**Name\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_Period\_\_\_\_\_\_Date\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

Geology-UNIT Guided Notes

Earthquakes

Text reference: ch 8 pg 217-232

Section 1: What is an Earthquake?

* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_: vibration of earth produced by the rapid release of \_\_\_\_\_\_\_\_\_\_\_
* Often caused by slippage along break in the earth’s \_\_\_\_\_\_\_\_\_\_\_\_\_
* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_: point within earth where the EQ starts; the \_\_\_\_\_\_\_\_\_ of the Earthquake
* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_: location on the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_the focus
* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_: \_\_\_\_\_\_\_\_\_\_\_\_\_ in the earth where \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ has occurred
* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
	+ Most EQs are produced by the rapid release of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ stored in rock that has been subjected to great forces
	+ As rock is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, it \_\_\_\_\_\_\_\_\_\_\_, \_\_\_\_\_\_\_\_\_\_\_\_\_ elastic energy. Once the rock is strained \_\_\_\_\_\_\_\_\_\_\_\_\_\_ its breaking point, it ruptures and release the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ in the form of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_(seismic waves) of earthquakes
* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_: small earthquakes \_\_\_\_\_\_\_\_\_\_a major earthquake
	+ Can happen \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ before the major quake
* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_: movements that \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ a major earthquake
	+ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ than the major EQ
	+ Can sometimes \_\_\_\_\_\_\_\_\_\_\_\_\_ structures weakened by the major earthquake
* Earthquake Zones
	+ \_\_\_\_\_\_\_\_ of all occur in circum \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
		- Most result from \_\_\_\_\_\_\_\_\_\_\_\_\_\_ margin activity
	+ \_\_\_\_\_\_\_\_\_ occur in \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
	+ \_\_\_\_\_\_\_\_\_ occur in the interiors of plates and on spreading ridge centers



Section 2: Earthquake Waves

* Measuring Earthquake Instruments
	+ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_: instruments that record EQ waves
	+ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_: traces of amplified, electronically recorded ground motion made by seismographs



*Types of Waves*

* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ waves (\_\_\_\_ waves)
	+ Travel along earth’s \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
	+ Especially damaging to buildings
	+ \_\_\_\_\_\_\_\_\_ destructive of the 3 types of waves
	+ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ movement (think of ocean wave movement)
* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_waves
	+ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ motion
	+ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ waves-material is moved in the \_\_\_\_\_\_\_\_ direction as the wave moves
	+ \_\_\_\_\_\_\_\_\_\_\_\_\_\_ moving wave
	+ Travel through \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_waves
	+ \_\_\_\_\_\_\_\_\_\_\_\_\_ than \_\_\_\_\_\_ waves, \_\_\_\_\_\_\_\_\_\_\_\_ than \_\_\_\_\_\_\_\_\_\_\_\_ waves
	+ Travel through \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ only
	+ Move \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_(90 degrees) to wave movement

*Locating an EQ’s Epicenter*

* \_\_\_\_\_\_ waves arrive \_\_\_\_\_\_, then \_\_\_\_\_ waves, then \_\_\_\_\_\_\_\_\_\_\_\_\_
* Earthquake distance
	+ Epicenter is located using the difference in the arrival times of \_\_\_\_\_\_\_\_\_\_\_\_\_ wave recordings which are related to distance
* Earthquake direction
	+ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ graphs from \_\_\_\_\_\_\_\_ or more seismograph can be used to find the exact location of an earthquake epicenter

Section 3: measuring Earthquakes

* Two different types of measurements: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* Intensity: based on \_\_\_\_\_\_\_\_\_\_\_\_ of ground shaking on \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
	+ Varies from place to place within disturbed region depending on the location of the observer with the respect to the EQ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* Magnitude: related to the amount of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ at the hypocenter of the earthquake
	+ Based on \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_of EQ waves recorded on instruments

*Scales*

* Richter Magnitude Scale
	+ Range from \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
	+ <2.0:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
	+ ~4.0:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
	+ 6.0-6.9:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
	+ 7.0-7.9:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
	+ 8.0-9.9:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
	+ 10+:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* Modified Mercali Intensity Scale
	+ Developed in \_\_\_\_\_\_\_\_\_\_\_\_\_\_
	+ \_\_\_\_\_\_\_ Different Levels:
	+ I:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
	+ II:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
	+ III:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
	+ IV:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
	+ V:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
	+ VI:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
	+ VII:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
	+ VIII:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
	+ IX:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
	+ X:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
	+ XI:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
	+ XII:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* Moment Magnitude
	+ Derived from the amount of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_that occurs along the fault zone
	+ Most widely used measurements for EQS because it is the only magnitude scale the estimates \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ by earthquakes
	+ Measures very large earthquakes
	+ Calculated by different factors including
		- \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
		- \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
		- \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
			* A x B x C=measure of how much energy rock can \_\_\_\_\_\_\_\_\_ before it slips and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ energy during an earthquake

Section 4: Destruction from Earthquakes

* Damage to buildings and other structures from earthquake waves depends on several factors including:
	+ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
	+ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
	+ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* Factors that determine structural damage:
	+ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
	+ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
		- Most serious safety threat
	+ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
	+ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
	+ Saturated material turns to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
	+ Underground objects may float to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
	+ Occurs when \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ saturated with \_\_\_\_\_\_\_\_\_\_\_ are shaken by EQ waves
* Tsunamis
	+ Japanese for \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
	+ Causes:
		- Triggered by an \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
		- Occurs where a slab of the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is displaced \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ along a fault
		- Can also occur when the vibration of a EQ sets an \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ in motion
	+ A tsunami is generated by movement of ocean floor. The \_\_\_\_\_\_\_\_\_of a wave moving across the ocean is related to the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* Tsunami Warning System
	+ Large EQs are reported to Hawaii from \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
	+ Although tsunamis travel quickly, there is sufficient time to evacuate all but the area \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ to the epicenter
	+ On average only \_\_\_\_\_\_\_\_\_\_\_\_\_ destructive tsunamis worldwide per year
	+ ON average, only \_\_\_\_\_\_\_ tsunami every \_\_\_\_\_\_ years causes major damage and loss of life
* Predicting Earthquakes
	+ Short range:
		- Not successful yet
	+ Long range forecasts
		- Data can be important for updating \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
		- Scientists don’t yet understand enough about how and where earthquakes occur will occur to make accurate long term predictions
		- A \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is an area along a fault where there has not been EQ activity for a long period of time
* Other Dangers
	+ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_:
		- Results from the violent shaking of EQs, causing the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ on slopes to fall
		- The \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ cause of structural damage
	+ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_:
		- In the San Francisco earthquake of 1906, most of the destruction was caused by fires that started when gas and electrical lines were cut