Lecture # 8

Structural Geology

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Structural Geology

- **The branch of geology that deals with:**
  - **Form, arrangement and internal architecture of rocks**
  - **Description, representation, and analysis of structures from the small to moderate scale**
  - **Reconstruction of the motions of rocks**

- **Structural geology provides information about the conditions during regional deformation using structures**

Structural Geology

- Structural geologists are concerned with why parts of the Earth have been bent into folds and others have been broken by faults.
- Mapping of these structures provides important information to land managers and mineral exploration.
- Understanding of these features help us understand the dynamic Earth.

Sub-disciplines of Structural Geology

- **Field Relations**
  - Make accurate geologic maps
  - Measure orientations of small structures to inform us of the shape of larger structures
  - Study the sequence of development and superposition of different kinds of structures
- **Rock Mechanics –** the application of physics to the study of rock materials.
- **Tectonic and Regional Structural Geology –** Study of mountain ranges, parts of entire continents, trenches and island arcs, oceanic ridges

Definitions

- **Tectonics**: Study of the **origin and geologic evolution** (history of motion and deformation) of large areas (regional to global) **of the Earth's lithosphere** (e.g., origin of continents; building of mountain belts; formation of ocean floor)

- **Structural Geology**: **Study of deformation in rocks at scales ranging from submicroscopic to regional (micro-, meso-, and macro-scale)**

Structural Geologist

- A geologist who:
  - Studies deformation of rock and Earth's crust
  - Identifies and interprets geological structures and their tectonic implications

Field Tectonic Studies

- Many tectonic problems are approached by studying structures at outcrop scale, and smaller (microscopic) or larger (100's to 1000's of km) scales

- Systematically observe/record the patterns of rock structures (e.g., fault, fold, foliation, fracture). This gives the geometry of the structures.

Tectonics vs. Structural Geology

- Both are concerned with the reconstruction of the motions that shape the outer layers of earth
- Both deal with motion and deformation in the Earth's crust and upper mantle
- Tectonic events at all scales produce deformation structures
- These two disciplines are closely related and interdependent

Applications of Structural Geology

- Engineering Issues
  - Bridges
  - Dams
  - Power Plants
  - Highway Cuts
  - Large Buildings
  - Airports

Applications of Structural Geology

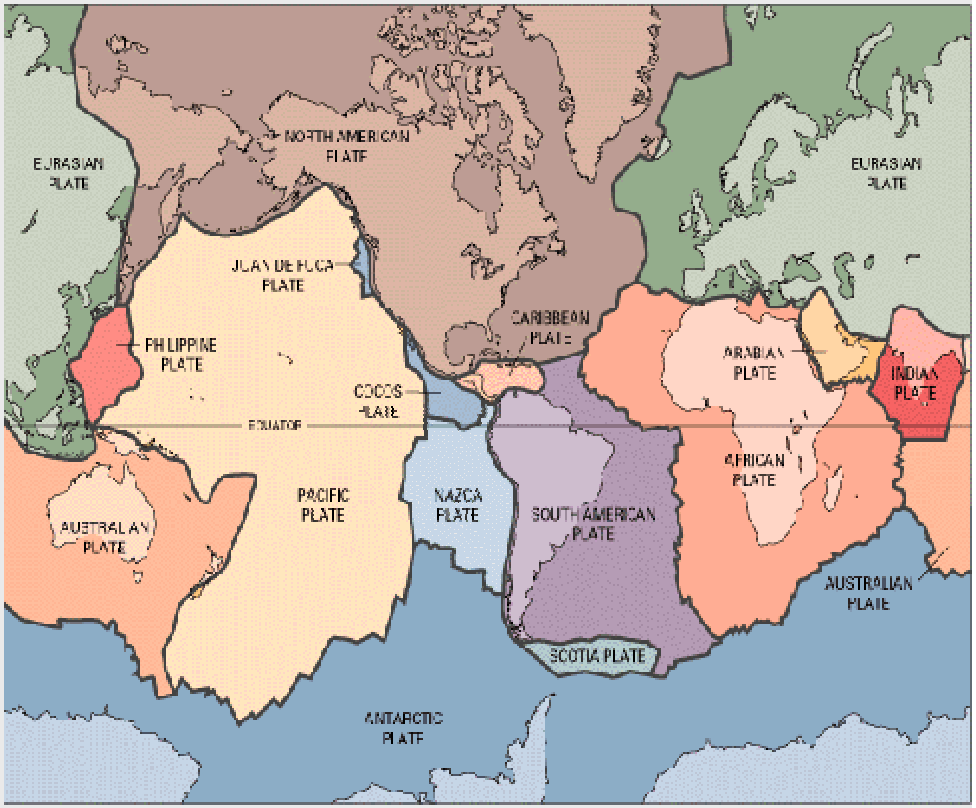
- Environmental Issues
  - Earthquake hazard
  - Location of landfill sites
  - Contamination cleanup
  - Distribution of groundwater
  - Mineral exploration

Scale in Structural Geology

- **Microscopic** – Need magnification
  - Foliation, Micro folds
- **Mesoscopic** – Hand specimens and outcrops
  - Foliation, Folds, Faults
- **Macroscopic** – Mountainside to map levels
  - Basins, domes, Metamorphic Core Complexes

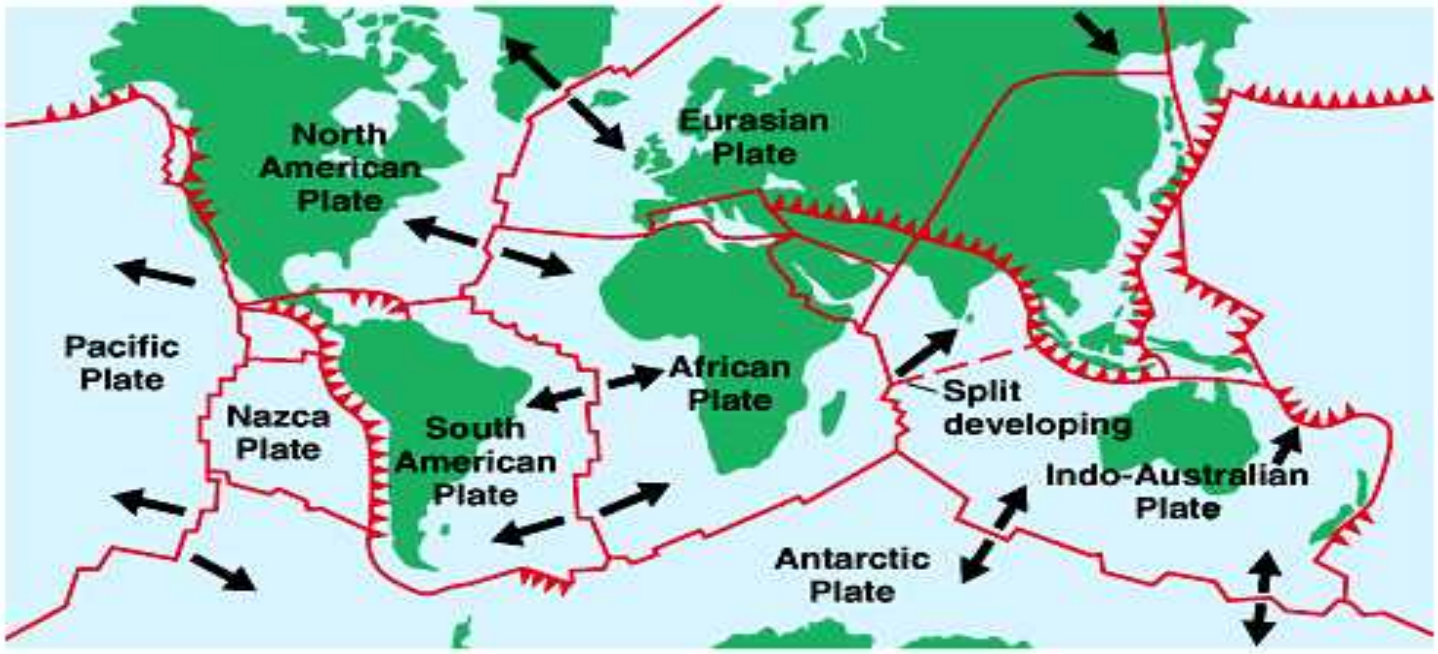
Plate Tectonics

- Theory of Plate Tectonics
  - The surface of the Earth is composed of about a dozen major rigid, moving crustal plates and several smaller plates
  - **Continental Drift** – states that the continents have drifted and still are drifting apart.

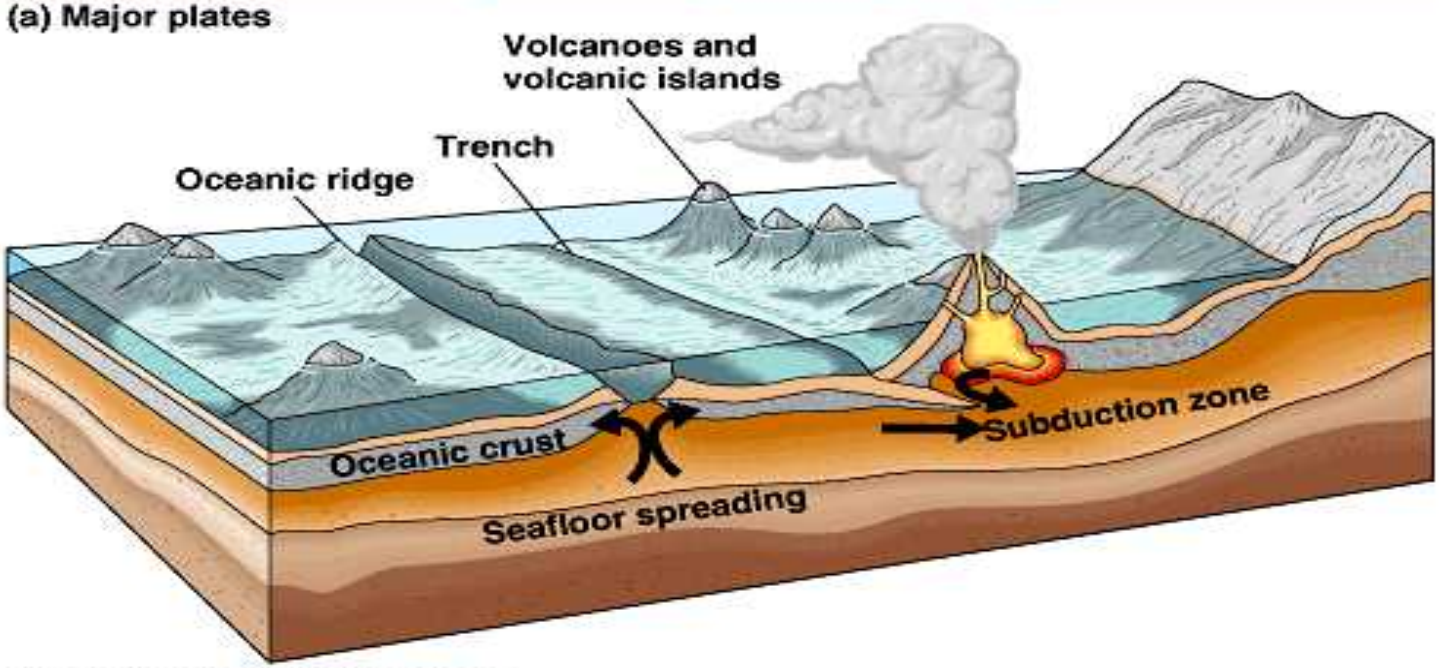


Why do the plates move?

1. Due to tremendous heat, rock in the asthenosphere is like hot taffy
2. This allows plates to ride on top of hot, flowing rock.
3. Plates move because heat is being released from deep inside the earth.
4. Convection currents causes hot material to rise and expand (plates diverge) and cooler material to sink and contract (plates converge).



(a) Major plates



(b) Events at plate boundaries

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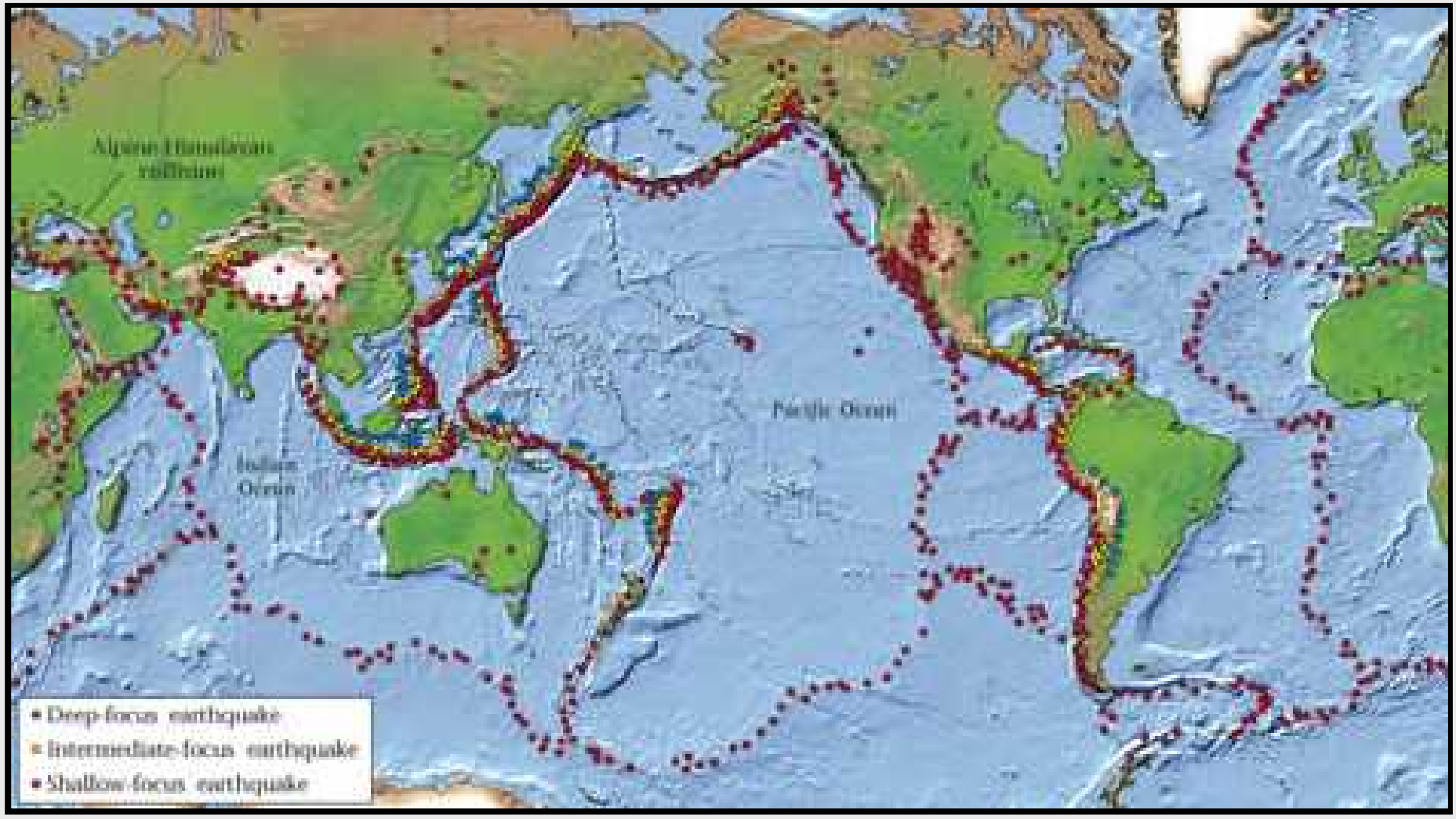
EARTHQUAKE :

An earthquake is an sudden tremor or movement of earth crust which originates naturally below the earth surface.

Global Earthquake Locations



Earthquakes

- **Shaking of earth due to movement of rocks along a fault.**
- **Rocks under stress accumulate strain energy over time.**
- **When stress exceeds strength of rocks, rock breaks.**
- **Strain energy is released as seismic waves. The longer that energy is stored up and is maintained without release, the more likely that a strong earthquake will occur.**

Types of seismic waves

1. **Body waves -- travel through interior**
2. **Surface waves -- travel on surface of earth**

Specific Body Waves

Primary or "P" Waves: Primary waves Highest velocity

Causes compression and expansion in direction of wave travel.

Secondary or "S" Waves: Secondary or shear waves

Slower than P waves but faster than surface waves.

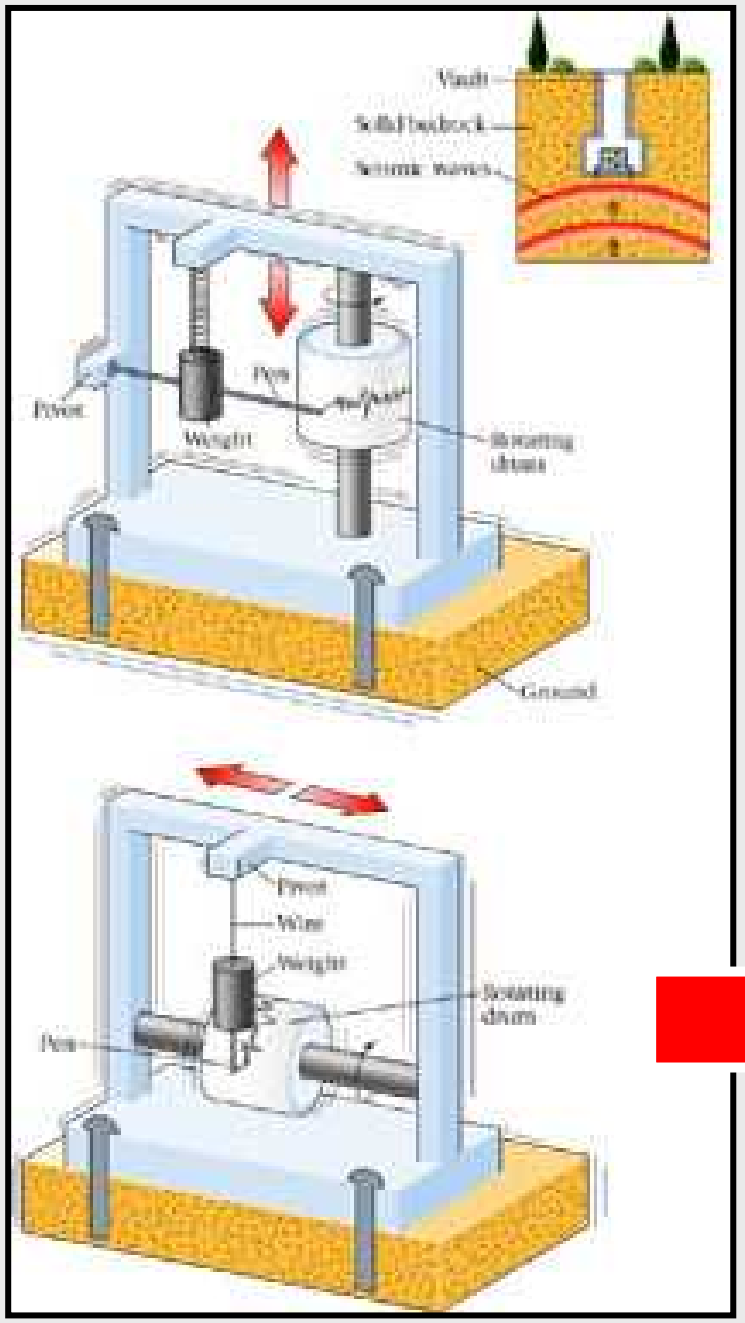
Causes shearing of rock perpendicular to direction of wave propagation -Cannot travel through liquids

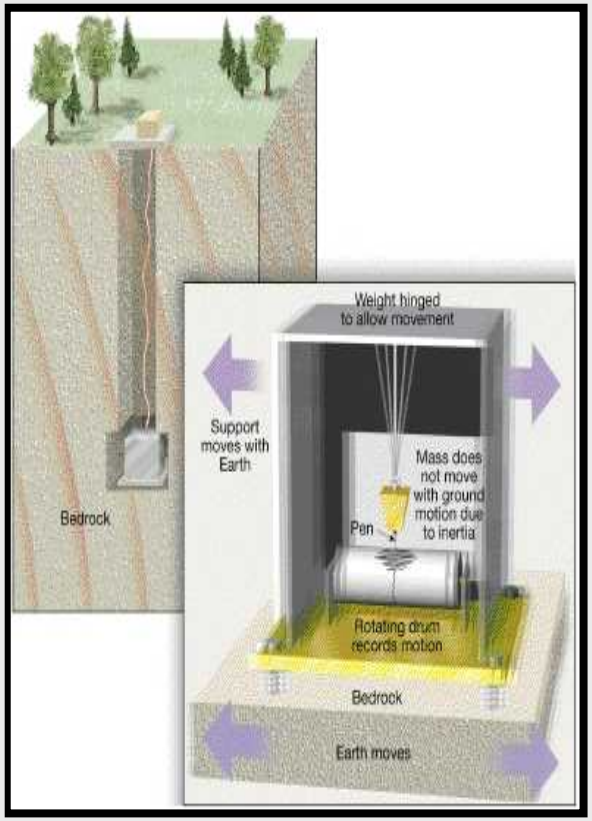
Surface Waves or "Love" ("L") Waves

Cause vertical & horizontal shaking

Travel exclusively along surface of earth

Types of Seismographs



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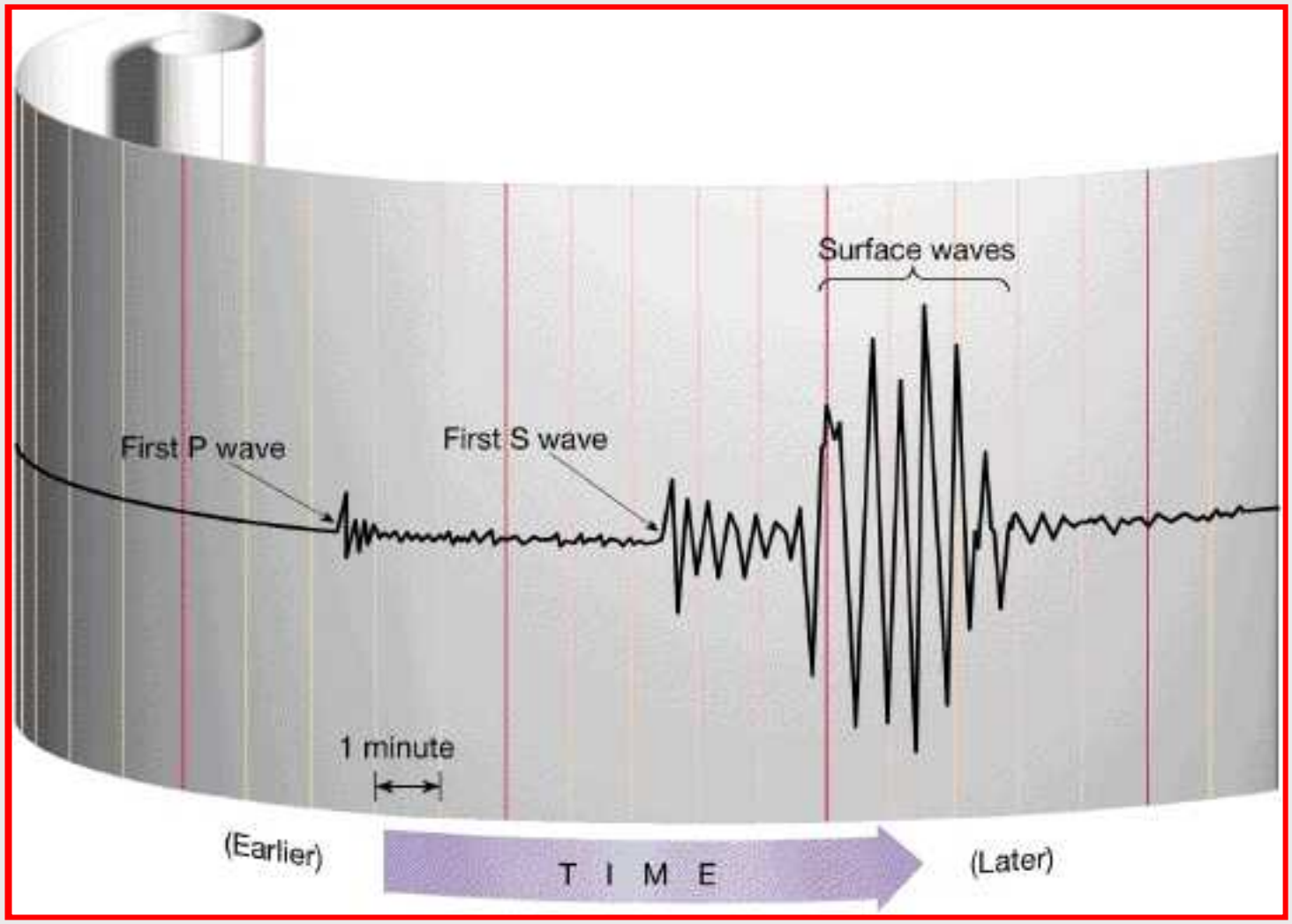
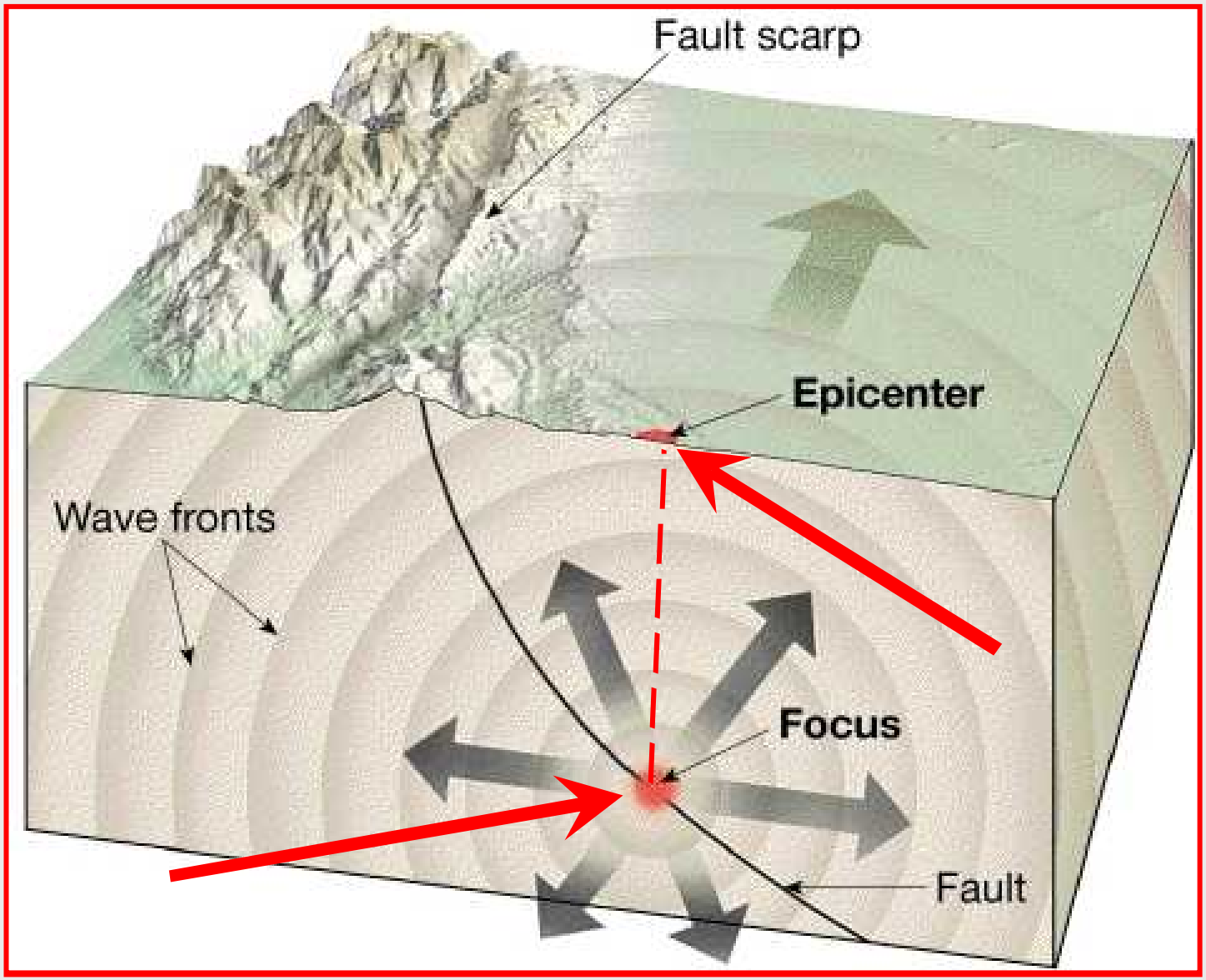
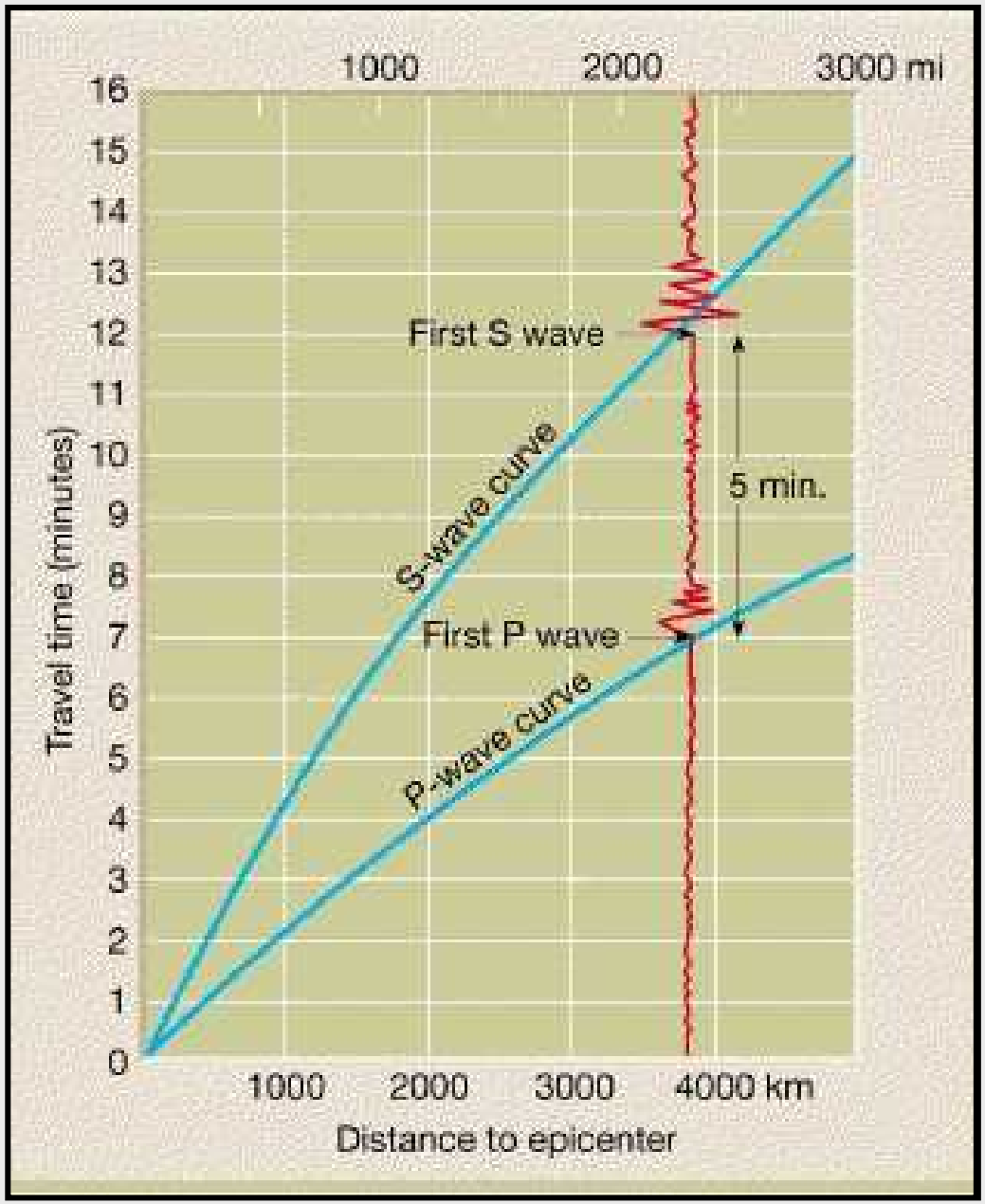
Seismogram Printout



- **FOCUS :**
- FOCUS The place where the energy is released . It is also known as hypocenter.
- **EPICENTRE :**
- EPICENTRE The point on the earth surface vertically above the focus. Given a geographic location
-

Focus and Epicenter of Earthquake





Time-Travel Curve

Determining the magnitude of an earthquake

Magnitude -- measure of energy released during earthquake. There are several different ways to measure magnitude.

Most common magnitude measure is **Richter Magnitude**, named for the renowned seismologist, Charles Richter.

Richter Magnitude:

- Measure amplitude of largest S wave on seismograph record.
- Take into account distance between seismograph & epicenter.

Richter Scale

- Logarithmic numerical (NOT a physical) scale
- Increasing one whole unit on Richter Scale represents 10 times greater magnitude.
- Going up one whole unit on Richter Scale represents about a 30 times greater release of energy.

Intensity

- Intensity refers to the amount of damage done in an earthquake
- Mercalli Scale is used to express damage.

Hazards associated with Quakes

- Shaking:

  Frequency of shaking differs for different seismic waves.

  High frequency body waves shake low buildings more.

  Low frequency surface waves shake high buildings more.

  Intensity of shaking also depends on type of subsurface material.

  Unconsolidated materials amplify shaking more than rocks do.

  Fine-grained, sensitive materials can lose strength when shaken. They lose strength by ***liquefaction***.

Buildings respond differently to shaking depending on construction styles, materials

Wood -- more flexible, holds up well

Earthen materials -- very vulnerable to shaking.

- Ground displacement:

  Ground surface may shift during an earthquake (esp. if focus is shallow).

  Vertical displacements of surface produce ***fault scarps***.

- Tsunamis (NOT tidal waves)

  Tsunamis are huge waves generated by earthquakes undersea or below coastal areas.

  If earthquake displaces sea surface, wave is generated that can grow as it moves over sea surface.

- Fires

  Usually occurs from shifting of subsurface utilities (gas lines)

Earthquakes and volcanic activity

- Earthquakes often occur in volcanic regions and are caused there, both by tectonic faults and the movement of magma in volcanoes.

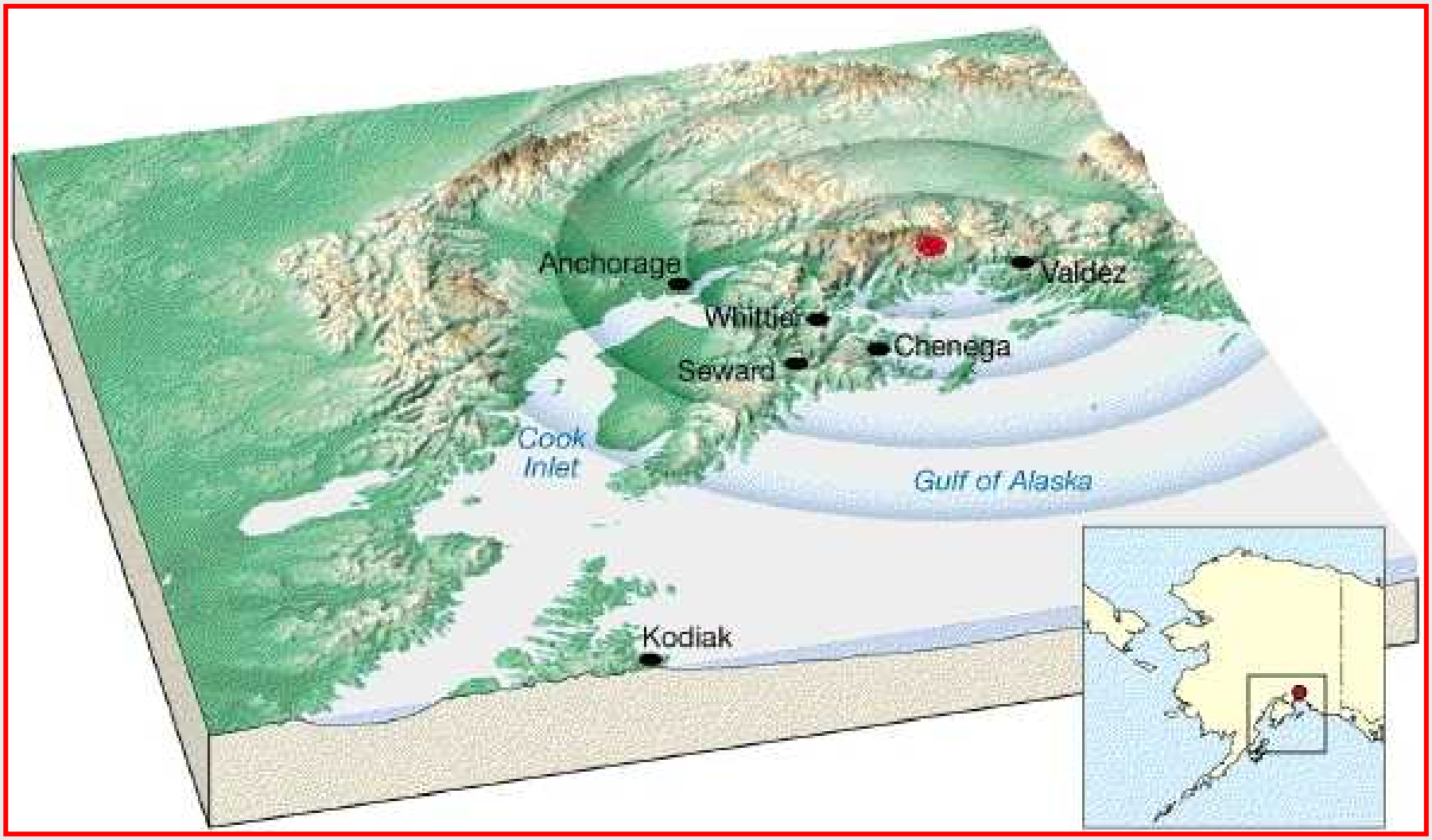
- Such earthquakes can serve as an early warning of volcanic eruptions, as during the Mount St. Helens eruption of 1980

- Earthquake swarms can serve as markers for the location of the flowing magma throughout the volcanoes.

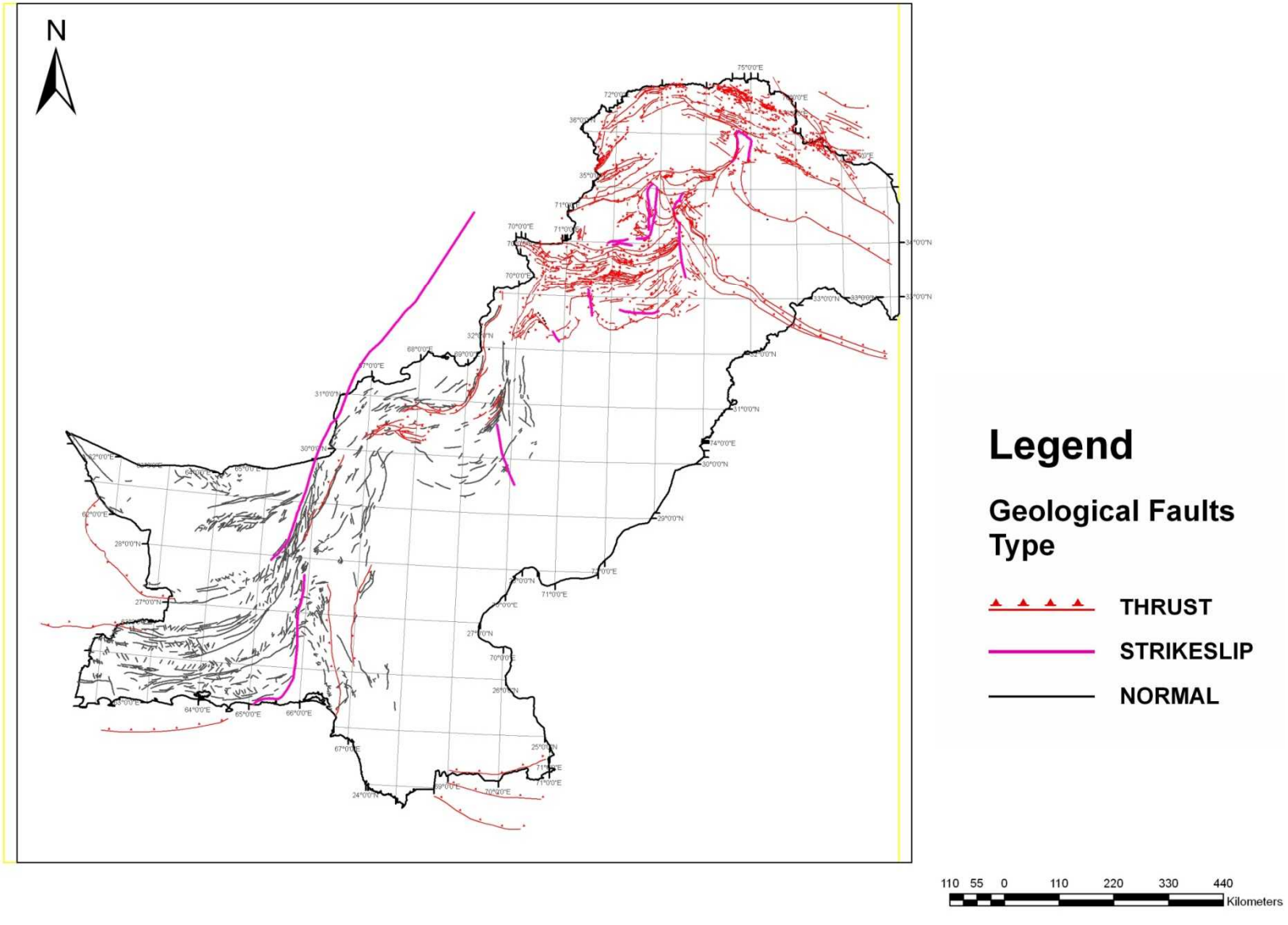
- These swarms can be recorded by seismometers and tiltmeters (a device which measures the ground slope) and used as sensors to predict imminent or upcoming eruptions

World's Largest Earthquake: 1964 Anchorage, Alaska

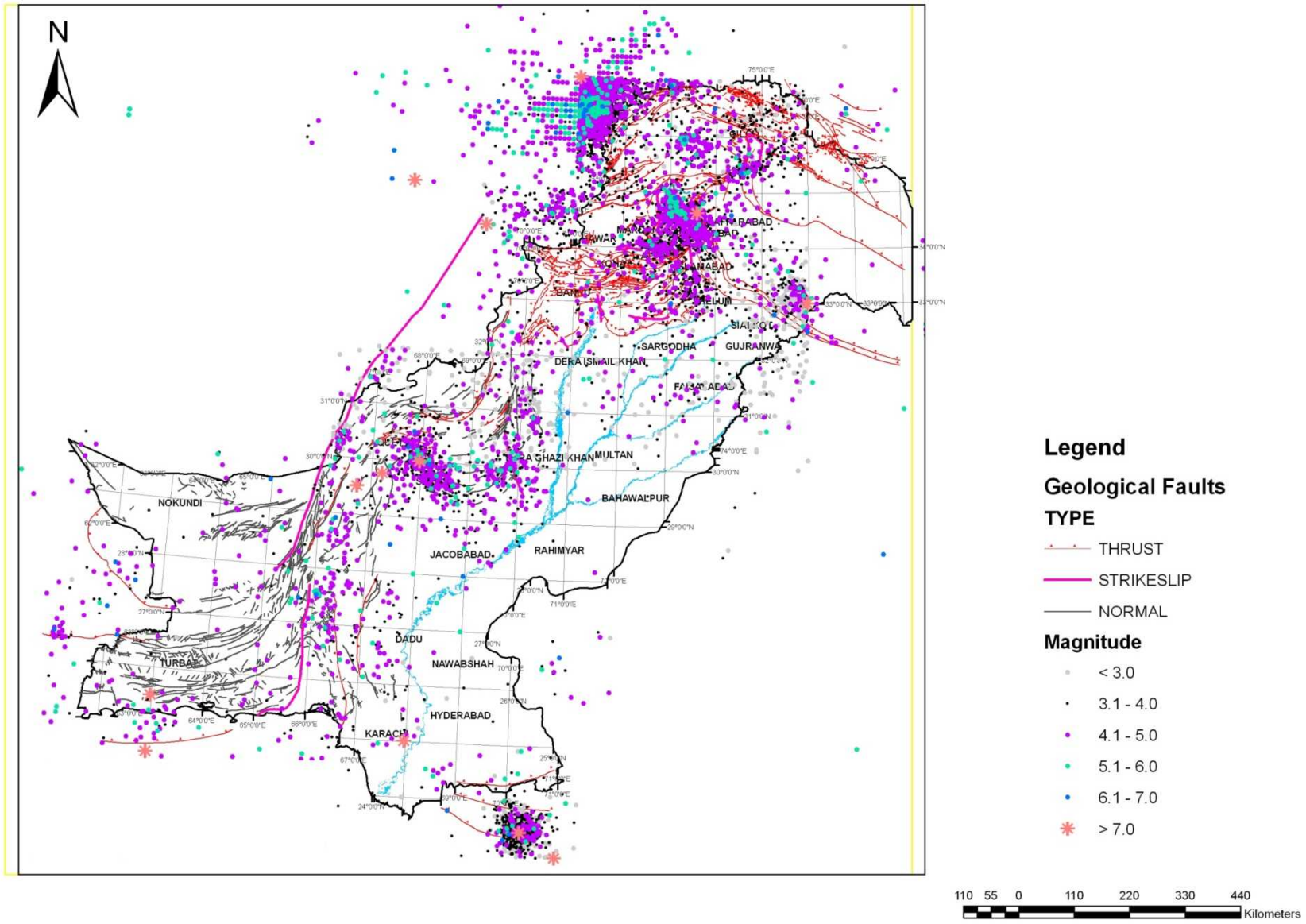
Registered 8.6 on Richter Scale



FAULT MAP OF PAKISTAN



SEISMOTECTONIC MAP OF PAKISTAN



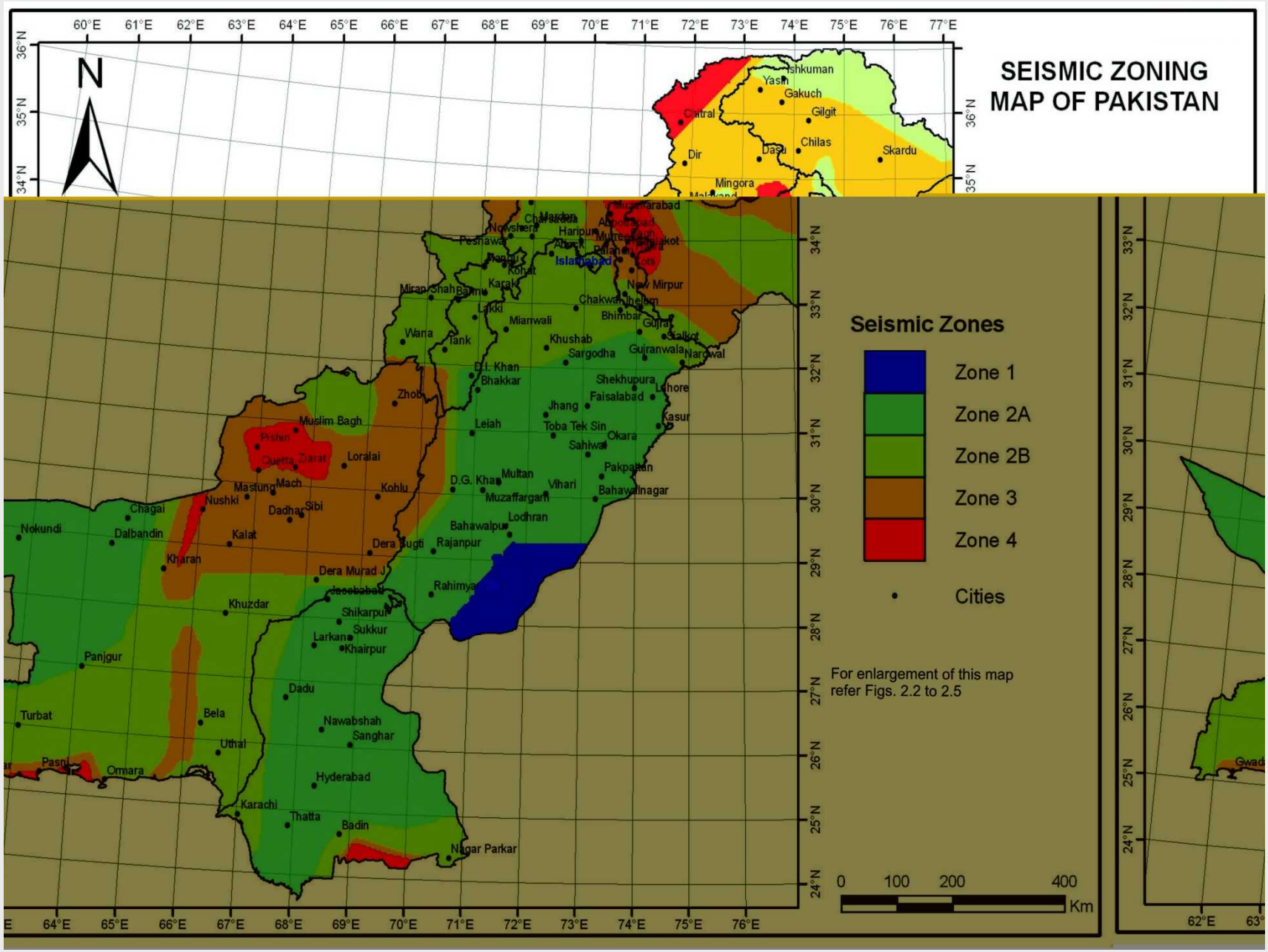
SEISMIC ZONING MAPS

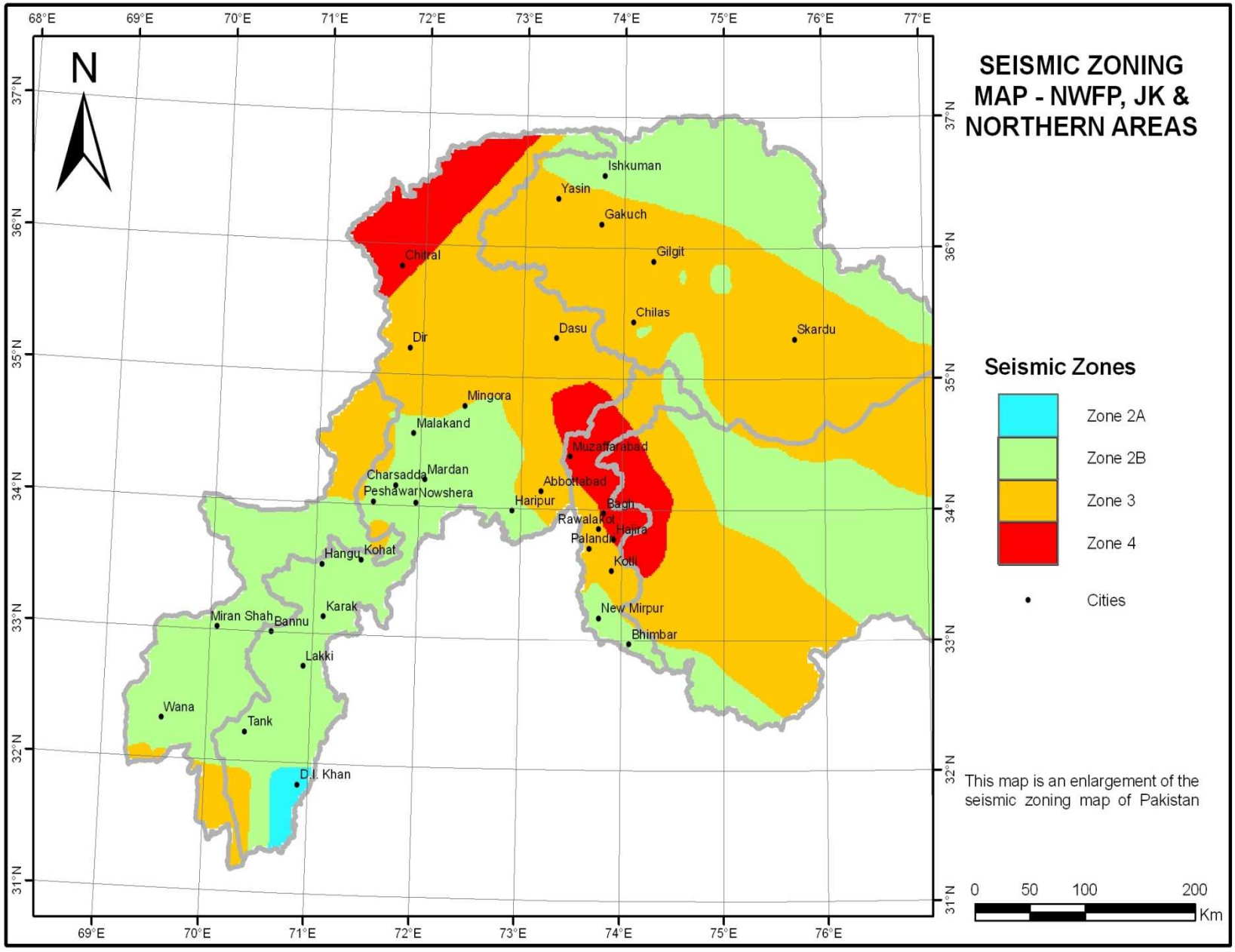
- **ALL POSSIBLE SEISMIC SOURCES WERE CONSIDERED**
- **PROBABILISTIC HAZARD ANALYSIS WAS MADE USING LATEST SOFTWARE**
- **GROUND MOTION WITH 10% PROBABILITY OF EXCEEDANCE IN 50 YEARS (RETURN PERIOD 500 YEARS) WERE CALCULATED AT A GRID OF 0.1 DEGREE**
- **SEISMIC ZONING MAP FOR PAKISTAN WAS PREPARED USING ABOVE EXHAUSTIVE WORK WHICH DIVIDED THE COUNTRY INTO FIVE ZONES, FOLLOWING UBC-1997.**

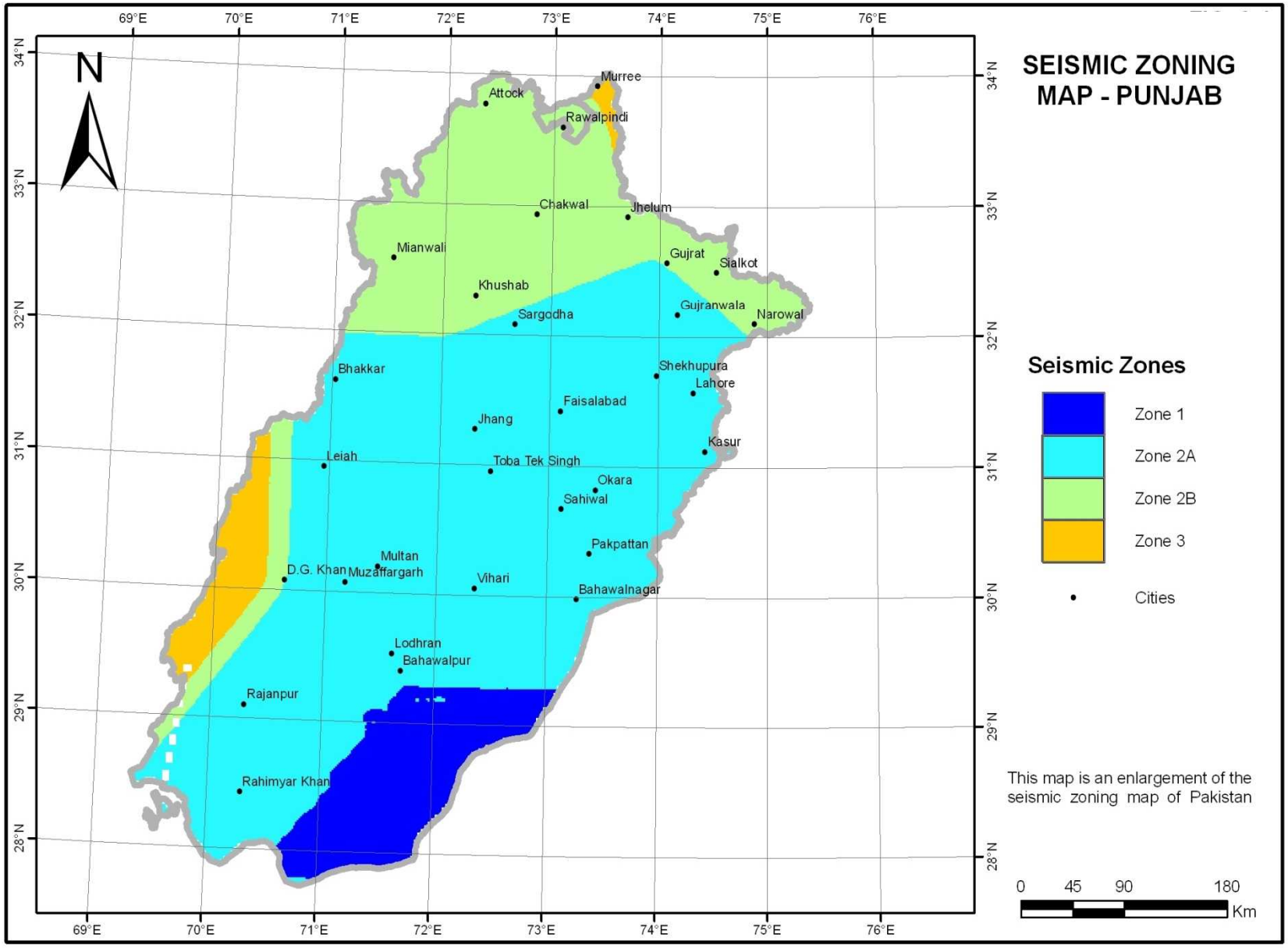
BASIS OF SEISMIC ZONING

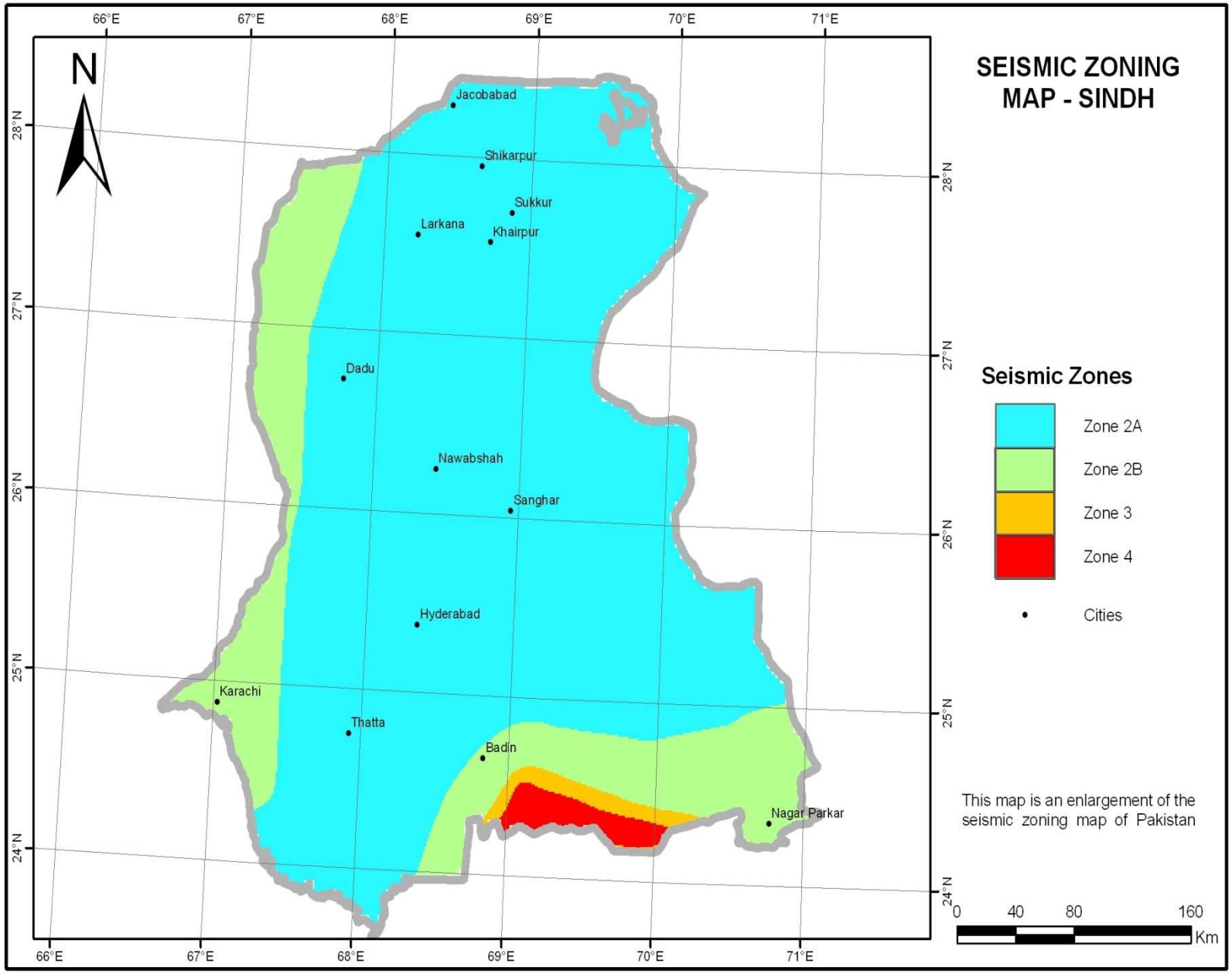
SEISMIC ZONE	PEAK HORIZONTAL GROUND ACCELERATION
1	0.05 to 0.08g
2A	0.08 to 0.16g
2B	0.16 to 0.24g
3	0.24 to 0.32g
4	> 0.32g

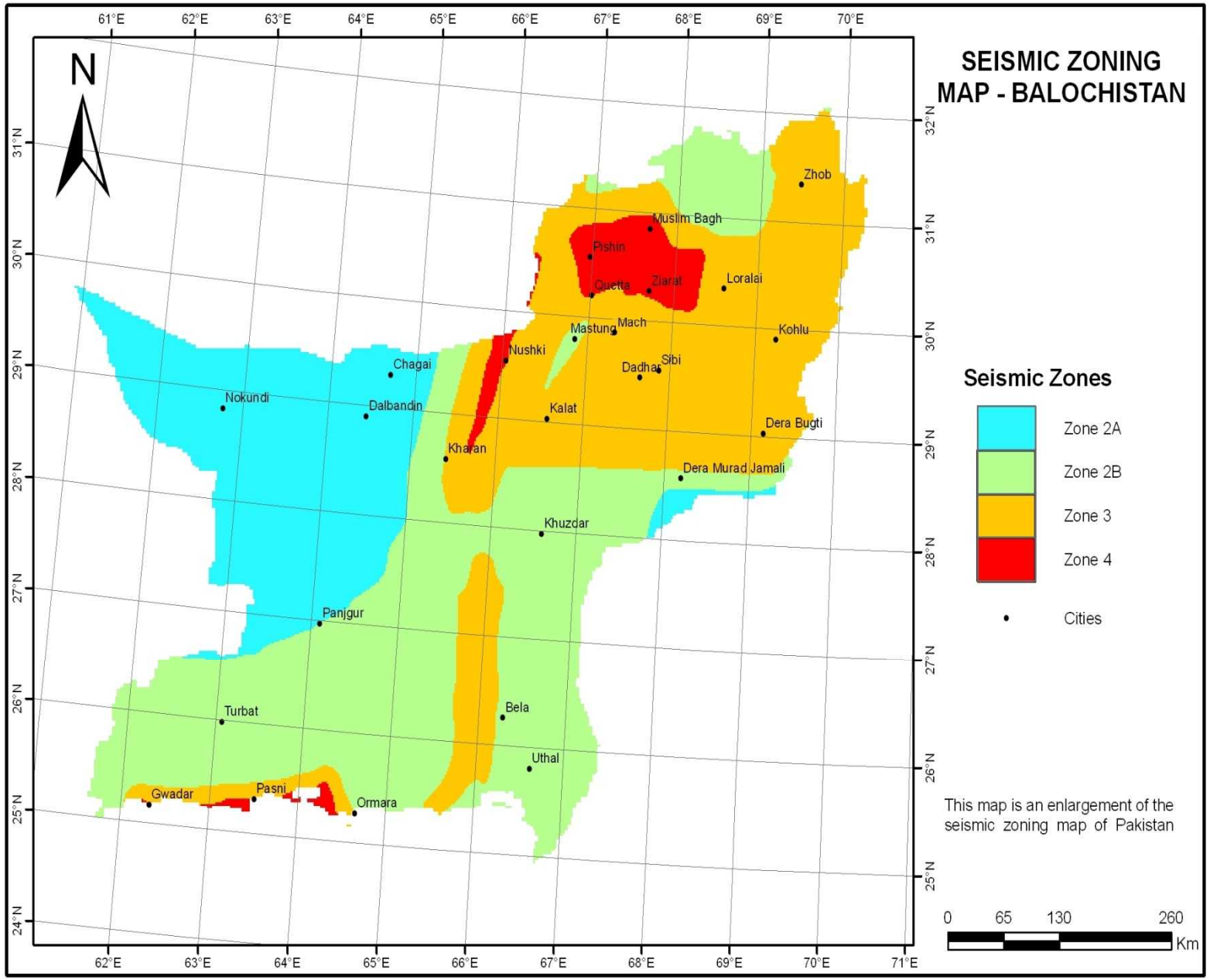
Where "g" is the acceleration due to gravity.


SEISMIC ZONING
MAP OF PAKISTAN
N
Seismic Zones
Zone 1
Zone 2A
Zone 2B
Zone 3
Zone 4
Cities
For enlargement of this map
refer Figs. 2.2 to 2.5
0 100 200 400
Km
Islamabad
Peshawar
Quetta
Karachi
Hyderabad
Multan
Lahore
Faisalabad
Gujranwala
Rawalpindi
Sargodha
Bahawalpur
Sukkur
Khairpur
Gilgit
Skardu
Chitral
Dir
Mingora
Chilas
Gakuch
Yasin
Ishkuman


SEISMIC ZONING MAP - NWFP, JK & NORTHERN AREAS
N
68°E
69°E
70°E
71°E
72°E
73°E
74°E
75°E
76°E
77°E
37°N
36°N
35°N
34°N
33°N
32°N
31°N
Ishkuman
Yasin
Gakuch
Gilgit
Chitral
Chilas
Dasu
Skardu
Dir
Mingora
Malakand
Muzaffarabad
Charsadda
Mardan
Peshawar
Nowshera
Abbottabad
Haripur
Bagh
Rawalakot
Hajira
Palandri
Kotli
Hangu
Kohat
Karak
New Mirpur
Miran Shah
Bannu
Bhimbar
Lakki
Wana
Tank
D.I. Khan
Seismic Zones
Zone 2A
Zone 2B
Zone 3
Zone 4
Cities
This map is an enlargement of the seismic zoning map of Pakistan
0
50
100
200
Km


SEISMIC ZONING MAP - PUNJAB
N
69°E
70°E
71°E
72°E
73°E
74°E
75°E
76°E
34°N
33°N
32°N
31°N
30°N
29°N
28°N
Murree
Attock
Rawalpindi
Chakwal
Jhelum
Mianwali
Gujrat
Sialkot
Khushab
Gujranwala
Narowal
Sargodha
Bhakkar
Shekhupura
Lahore
Faisalabad
Jhang
Kasur
Leiah
Toba Tek Singh
Okara
Sahiwal
Pakpattan
Multan
D.G. Khan
Muzaffargarh
Vihari
Bahawalnagar
Lodhran
Bahawalpur
Rajanpur
Rahimyar Khan
Seismic Zones
Zone 1
Zone 2A
Zone 2B
Zone 3
Cities
This map is an enlargement of the seismic zoning map of Pakistan
0
45
90
180
Km


SEISMIC ZONING
MAP - SINDH
N
66°E
67°E
68°E
69°E
70°E
71°E
28°N
27°N
26°N
25°N
24°N
Jacobabad
Shikarpur
Sukkur
Larkana
Khairpur
Dadu
Nawabshah
Sanghar
Hyderabad
Karachi
Thatta
Badin
Nagar Parkar
Seismic Zones
Zone 2A
Zone 2B
Zone 3
Zone 4
Cities
This map is an enlargement of the seismic zoning map of Pakistan
0
40
80
160
Km


SEISMIC ZONING
MAP - BALOCHISTAN
N
61°E
62°E
63°E
64°E
65°E
66°E
67°E
68°E
69°E
70°E
71°E
24°N
25°N
26°N
27°N
28°N
29°N
30°N
31°N
32°N
Zhob
Muslim Bagh
Pishin
Quetta
Ziarat
Loralai
Mastung
Mach
Kohlu
Nushki
Chagai
Dadhar
Sibi
Nokundi
Dalbandin
Kalat
Dera Bugti
Kharan
Dera Murad Jamali
Khuzdar
Panjgur
Turbat
Bela
Uthal
Gwadar
Pasni
Ormara
Seismic Zones
Zone 2A
Zone 2B
Zone 3
Zone 4
Cities
This map is an enlargement of the seismic zoning map of Pakistan
0
65
130
260
Km

SEISMIC ZONES OF TEHSILS OF PAKISTAN (EXAMPLE)

Tehsil	Seismic Zone	Tehsil	Seismic Zone	Tehsil	Seismic Zone
Punjab					
Attock	2B	Shorkot	2A	**Multan** City	2A
Hassanabdal	2B	**Toba Tek Singh**	2A	Multan Saddar	2A
Fateh Jang	2B	Kamalia	2A	Shujabad	2A
Pindi Gheb	2B	Gojra	2A	Jalalpur Pirwala	2A
Jand	2B	**Gujranwala** City	2A	**Lodhran**	2A
Rawalpindi	2B	Wazirabad	2A	Kahror Pacca	2A
Taxila	2B	Gujranwala Saddar	2A	Dunyapur	2A
Kahuta	2B	Nowshera Virkan	2A	**Khanewal**	2A
Murree	3	Kamoki	2A	Jehanian	2A

SEISMIC ZONES OF TEHSILS OF PAKISTAN

Kotli Sattian	3	**Hafizabad**	2A	Main Channu	2A
Gujar Khan	2B	Pindi Bhattian	2A	Kabirwala	2A
Jhelum	2B	**Gujrat**	2B	**Dera Ghazi Khan**	2A
Sohawa	2B	Kharian	2B	Taunsa	2B
Pind Dadan Khan	2B	Sarai Alamgir	2B	De-Ex.Area of D.G.Khan	2B
Dina	2B	**Mandi Bahauddin**	2B	**Rajanpur**	2A
Chakwal	2B	Malikwal	2B	Rojhan	2A
Talagang	2B	Phalia	2A	Jampur	2A
Choa Saidan Shah	2B	**Sialkot**	2B	De-Ex.Area of Rajanpur	2B
Sargodha	2A	Daska	2B	**Leiah**	2A
Sillanwali	2A	Pasrur	2B	Chaubara	2A
Bhalwal	2A	**Narowal**	2B	Karor Lal Esan	2A
Shahpur	2B	Shakargarh	2B	**Muzaffargarh**	2A

SEISMIC ZONES OF TEHSILS OF PAKISTAN

Sahiwal	2A	**Lahore** City	2A	Alipur	2A
Kot Momin	2A	Lahore Cantt	2A	Jatoi	2A
Bhakkar	2A	**Kasur**	2A	Kot Addu	2A
Kalur Kot	2B	Chunian	2A	**Bahawalpur**	2A
Mankera	2A	Pattoki	2A	Hasilpur	2A
Darya Khan	2A	**Okara**	2A	Yazman	2A
Khushab	2B	Depalpur	2A	Ahmadpur East	2A
Nurpur	2A	Renala Khurd	2A	Khairpur Tamewali	2A
Mianwali	2B	**Sheikhupura**	2A	**Bahawalnagar**	2A
Isa Khel	2B	Nankana Sahib	2A	Minchinabad	2A
Piplan	2B	Ferozwala	2A	Fort Abbas	1
Faisalabad City	2A	Safdarabad	2A	Haroonabad	2A
Faisalabad Saddar	2A	**Vehari**	2A	Chishtian	2A
Chak Jhumra	2A	Burewala	2A	**Rahim Yar Khan**	2A
Sammundri	2A	Mailsi	2A	Khanpur	2A
Jaranwala	2A	**Sahiwal**	2A	Liaquatpur	2A
Tandlianwala	2A	Chichawatni	2A	Sadiqabad	2A
Jhang	2A	**Pakpattan**	2A		
Chiniot	2A	Arifwala	2A		

SEISMIC ZONES OF TEHSILS OF PAKISTAN

Tehsil	Seismic Zone	Tehsil	Seismic Zone	Tehsil	Seismic Zone
Balochistan					
Quetta	3	**Dera Bugti**	3	Aranji (S/T)	2B
Panjpai (S/T)	3	Sangsillah (S/T)	3	**Awaran**	2B
Pishin	4	Sui	3	Mshki (S/T)	3
Hurramzai (S/T)	4	Loti	3	Jhal Jao	3
Barshore (S/T)	3	Phelawagh	3	**Kharan**	3
Karezat (S/T)	4	Malam (S/T)	3	Besima (S/T)	2B
Bostan (S/T)	4	Baiker (S/T)	3	Nag (S/T)	2B
Killa Abdullah	3	Pir Koh (S/T)	3	Wasuk (S/T)	2B
Gulistan (S/T)	3	**Jaffarabad/**Jhat Pat	2B	Mashkhel (S/T)	2A
Chaman	3	Panhwar (S/T)	2B	**Bela**	2B
Dobandi (S/T)	3	Usta Mohammad	2B	Uthal	2B

SEISMIC ZONES OF TEHSILS OF PAKISTAN

Chagai (S/T)	2A	Gandaka (S/T)	2B	Lakhra	2B
Dalbandin	2A	**Nasirabad/**Chattar	3	Liari (S/T)	2B
Nushki	4	Tamboo	3	Hub	2B
Nokundi S/T	2A	D.M.Jamali	2B	Gadani (S/T)	2B
Taftan	2A	**Bolan**/Dhadar	3	Sonmiani/Winder	2B
Loralai/Bori	3	Bhag	3	Dureji	2B
Mekhtar (S/T)	3	Balanari (S/T)	3	Kanraj	2B
Duki	3	Sani (S/T)	3	**Kech**	2B
Barkhan	3	Khattan (S/T)	3	Buleda (S/T)	2B
Musakhel	3	Mach	3	Zamuran (S/T)	2B
Kingri (S/T)	3	**Kachhi**/Gandawa	2B	Hoshab (S/T)	2B
Killa Saifullah	3	Mirpur (S/T)	2B	Balnigor (S/T)	2B
Muslim Bagh	4	Jhal Magsi	2B	Dasht (S/T)	3
Loiband (S/T)	3	**Kalat**	3	Tump	2B
Baddini (S/T)	3	Mangochar (S/T)	3	Mand (S/T)	2B
Zhob	3	Johan (S/T)	3	**Gwadar**	3

SEISMIC ZONES OF TEHSILS OF PAKISTAN

Sambaza (S/T)	3	Surab	2B	Jiwani	2B
Sherani (S/T)	3	Gazg (S/T)	3	Suntsar (S/T)	2B
Qamar Din Karez	2B	**Mastung**	3	Pasni	3
Ashwat (S/T)	2B	Kirdgap (S/T)	3	Ormara	3
Sibi	3	Dasht	3	**Panjgur**	2B
Kutmandai (S/T)	3	Khad Koocha (S/T)	3	Parome (S/T)	2B
Sangan (S/T)	3	**Khuzdar**	2B	Gichk (S/T)	2B
Lehri	3	Zehri	2B	Gowargo	2A
Ziarat	4	Moola (S/T)	2B		
Harnai	3	Karakh (S/T)	2B		
Sinjawi (S/T)	4	Nal (S/T)	3		
Kohllu	3	Wadh (S/T)	2B		
Kahan	3	Ornach (S/T)	3		
Mawand	3	Saroona (S/T)	2B		

SEISMIC ZONES OF TEHSILS OF PAKISTAN

Tehsil	Seismic Zone	Tehsil	Seismic Zone	Tehsil	Seismic Zone
NWFP					
Chitral	4	**Swabi**	2B	**Kurram**	
Drosh	3	Lahore	2B	Lower **Kurram**	2B
Lutkoh	3	**Charsadda**	2B	Upper Kurram	2B
Mastuj	3	Tangi	3	Kurram F.R.	2B
Turkoh	3	**Peshawar**	2B	**Orakzai**	
Mulkoh	3	**Nowshera**	2B	Central **Orakzai**	2B
Dir	3	**Kohat**	2B	Lower Orkzai	2B
Barawal	3	Lachi	2B	Upper Orkzai	2B
Kohistan	3	**Hangu**	2B	Ismailzai	2B
Wari	3	**Karak**	2B	**South Waziristan**	
Khall	3	Banda Daud Shah	2B	Ladha	2B
Temergara	3	Takht-E-Nasrati	2B	Makin (Charlai)	2B
Balambat	3	**Bannu**	2B	Sararogha	2B
Lalqila	3	**Lakki Marwat**	2B	Sarwekai	2B
Adenzai	3	**Dera Ismail Khan**	2A	Tiarza	2B

SEISMIC ZONES OF TEHSILS OF PAKISTAN

Munda	3	Daraban	3	Wana	2B
Samarbagh (Barwa)	3	Paharpur	2B	Toi Khullah	2B
Swat		Kulachi	2B	Birmal	2B
Matta	3	**Tank**	2B	**North Waziristan**	
Shangla/Alpuri	3	**Bajaur**		Datta Khel	2B
Besham	3	Barang	3	Dossali	2B
Puran	2B	Mamund	3	Mir Ali	2B
Buner/Daggar	2B	Salarzai	3	Miran Shah	2B
Malakand/Swat Ranizai	3	Utmankhel (Qzafi)	3	Razmak	2B
Sam Ranizai	2B	Nawagai	3	Spinwam	2B
Dassu	3	**Mohmand**		Shewa	2B
Pattan	3	Halimzai	3		
Palas	3	Pindiali	3		
Mansehra	3	Safi	3		
Balakot	4	Upper Mohmand	3		

SEISMIC ZONES OF TEHSILS OF PAKISTAN

Tehsil	Seismic Zone	Tehsil	Seismic Zone	Tehsil	Seismic Zone
Sindh					
Jacobabad	2A	Khairpur Nathan Shah	2B	**Tharparkar**/Chachro	2A
Kandhkot	2A	Johi	2B	Mithi	2B
Kashmor	2A	Kotri	2A	**Karachi East**	2B
Shikarpur	2A	Thano Bula Khan	2A	**Karachi West**	2B
Khanpur	2A	**Hyderabad** City	2A	**Karachi South**	2B
Garhi Yasin	2A	Matiari	2A	**Karachi Central**	2B
Lakhi	2A	Tando Allahyar	2A	**Malir**	2B
Larkana	2A	Hala	2A		
Miro Khan	2A	Latifabad	2A	**FEDERAL AREA**	
Rato Dero	2A	Hyderabad	2A	Islamabad	2B
Shahdadkot	2B	Qasimabad	2A		
Dokri	2A	Tando Mohd Khan	2A	**AJK**	
Kambar	2B	**Badin**	2B	Bagh	4

SEISMIC ZONES OF TEHSILS OF PAKISTAN

Warah	2A	Golarchi	2A	Bhimbar	2B
Sukkur	2A	Matli	2A	Hajira	4
Rohri	2A	Tando Bagho	2B	Kotli	3
Pano Aqil	2A	Talhar		Muzaffarabad	4
Salehpat	2A	**Thatta**	2A	New Mirpur	2B
Ghotki	2A	Mirpur Sakro	2A	Palandri	3
Khangarh	2A	Keti Bunder	2A	Rawalakot	3
Mirpur Mathelo	2A	Ghorabari	2A		
Ubauro	2A	Sujawal	2A	**NORTHERN AREA**	
Daharki	2A	Mirpur Bathoro	2A	Chilas	3
Khairpur	2A	Jati	2A	Dasu	3
Kingri	2A	Shah Bunder	2A	Gakuch	3
Sobhodero	2A	Kharo Chan	2A	Gilgit	3
Gambat	2A	**Sanghar**	2A	Ishkuman	2B
Kot Diji	2A	Sinjhoro	2A	Skardu	3
Mirwah	2A	Khipro	2A	Yasin	3

SEISMIC ZONES OF TEHSILS OF PAKISTAN

Faiz Ganj	2A	Shahdadpur	2A		
Nara	2A	Jam Nawaz Ali	2A		
Naushahro Feroze	2A	Tando Adam	2A		
Kandioro	2A	**Mirpur Khas**	2A		
Bhiria	2A	Digri	2A		
Moro	2A	Kot Ghulam Moh	2A		
Nawab Shah	2A	**Umerkot**	2A		
Skrand	2A	Samaro	2A		
Daulatpur	2A	Kunri	2A		
Dadu	2A	Pithoro	2A		

SEISMIC ZONES

- **ONLY ONE TEHSIL “FORT ABBAS” FALLS IN SEISMIC ZONE - 1.**
- **TEN TEHSILS LIE IN SEISMIC ZONE – 4.**
- **REST OF PAKISTAN IS COVERED BY ZONE – 2 AND 3.**
- **WELL REGULATED SEISMIC DESIGN – NEED OF THE HOUR.**

BUILDING CODE SEISMIC PROVISIONS

BASIC APPROACH:

- **LEVEL OF EARTHQUAKE SAFETY IN BUILDINGS SHOULD NOT INCREASE COST UNNECESSARILY.**
- **DIFFERENT TYPES OF CONSTRUCTION COMMONLY USED IN PAKISTAN SHOULD BE COVERED.**
- **BEST AVAILABLE KNOWLEDGE BASE IN THE WORLD FOR EARTHQUAKE DESIGN OF BUILDINGS SHOULD BE INCLUDED IN THE CODE.**

REFERENCE DOCUMENTS

- **UBC-97: UNIFORM BUILDING CODE**
- **ACI-2005: AMERICAN CONCRETE INSTITUTE: BUILDING DESIGN REQUIREMENTS**
- **AISC-2005: AMERICAN INSTITUTE OF STEEL CONSTRUCTION, PROVISIONS FOR STRUCTURAL STEEL BUILDINGS**
- **ASCE-2005: AMERICAN SOCIETY OF CIVIL ENGINEERS: MINIMUM DESIGN LOADS FOR BUILDINGS**