. McL. D. 2002: Holme's Principles of Physical Geology. *Nelson Thornes Ltd*. 4th Edition. 791 p.

Plate Tectonics: Earthquake & Vocanic belts

GURE 2.31 The locations of most earthquakes fall in distinct bands. These earthquake belts efine the positions of the plate boundaries.

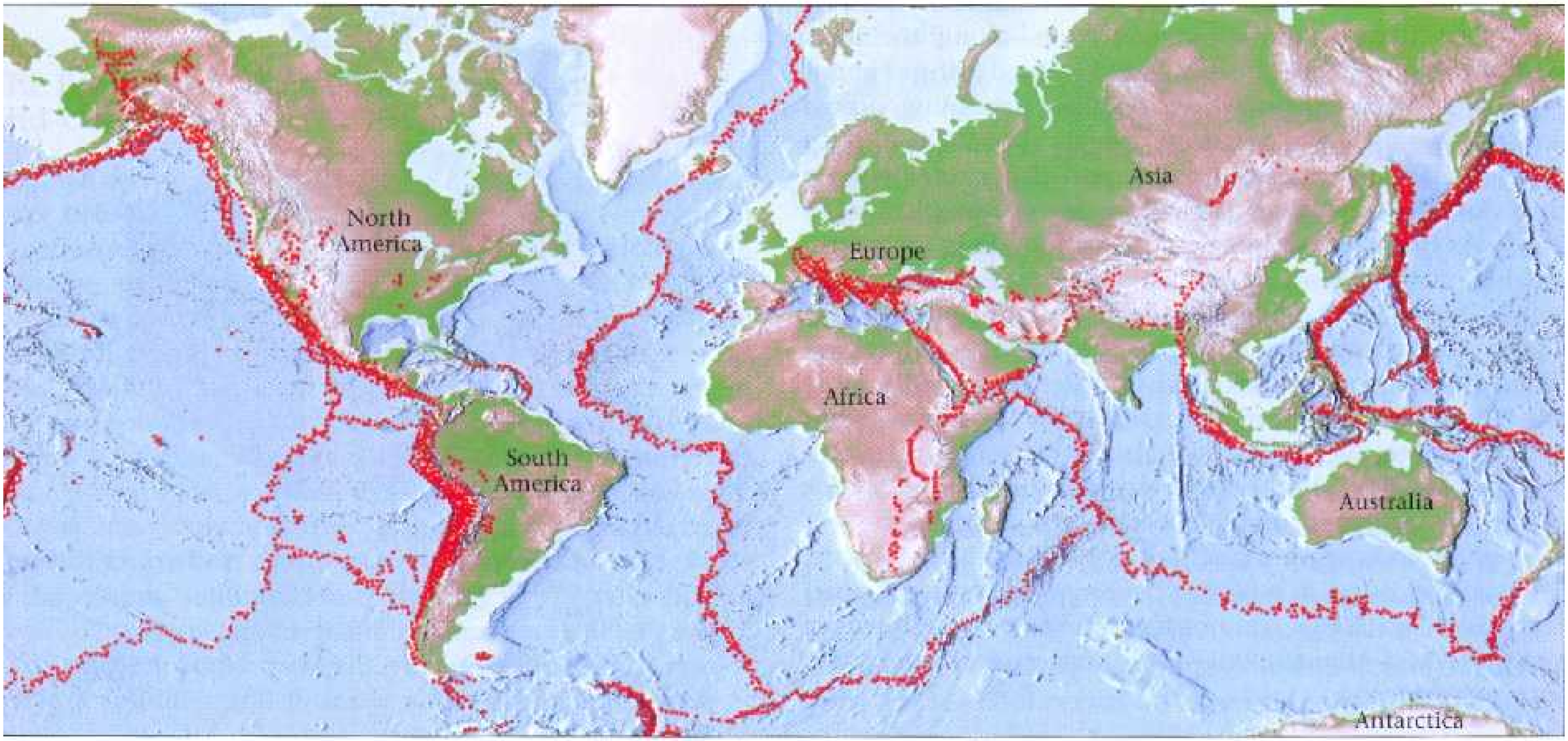


Plate Tectonics

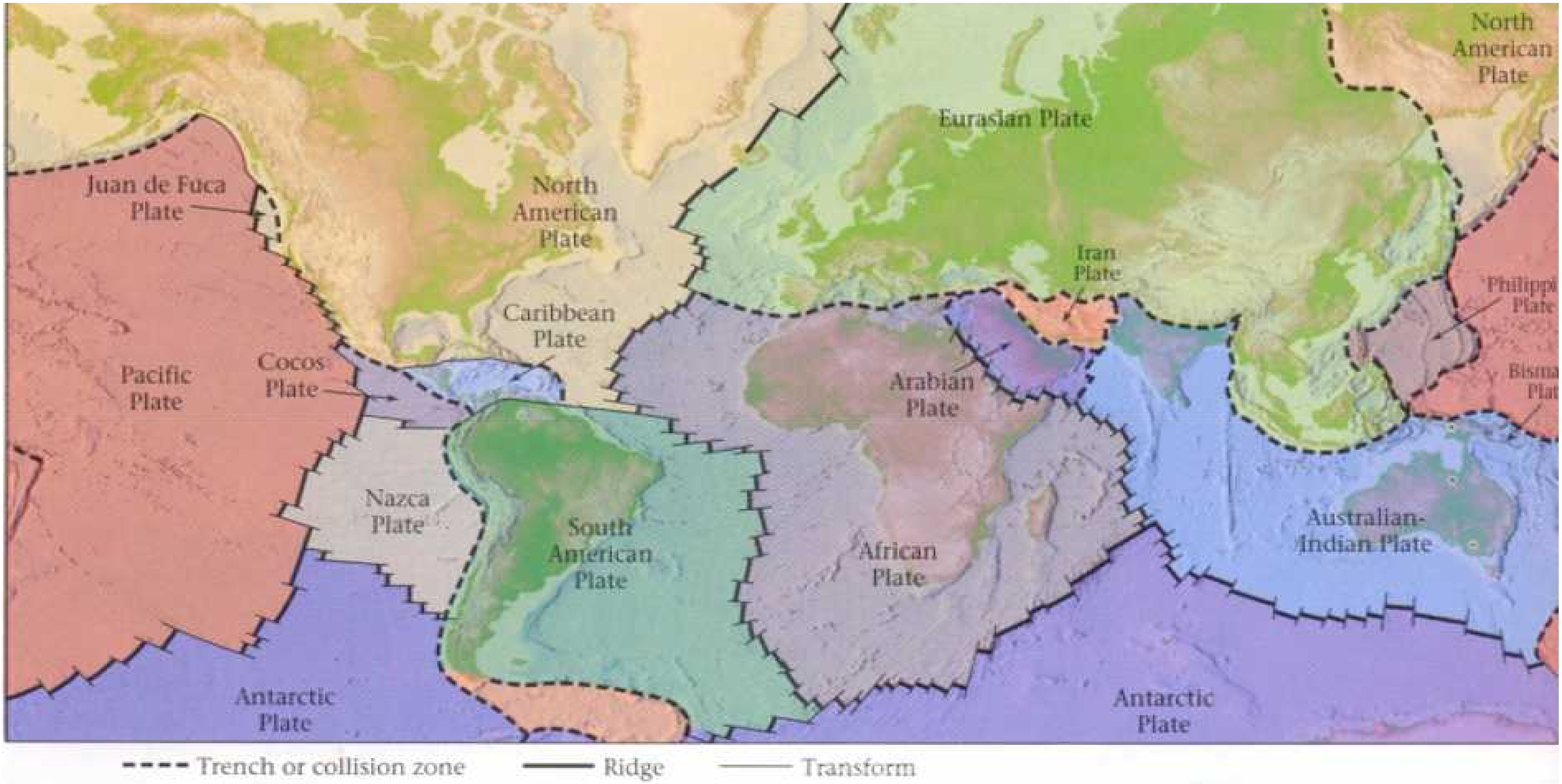


FIGURE 2.29 The major plates making up the lithosphere. Note that some plates are all ocean floor, while some contain both continents and oceans. Thus, some plate boundaries lie along continental margins (coasts), while others do not. For example, the eastern border of South America is not a plate boundary, but the western edge is.

Plate Tectonics

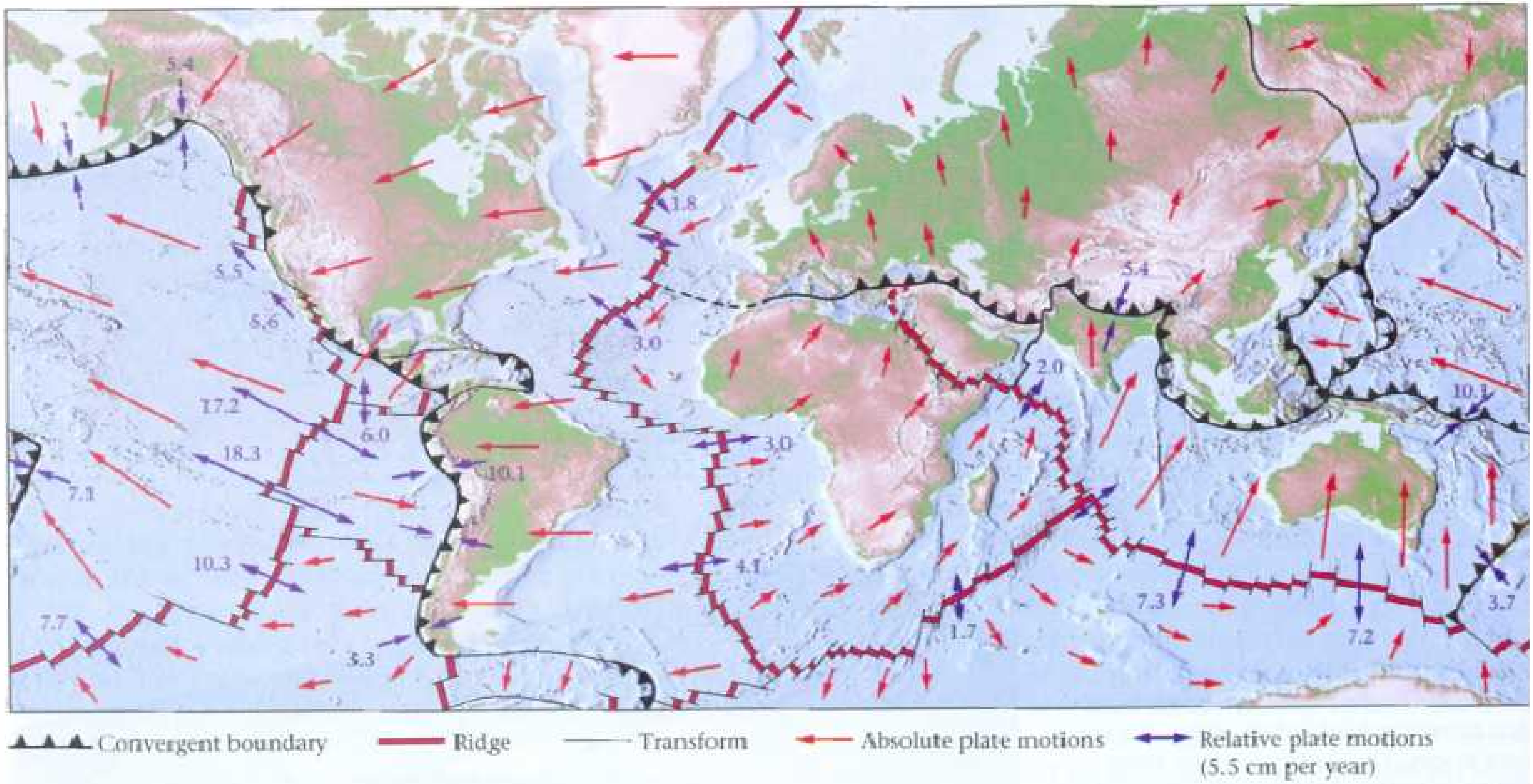
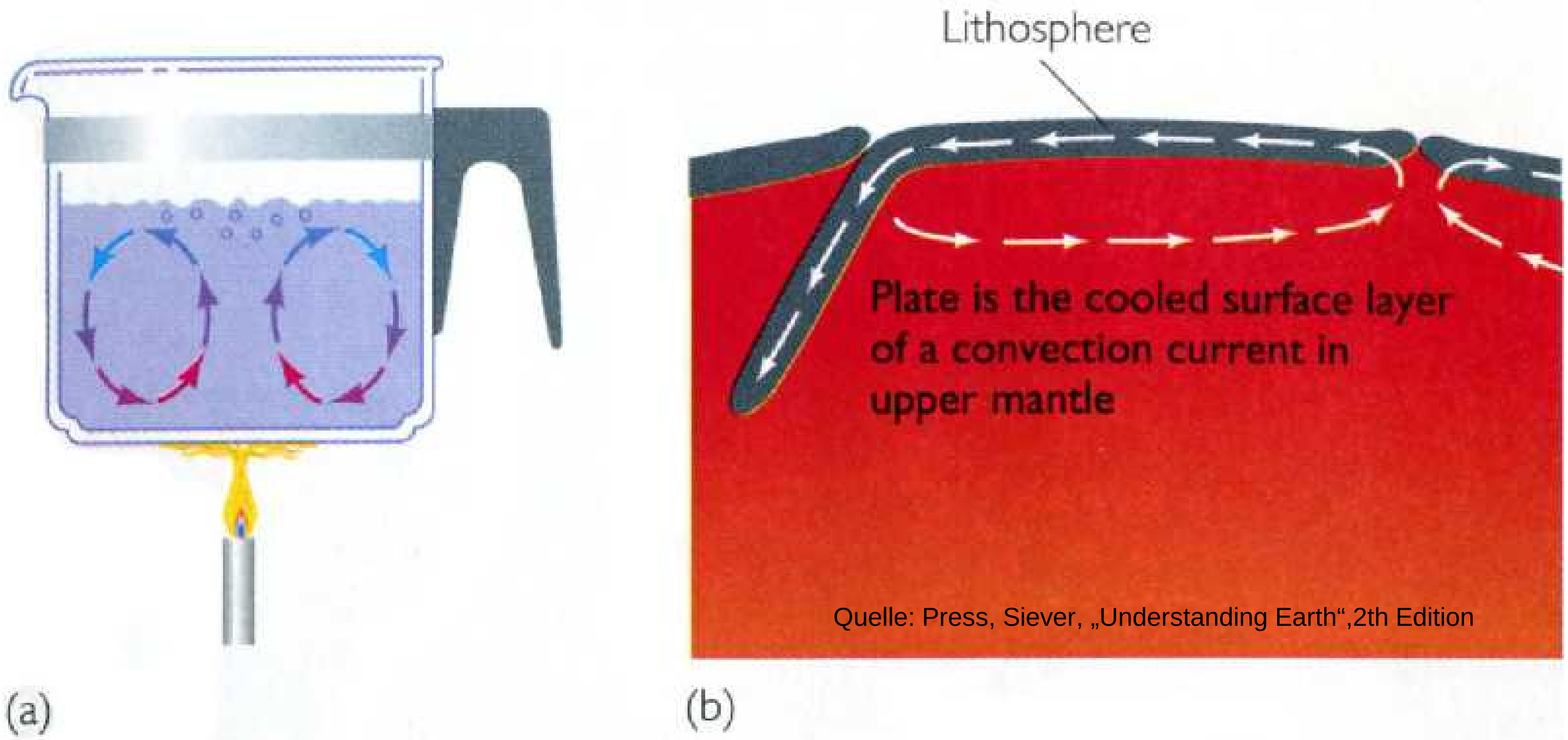


FIGURE 2.53 Relative plate velocities: the light-blue arrows show the rate and direction at which the plate on one side of the boundary is moving with respect to the plate on the other side. Outward-pointing arrows indicate spreading (divergent boundaries), inward-pointing arrows indicate subduction (convergent boundaries), and parallel arrows show transform motion. The length of an arrow represents the velocity. Absolute plate velocities: the dark-blue arrows show the velocity of the plates with respect to a fixed point in the mantle.

Plate Tectonics



Quelle: Press, Siever, „Understanding Earth“,2th Edition

Mantle convection

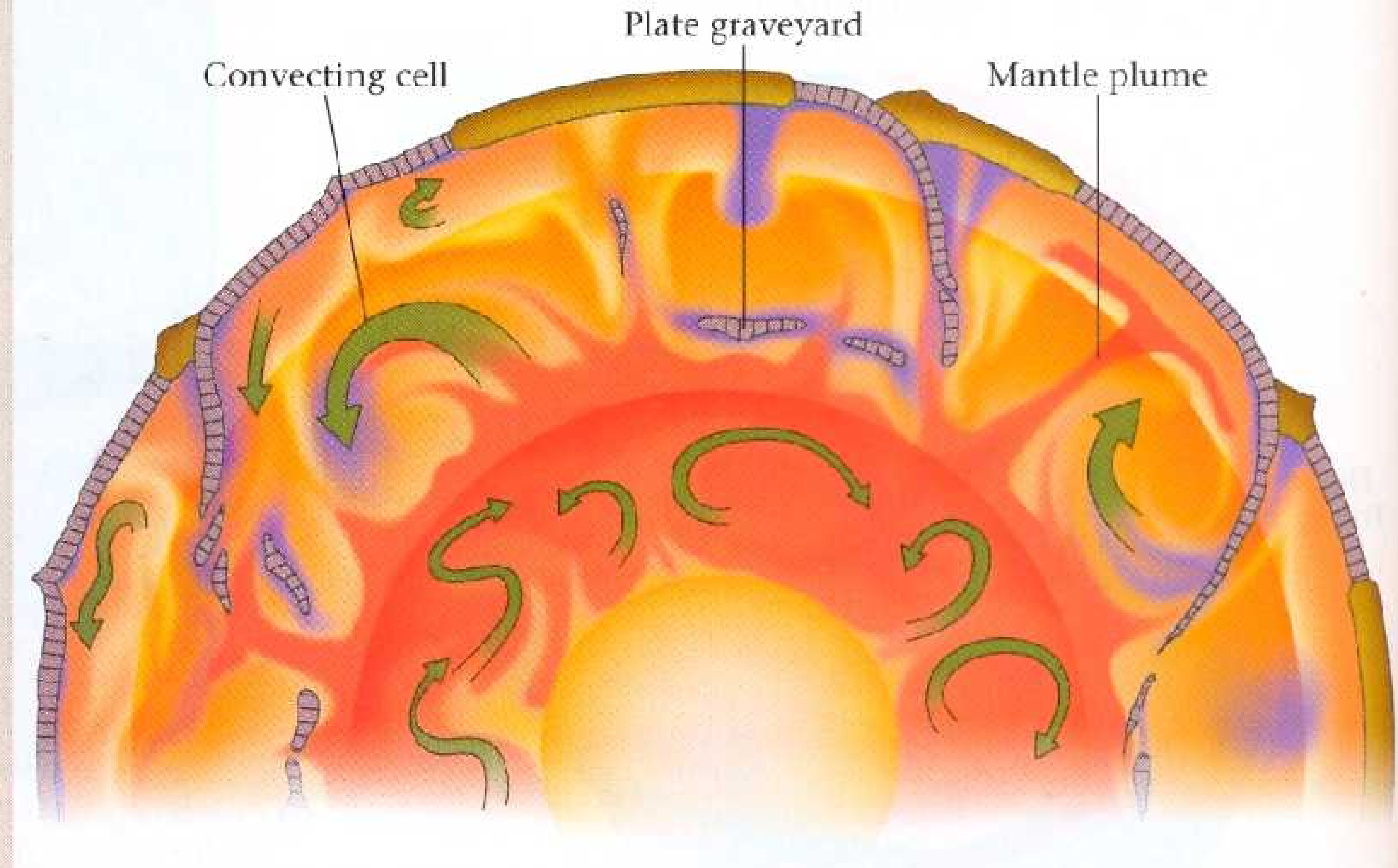


FIGURE C.13 The modern view of a complex and dynamic Earth interior. Note the convecting cells, the mantle plumes, and the subducted-plate graveyards.

The Theory of Plate Tectonics

According to the theory of plate tectonics, the lithosphere is broken into about twenty plates that move relatively to one another. Each plate moves as a distinct unit, riding on the asthenosphere. Plate movement occurs at rates of 1 to 15 cm per year.

Why should the plates move?

Because the mantle beneath the lithosphere is hot and mouldable, this allows the materials of the mantle to move by convection.

Plate Tectonics

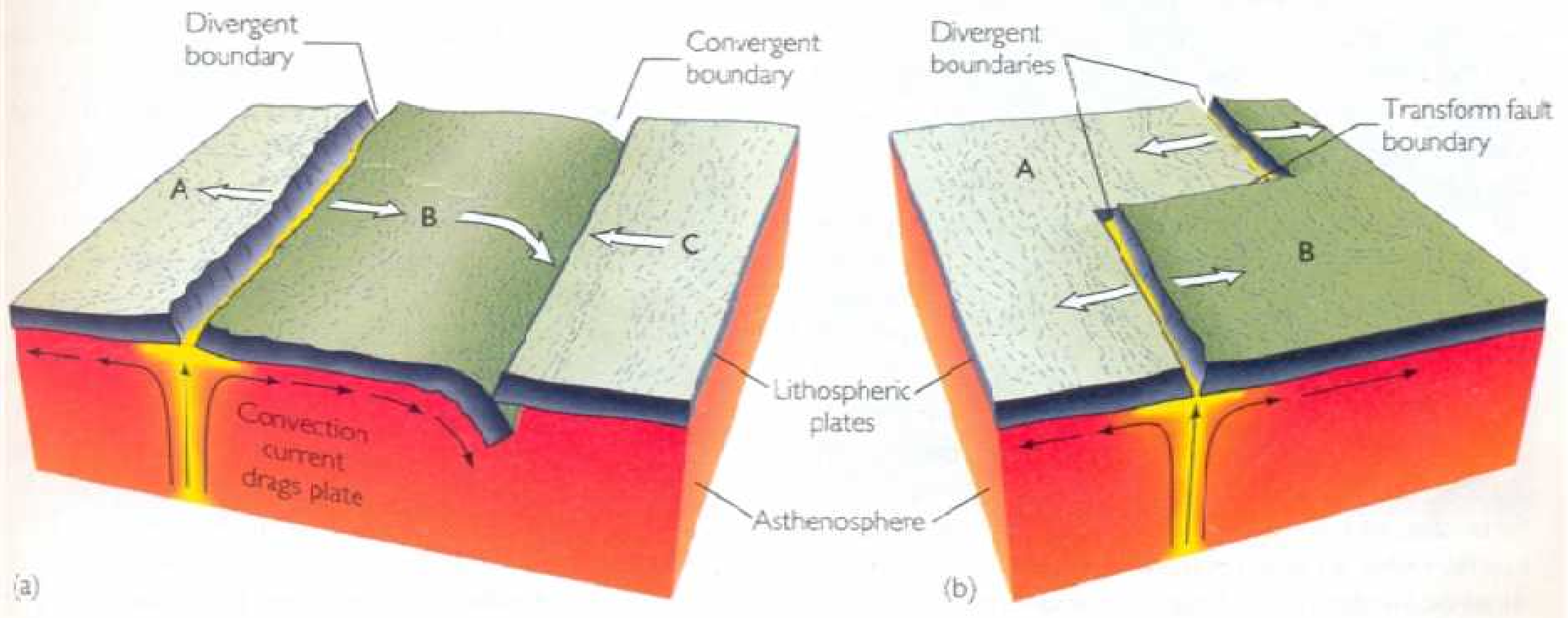


FIGURE 1.14 The three types of plate boundaries: (a) A divergent boundary, where plates A and B separate, and a convergent boundary, where plates B and C collide. (b) A transform fault boundary, where plates A and B slip past each other.

Plate boundaries

Divergent boundaries: Here two plates move apart by a process called **sea-floor spreading**. Divergent boundaries are marked by a mid-ocean ridge. Asthenospheric mantle rises beneath a mid-ocean ridge and partially melts, forming magma. The magma rises to create new ocean crust. The lithospheric mantle thickens progressively away from the ridge axis as the plate cools.

Convergent boundaries: Here two plates collide and one plate subducts beneath another (it sinks down into the mantle). Only oceanic lithosphere can subduct. At the Earth’s surface, the boundary between the two plates is marked by a deep ocean trench.

Transform boundaries: Here plates slid sideways past one another without creating a new crust or the subduction of one plate.

A point at which three plate boundaries meet is called a triple junction.

Earthquake

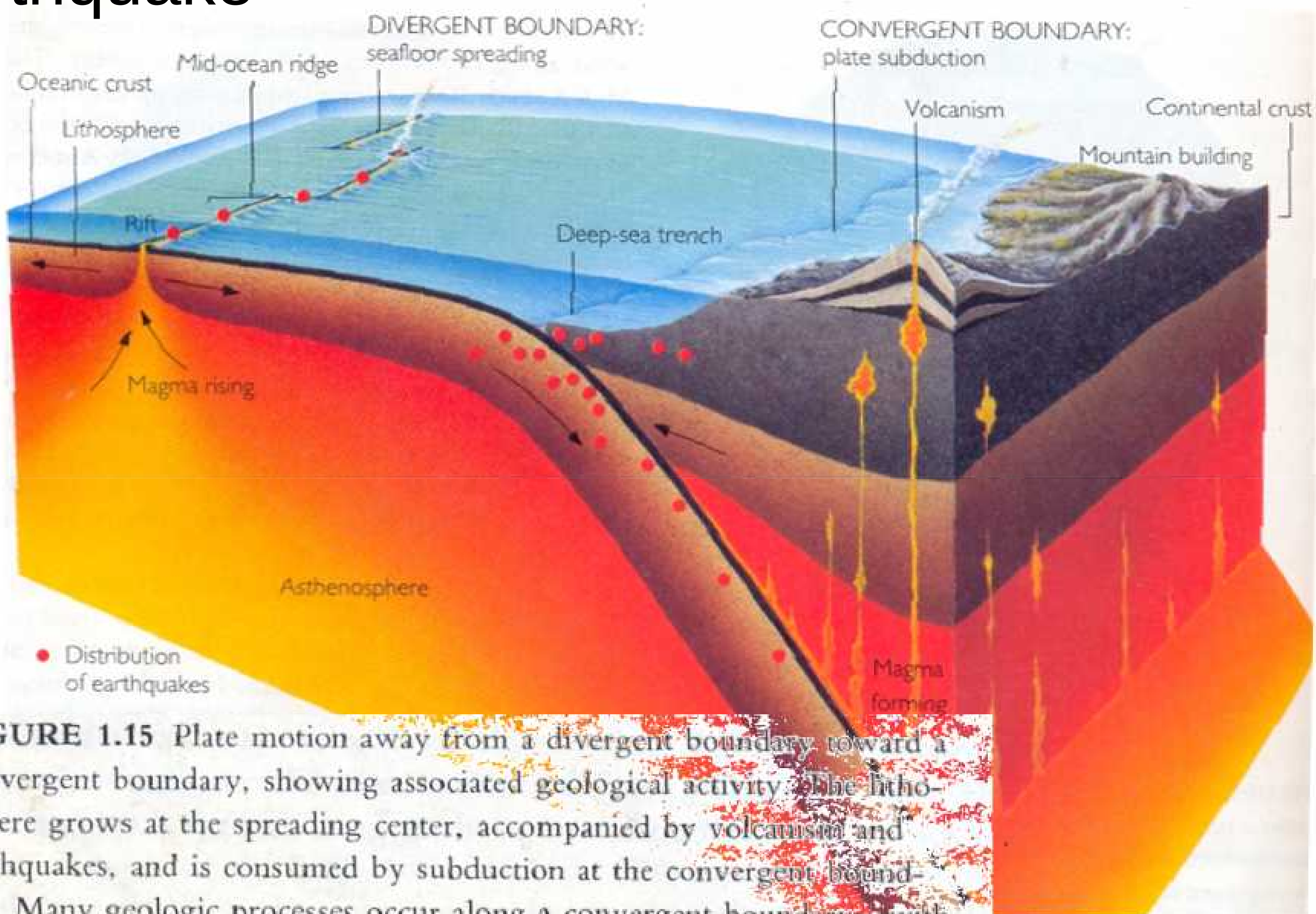


FIGURE 1.15 Plate motion away from a divergent boundary toward a convergent boundary, showing associated geological activity. The lithosphere grows at the spreading center, accompanied by volcanism and earthquakes, and is consumed by subduction at the convergent boundary. Many geologic processes occur along a convergent boundary—with the creation and upwelling of magma, volcanism, mountain building, creation of a deep-sea trench, and earthquakes.

Earthquakes

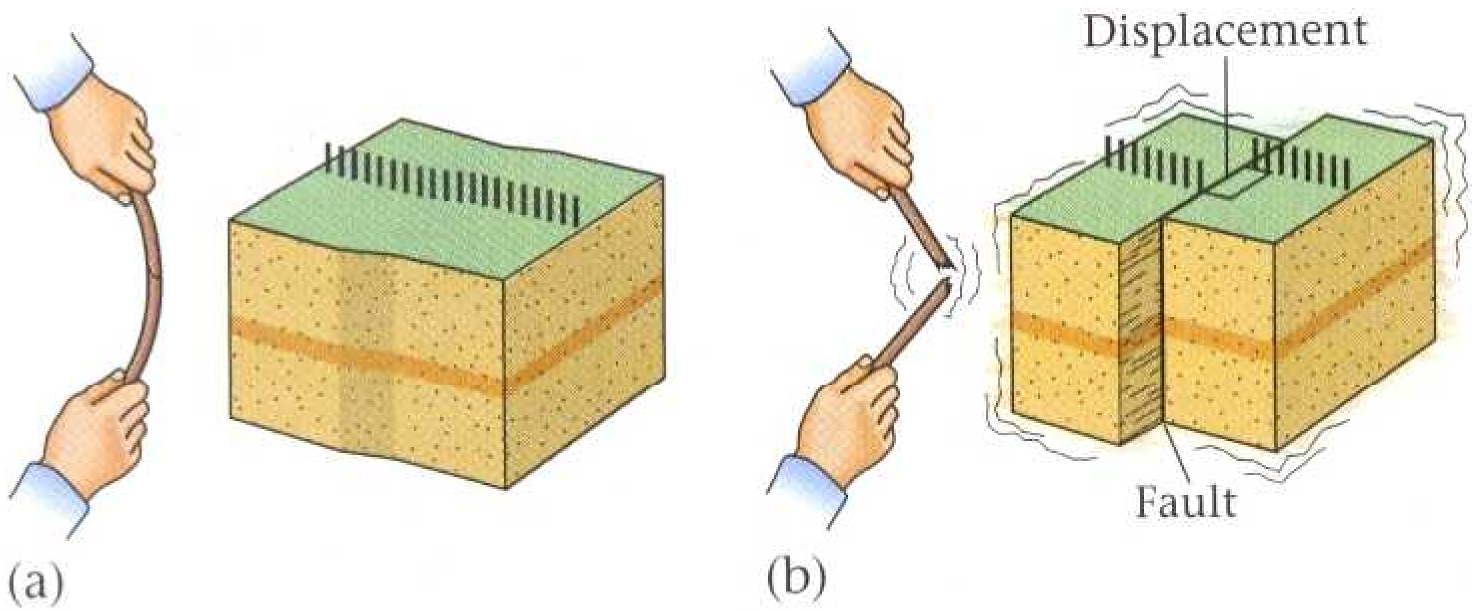


FIGURE 8.1 Most earthquakes happen when rock in the ground first bends slightly and then suddenly snaps and breaks, like a stick you flex in your hands. (a) Before an earthquake, the crust bends (the amount of bending is greatly exaggerated here). (b) When the crust breaks, sliding suddenly occurs on a fault, generating vibrations.

Earthquakes

An earthquake is a shaking or vibration of the ground. An earthquake occur when rocks being deformed suddenly break along fault. The two blocks of rocks on both sides of the fault slip suddenly, setting off the ground vibrations. This slippage occurs most commonly at plate boundaries. Regions of the Earth’s crust or upper mantle where most of the ongoing deformation takes place.

Earthquakes

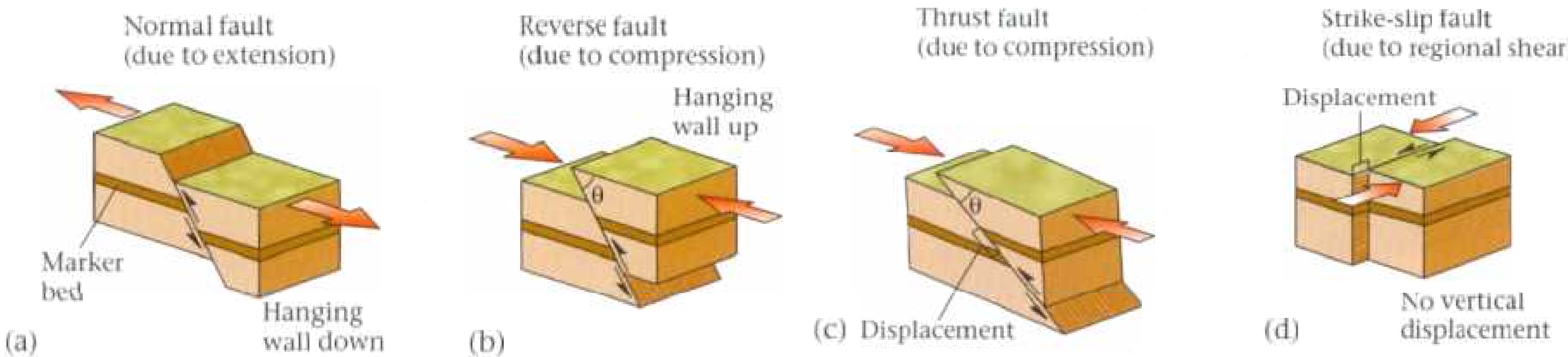
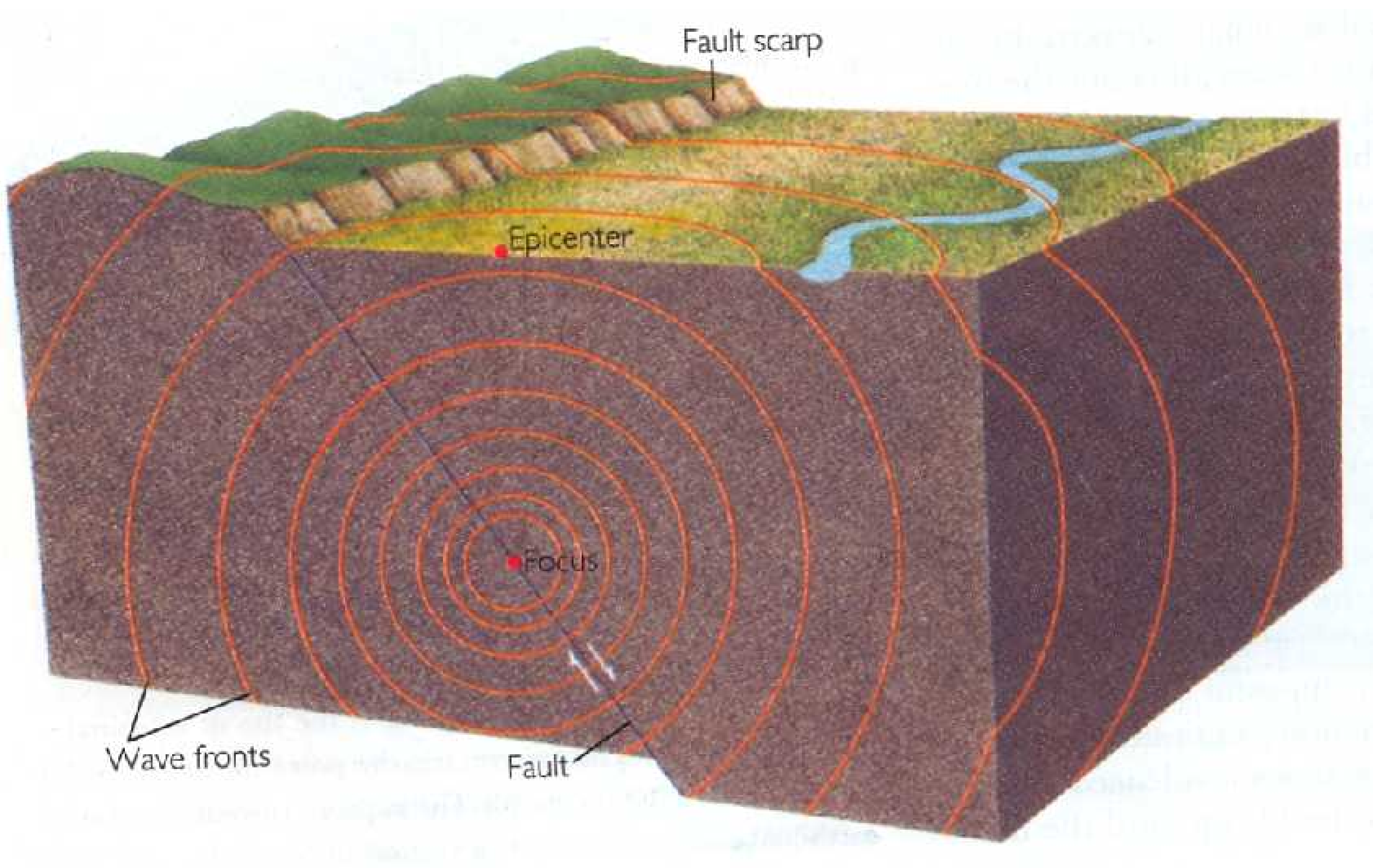


FIGURE 8.4 (a) On a normal fault, the hanging-wall block slides down the slope of the fault plane, relative to the footwall block. (b) A reverse fault is a steeply sloping fault on which the hanging-wall block slides up, relative to the footwall block. (c) A thrust fault is a gently sloping fault on which the hanging-wall block slides up, relative to the footwall block. (d) On a strike-slip fault, one block slides laterally past the other, and there is no up or down motion.

Earthquakes



Earthquake Destructiveness

R-wave (Rayleigh wave) L-wave (love wave)

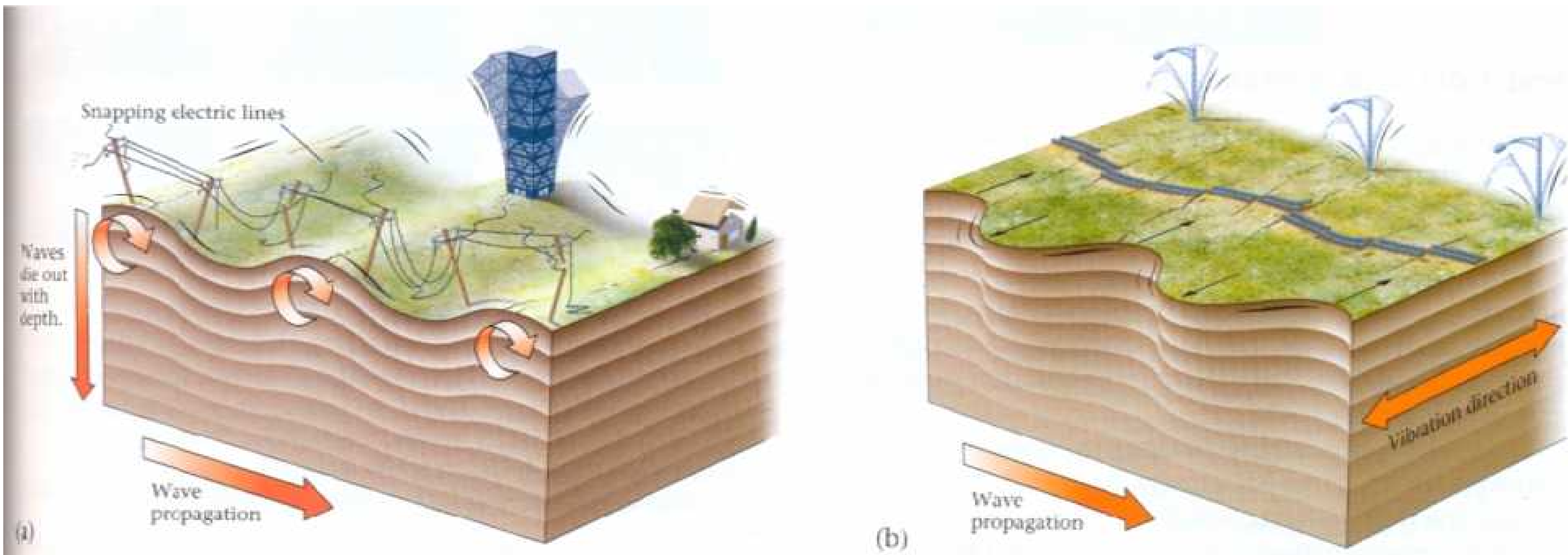
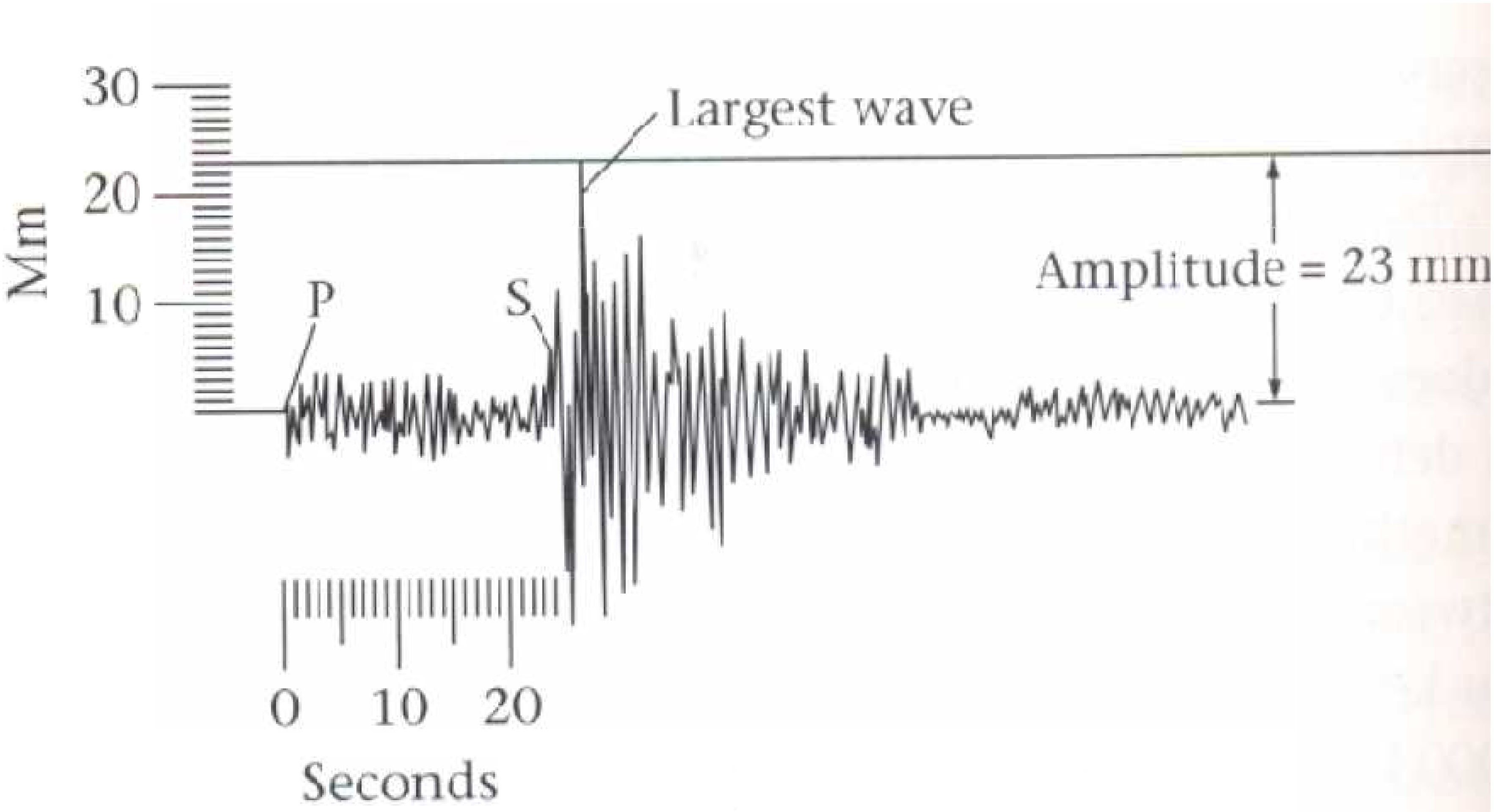


FIGURE 8.21 (a) Rayleigh waves make the ground undulate in a rolling motion, like the sea surface. (b) Love waves cause the ground to undulate laterally.

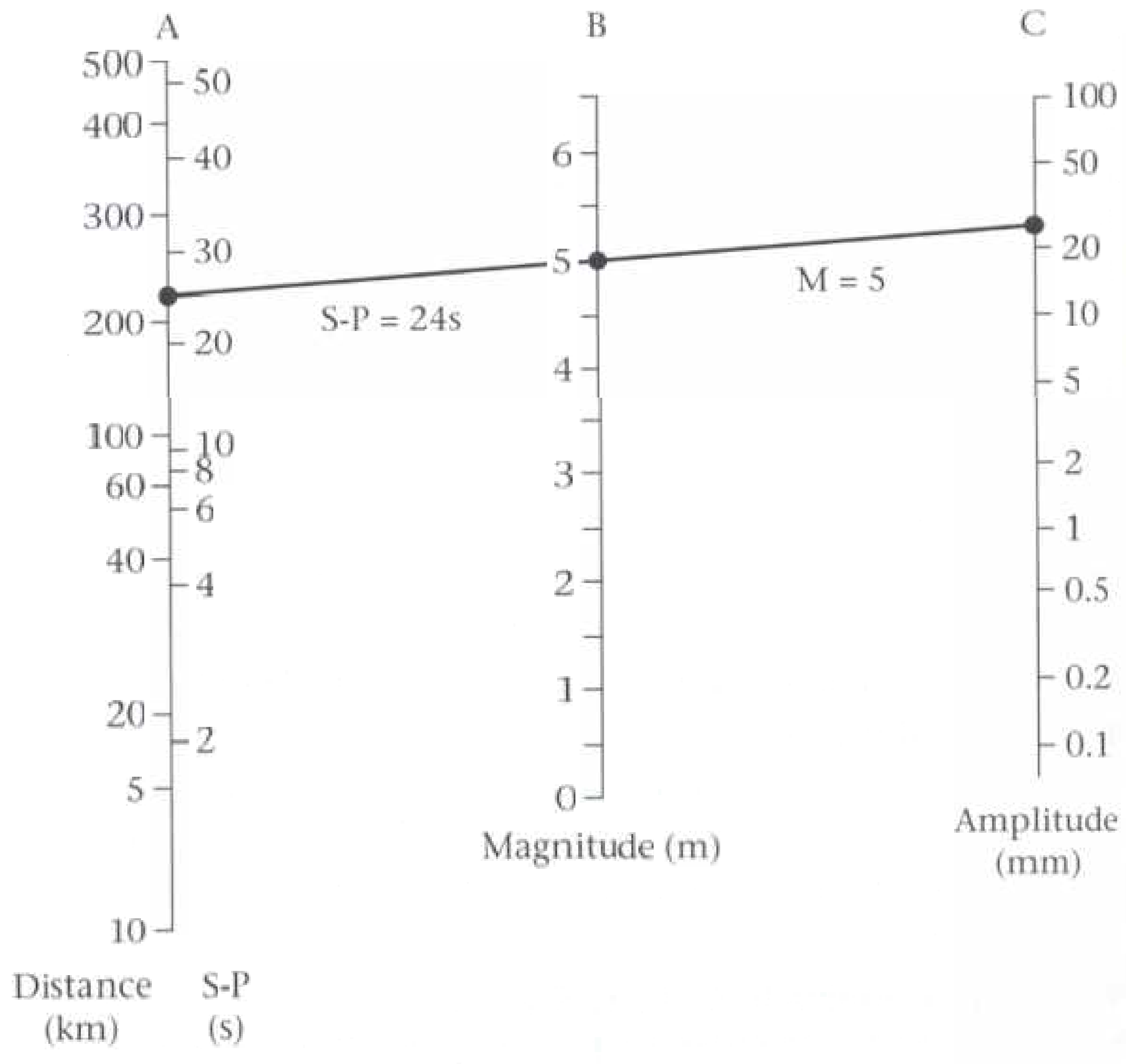
Size of an earthquake

Richter magnitude scale



Size of an earthquake

Richter magnitude scale



Size of an earthquake

Richter magnitude scale

m (M_L)	*Effects*	*Average Number per Year*	*Approximate Energy Equivalent*
8.9	Absolute devastation (M = XII)	0.03	m = 8.9 ≈ 3 billion tons of TNT
8.0–8.8	Nearly total destruction (M = XI)	0.1	m = 8.0 ≈ H-bomb (100 million tons of TNT)
7.4–7.9	Great damage	4	
7.0–7.3	Serious damage	15	
6.2–6.9	Moderate to serious damage	100	
5.5–6.1	Slight to moderate damage	500	m = 6.0 ≈ atomic bomb (100,000 tons of TNT)
4.9–5.4	Felt by all; slight damage	1,400	
4.3–4.8	Felt by many (M = V)	4,800	
3.5–4.2	Felt by some; recorded globally	30,000	m = 4.0 ≈ 100 tons of TNT
2.0–3.4	Not felt but recorded at a distance	800,000	m = 2.0 ≈ lightning bolt
less than 2.0	Not felt; recorded only locally	millions	m = 1.0 ≈ like a 2-ton truck driving by

Based on data from the U.S. Geological Survey.

Where do earthquake Occur?

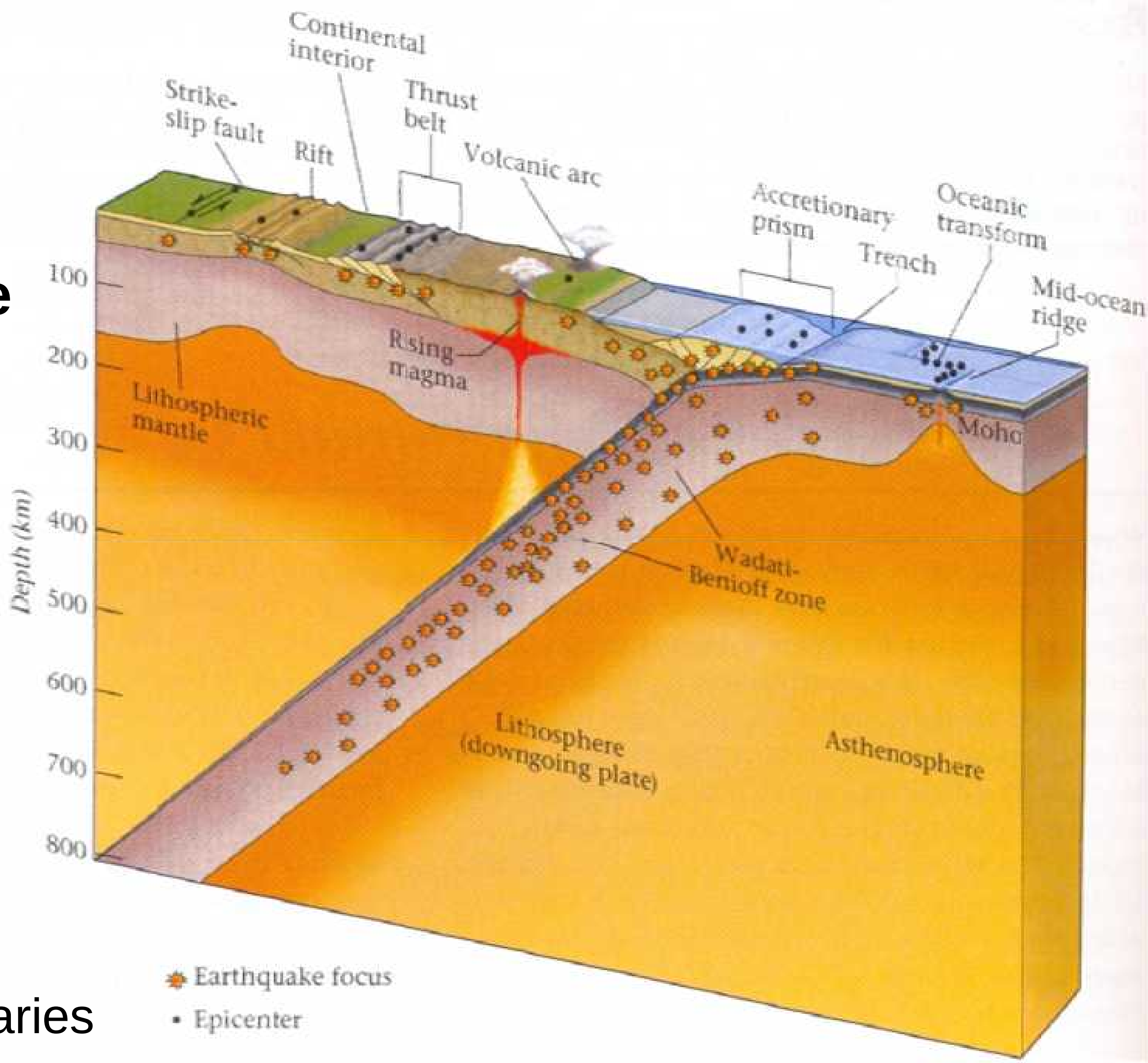


Plate boundaries

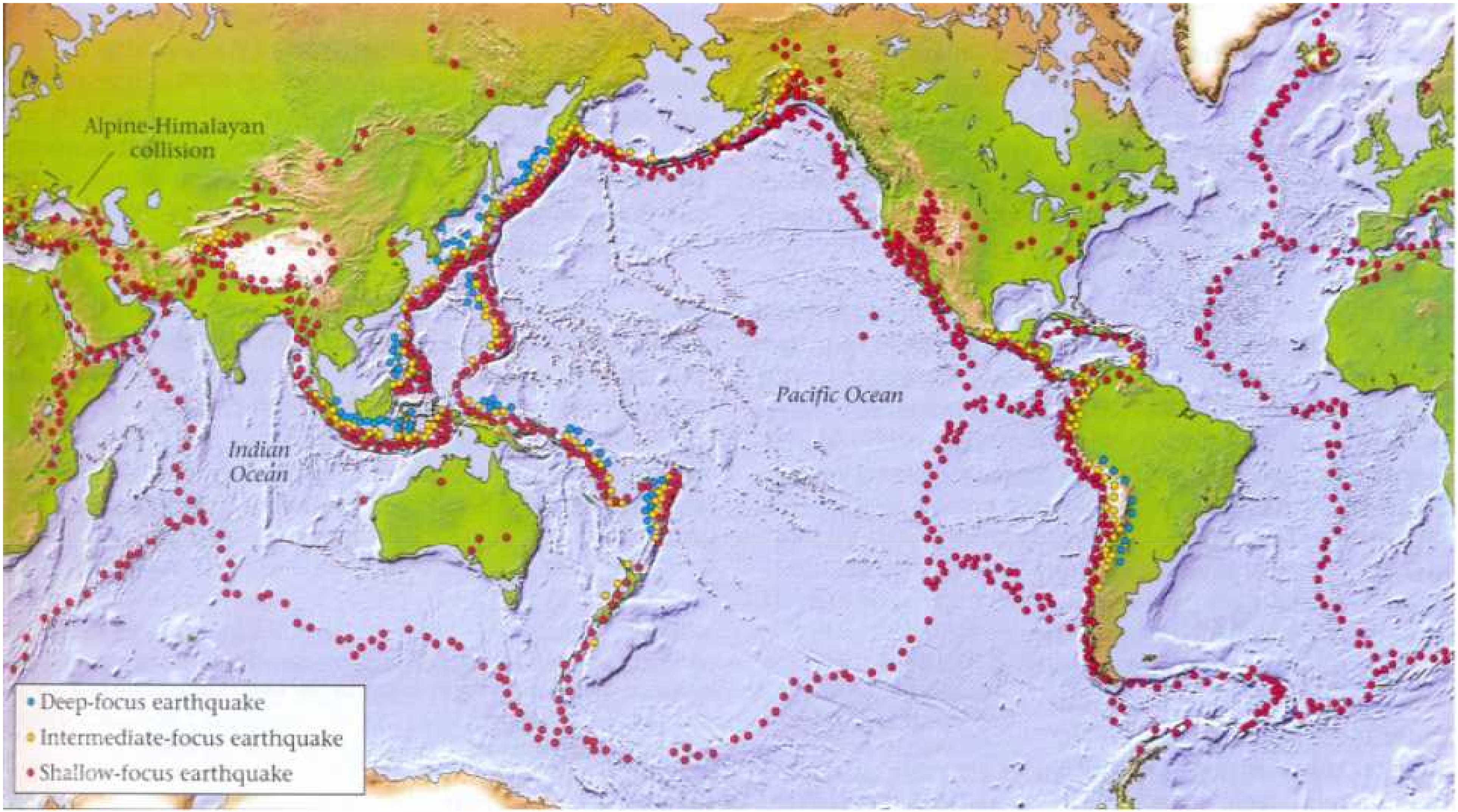
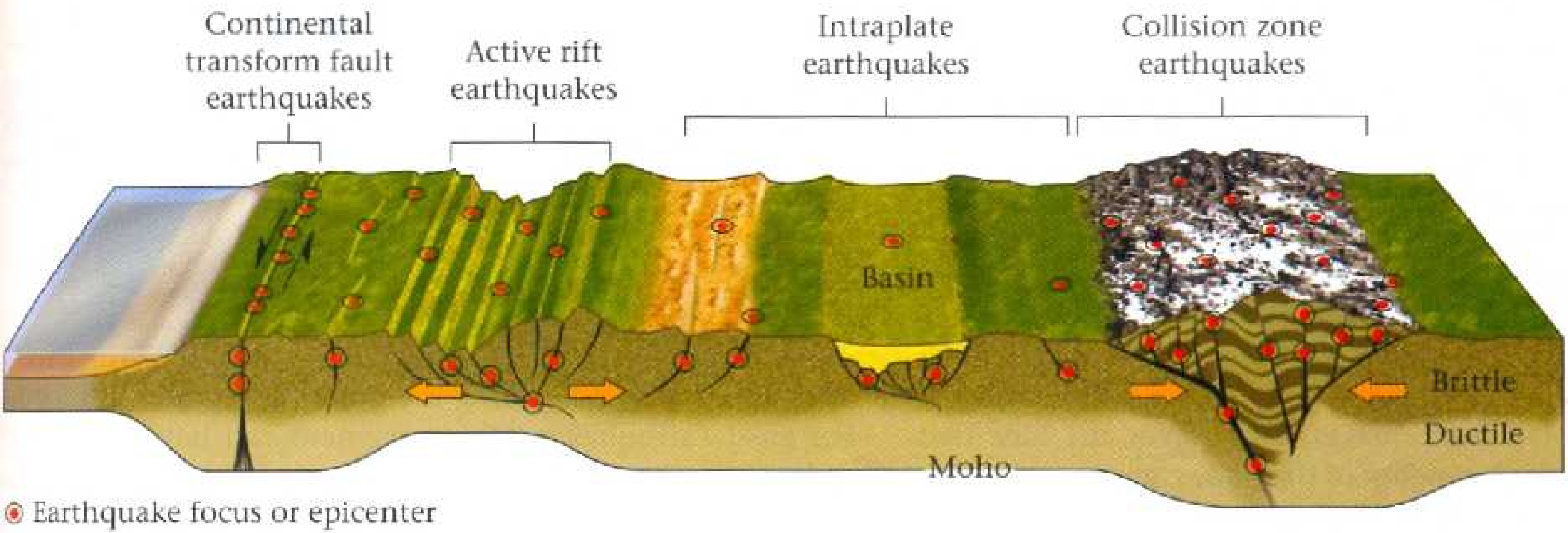


FIGURE 8.17 A map of epicenters shows that most earthquakes occur in distinct belts that define plate boundaries. Epicenters that do not lie along plate boundaries are the result of rifting (in, for example, the western United States and eastern Africa) or collision (along the Alpine-Himalayan collision zones), or are in intraplate settings (the eastern United States and Canada, central Australia, the interior of the Indian Ocean Plate). Intermediate- and deep-focus earthquakes occur only along convergent plate boundaries, except for a few that happen in collisional zones.

Within Plate earthquakes

FIGURE 8.19 Continental earthquakes occur in continental transform faults (such as the San Andreas), in continental rifts (the East African Rift, the Basin and Range Province), in intraplate settings (usually by reactivating old faults), and in collision zones (mountain ranges). Continental earthquakes mostly happen in the brittle crust, at depths of less than about 15 km.



Earthquake Destructiveness

1) Ground shaking and displacements
2) Landslides
3) Sediment liquefaction
4) Fire
5) Tsunamis

Ground shaking and displacement

An elevated bridge, balanced on a single row of columns, simply tipped over during the 1995 Kobe, Japan

earthquake

Landslide

(a)

Liquefaction

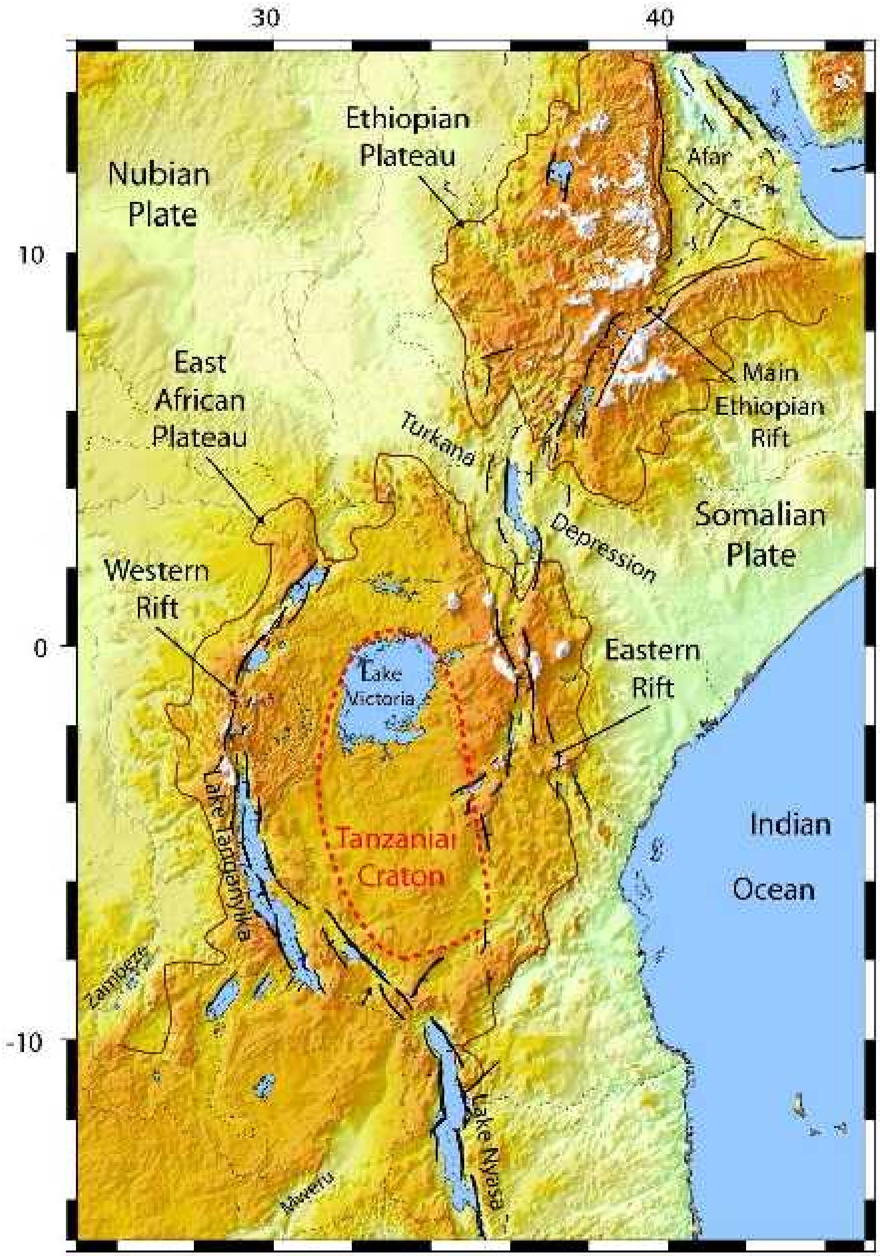
(b)

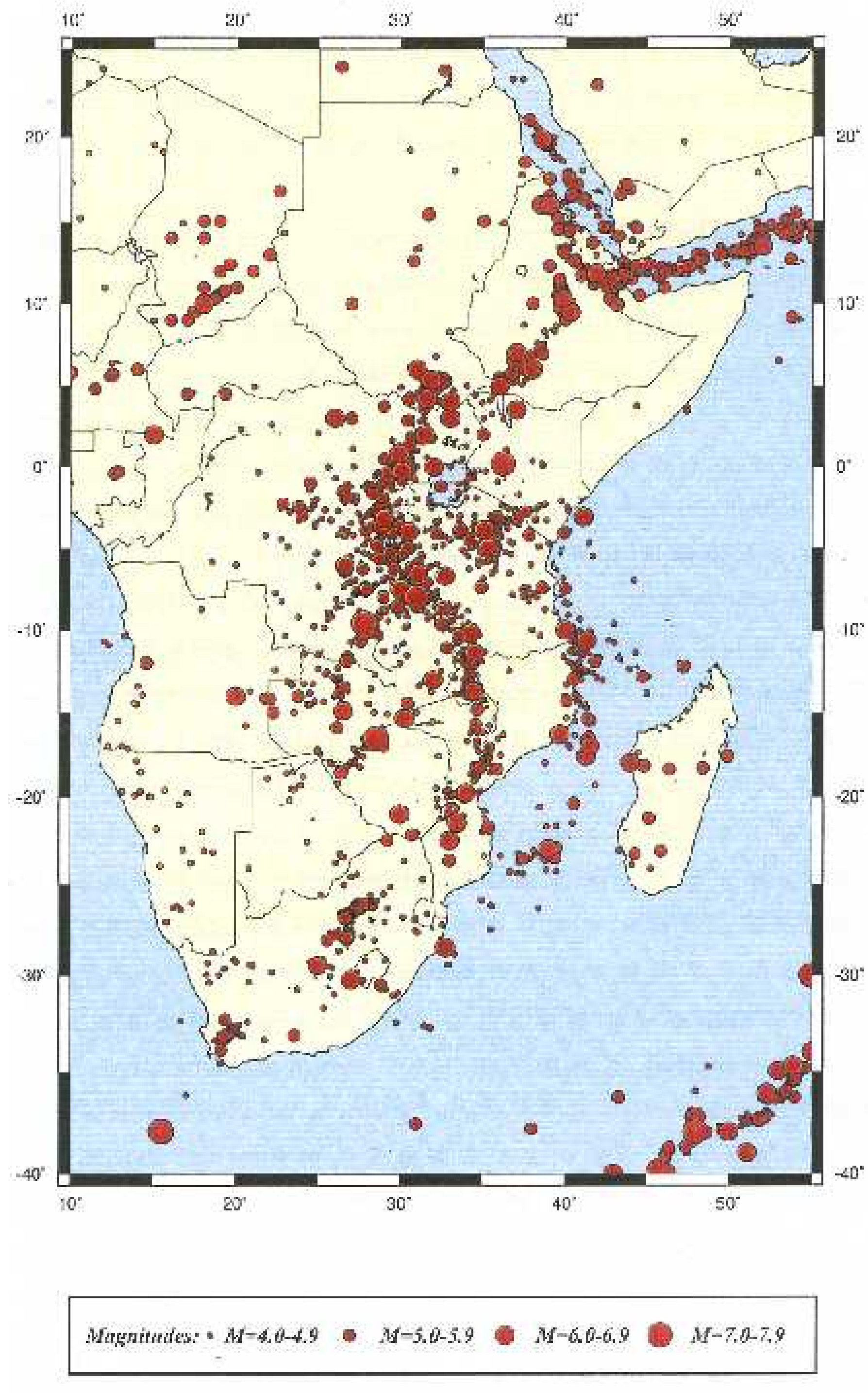
FIGURE 8.24 (a) A landslide along the California coast, triggered by the Northridge earthquake, carried part of a luxury home down to the beach below. (b) The foundation of this apartment in Hsingchung, Taiwan, liquefi during a 1999 earthquake, and the building tipped over.

Fire

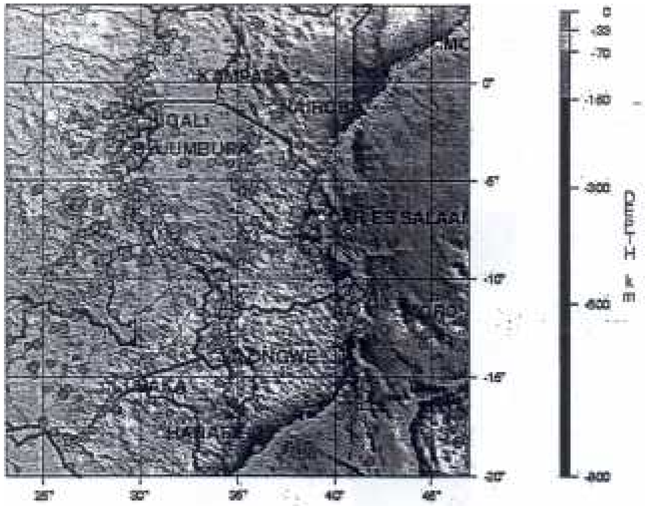
FIGURE 8.26 Fire may consume large areas of toppled buildings after an earthquake.

Earthquakes in the EARS





RUNGWE, 2000 (mb 4.2) BARIADI, 2001 (mb 5.6)



TANZANIA
2001 05 26 19:45:22.4* 8.549S 35.185E Depth: 56D km 4.5mb
Seismicity 1977 - 1997, Plate Boundaries in Yellow
USGS National Earthquake Information Center

Sunday Observer *Online*

www.ippmedia.com

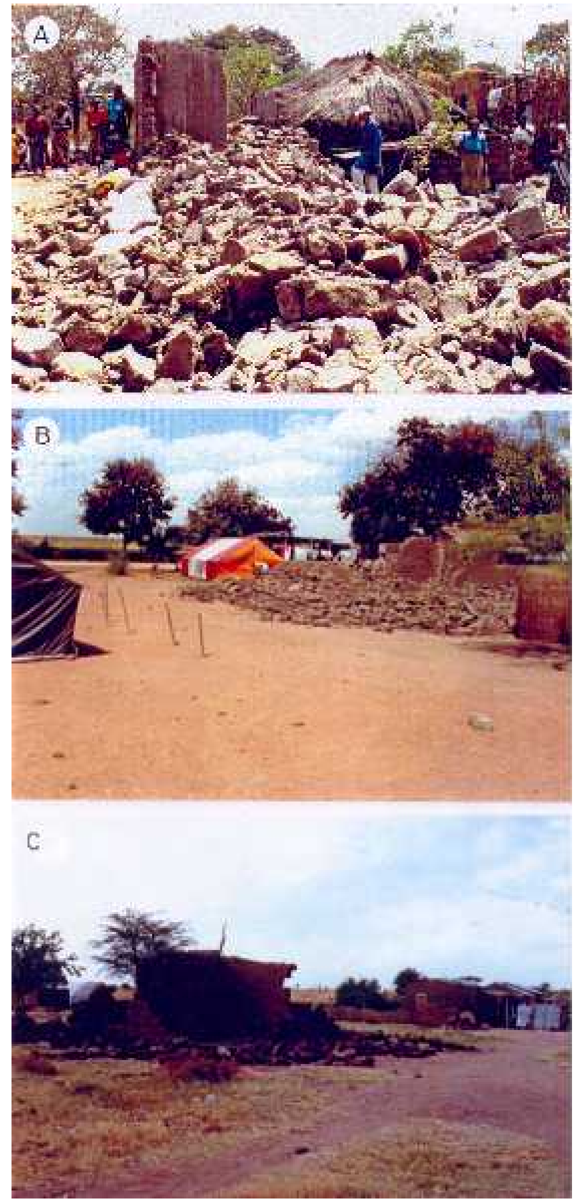
LOCAL NEWS
WORLD
BUSINESS
SPORTS
TELEVISION
RADIO
SPECIAL
IPP GROUP

181 families homeless in Rungwe

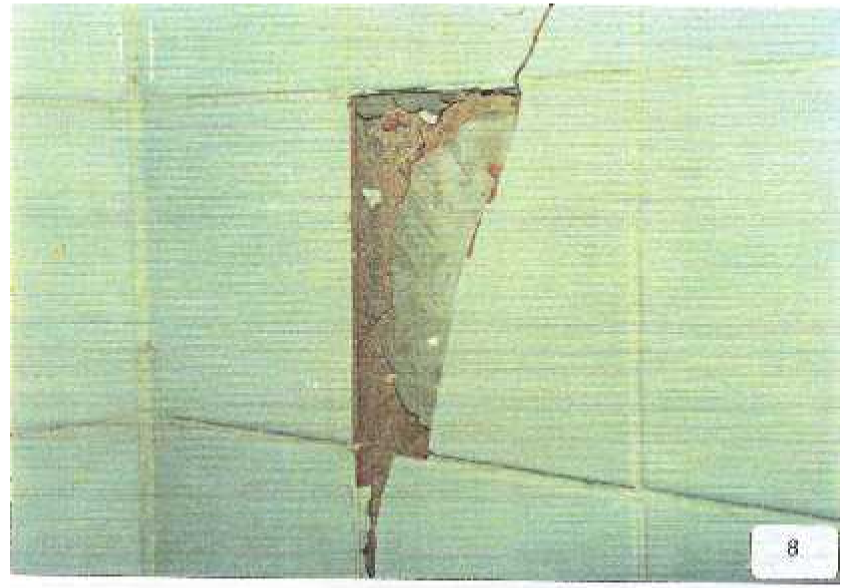
Sunday,

By PST Correspondent, Mbeya

About 181 families at Rungwe district in Mbeya region are homeless following a tremor which hit the area last month.
The Rungwe District Commissioner, Abeid Mwinyimsa, said following the tremor, seven houses were demolished and another 147 were cracked.
The DC named the affected villages as Ndaka, Nditu, Busona, Suma and Ibumba.
Mwinyimsa said the homeless families needed help immediately as some of them have built temporary houses built with tree branches, and roofed with banana leaves.
The tremor also demolished classrooms, a teacher's house and offices of one of the schools in the district.
Mwinyimsa said last month's tremor affected the same areas which were hit last December leaving 8000 people homeless.
He said already the Catholic Church Aid Agency, Caritas, have offered some assistance to the affected people.



NORTH DODOMA, 2002 (mb = 5.6)

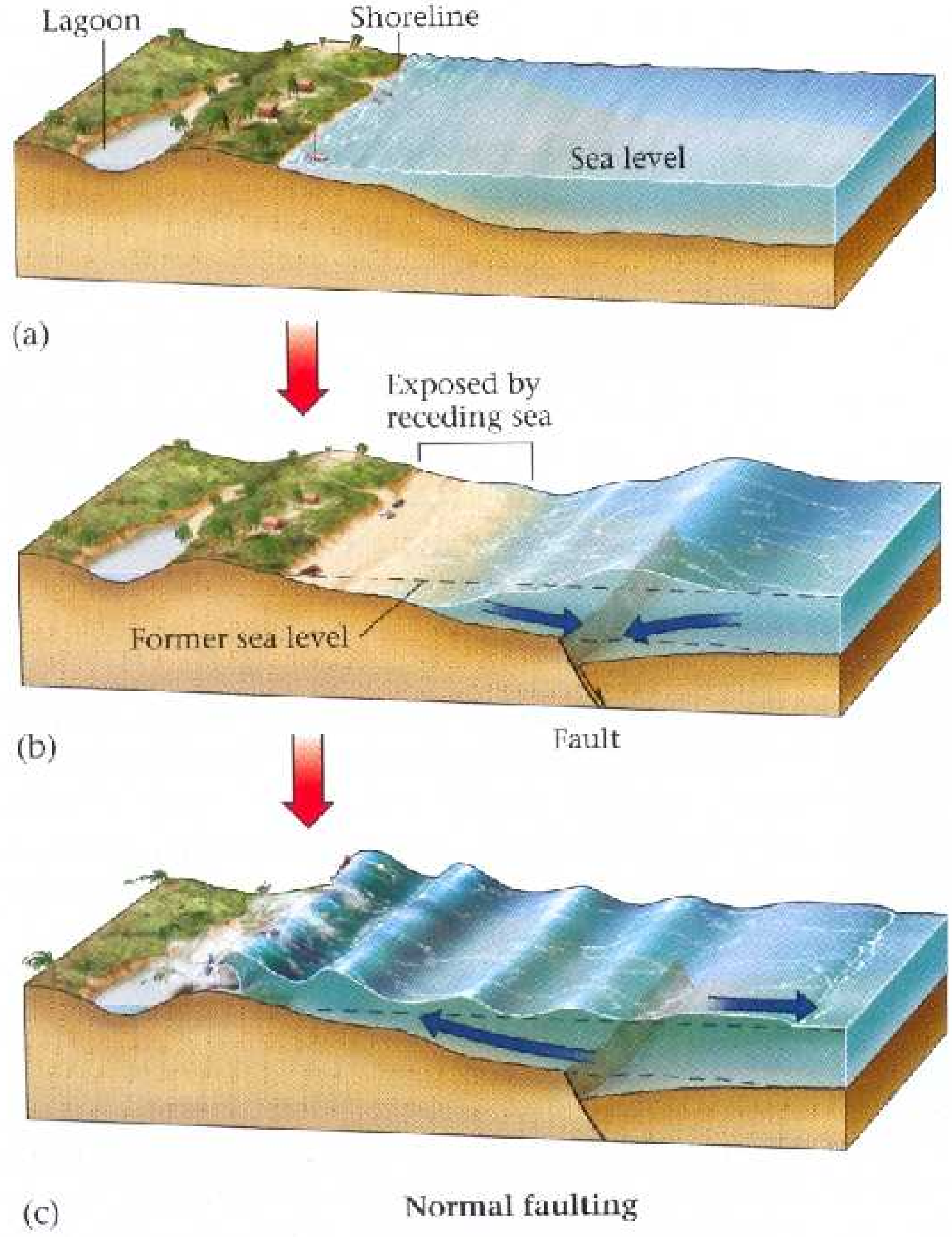


LAKE TANGANYIKA, DEC. 2005 (Mw = 6.8)

- Lake Tsunami
- Destruction on burnt bricks houses
- Shaking of distant high raised buildings in cities of Arusha, Dar es Salaam, Nairobi.

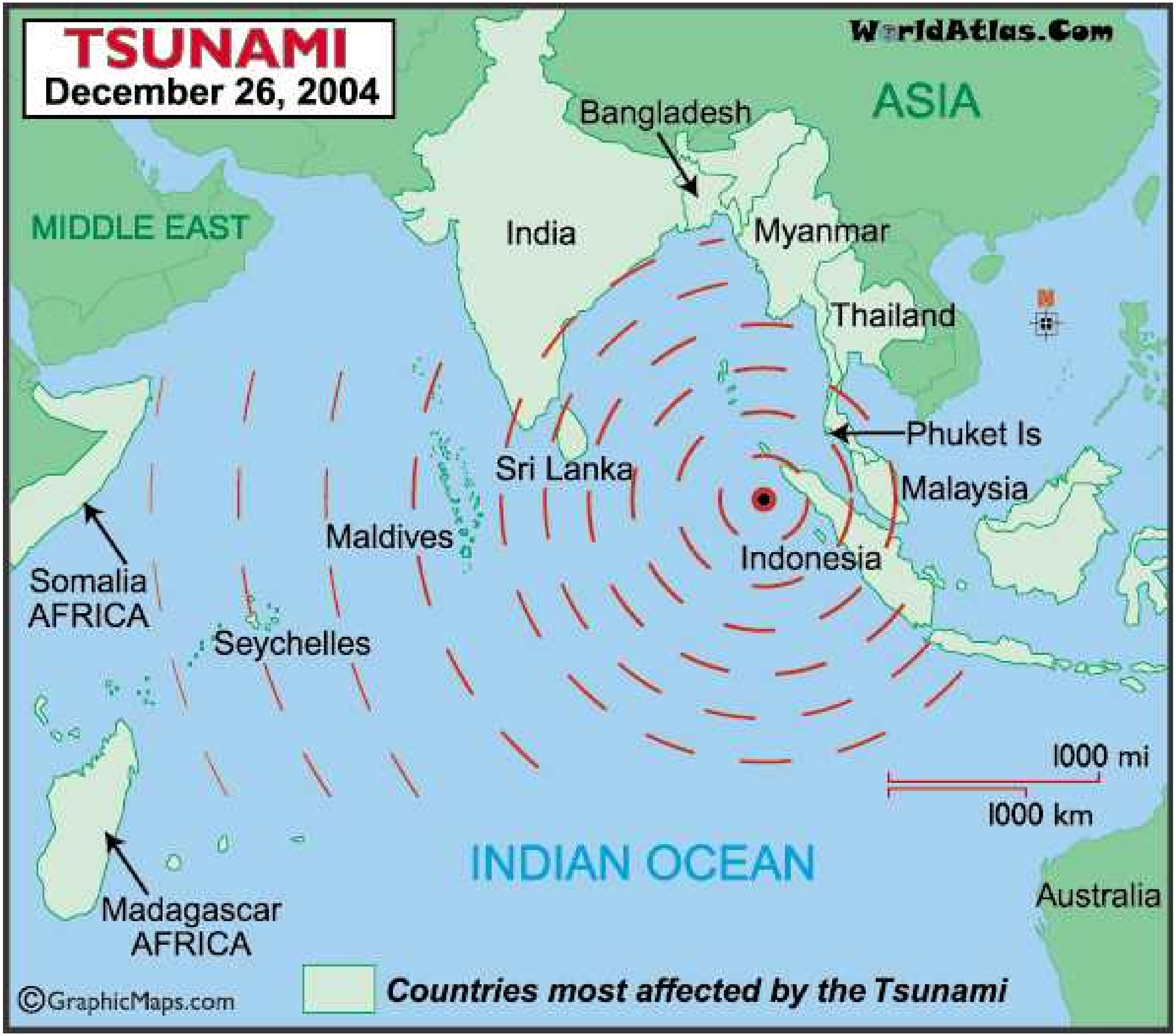



Tsunami


Lagoon
Shoreline
Sea level
(a)
Exposed by receding sea
Former sea level
(b)
Fault
(c)
Normal faulting

Tsunami

FIGURE 18.21 Destruction at Maumere, Flores Island, Indonesia, caused by a tsunami generated during an earthquake on December 12, 1992. Although a warning system exists to alert people on distant coasts to the danger of tsunamis, it cannot yet function rapidly enough to help residents in the epicenter region. *Reuters/Bettman.*


TSUNAMI
December 26, 2004
WorldAtlas.Com
ASIA
Bangladesh
MIDDLE EAST
India
Myanmar
Thailand
Phuket Is
Sri Lanka
Malaysia
Maldives
Indonesia
Somalia
AFRICA
Seychelles
1000 mi
1000 km
INDIAN OCEAN
Australia
Madagascar
AFRICA
©GraphicMaps.com
Countries most affected by the Tsunami

Tsunami

On Sunday, December 26, 2004, a significant earthquake occurred off the western coast of Indonesia’s Sumatra Island.

The powerful earthquake then triggered a tsunami (or tidal wave), that radiated-out across the Indian Ocean for almost 2,000 miles.

The 2004 Indian Ocean tsunami killed over 300,000 people with many bodies either being lost to the sea or unidentified.

Tsunami are not rare, with at least 25 tsunami occurring in the last century. Of these, many were recorded in the Asia–Pacific region—particularly Japan.

Tsunami

A devastated Marina beach in Chennai after the Indian Ocean Tsunami

POWERFUL EARTHQUAKES

Qinghai, China, 14 April, 2010: 6.9 Magnitute, focus at 10 km deep, killed 400 people

Chile North of Concepcion, 27 February 2010: 8.8 magnitude massive earthquake struck. kills at least 450

Haiti, 12 Jan 2010: About **230,000 people die** after shallow **7.0 magnitude** quake

Sumatra, Indonesia, 26 Dec 2004: 9.2 magnitude. Triggers Asian tsunami that kills nearly **250,000 people**

Alaska, US, 28 March 1964: 9.2 magnitude; **128 people** killed. Anchorage badly damaged

Chile, south of Concepcion, 22 May 1960: 9.5 magnitude. About **1,655 deaths**. Tsunami hits Hawaii and Japan.

Kamchatka, NE Russia, 4 Nov 1952: **9.0** magnitude

Pakistan Earthquake

Reports said the quake was felt across Pakistan and as far away as Delhi, India, and the Gulf emirates of Dubai and Qatar, BBC news January 19,2011.