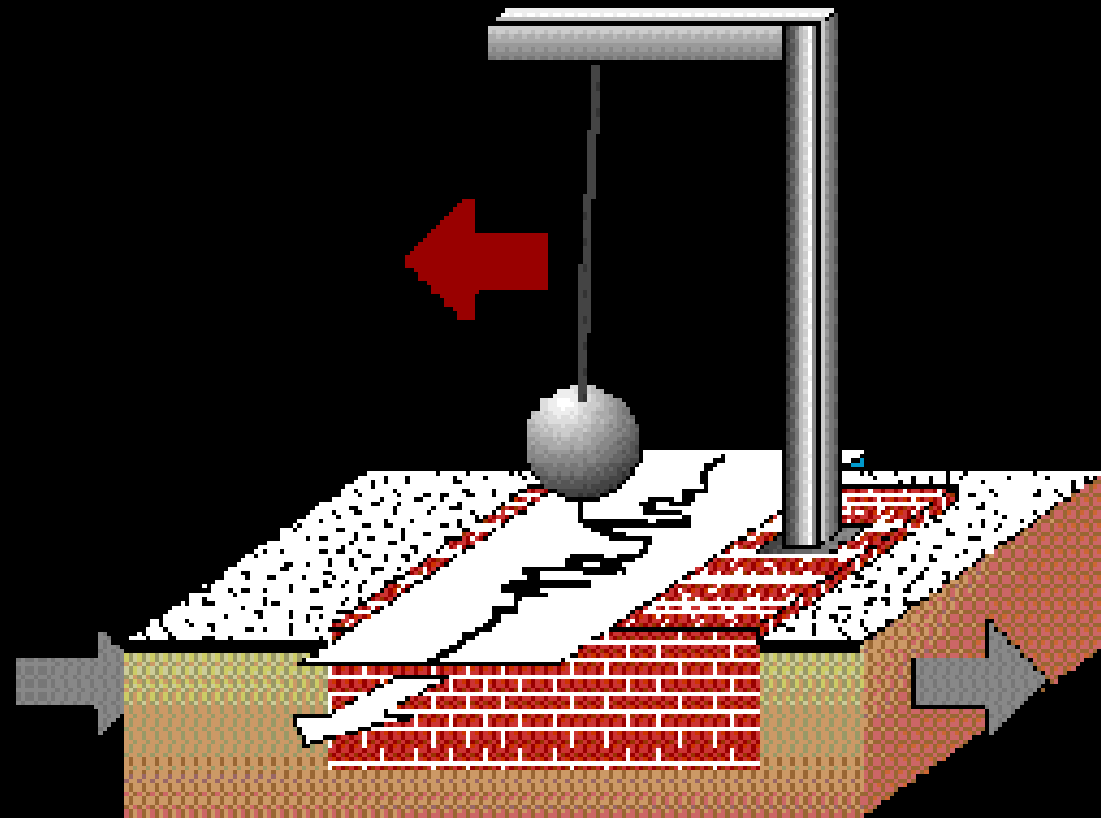
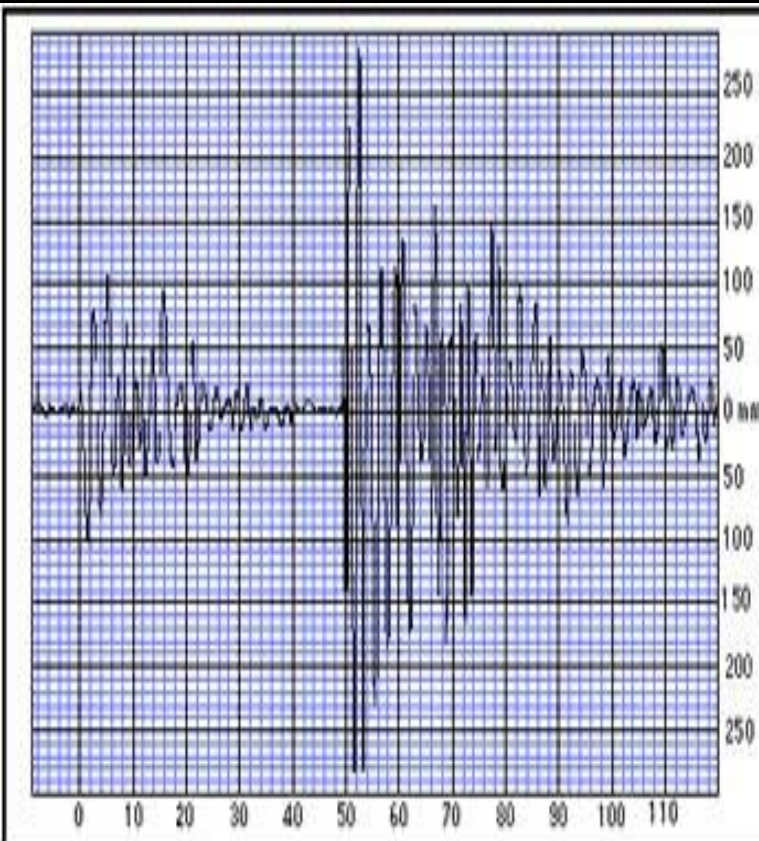


1. The Lithosphere includes Earth's C\_\_\_\_\_ and part of the M\_\_\_\_\_.
2. What are the three types of plate boundaries called?
3. Describe what happens at each type of plate boundary.
4. How can dogs tell that a major earthquake is about to happen? (What might they feel?)

# “Measuring Earthquakes”

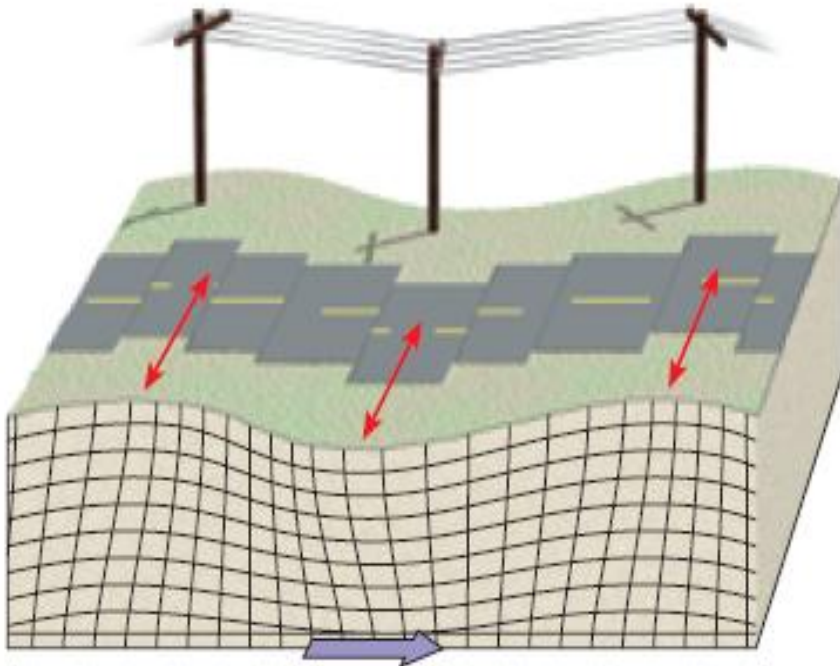
## Chapter 8, Section 2



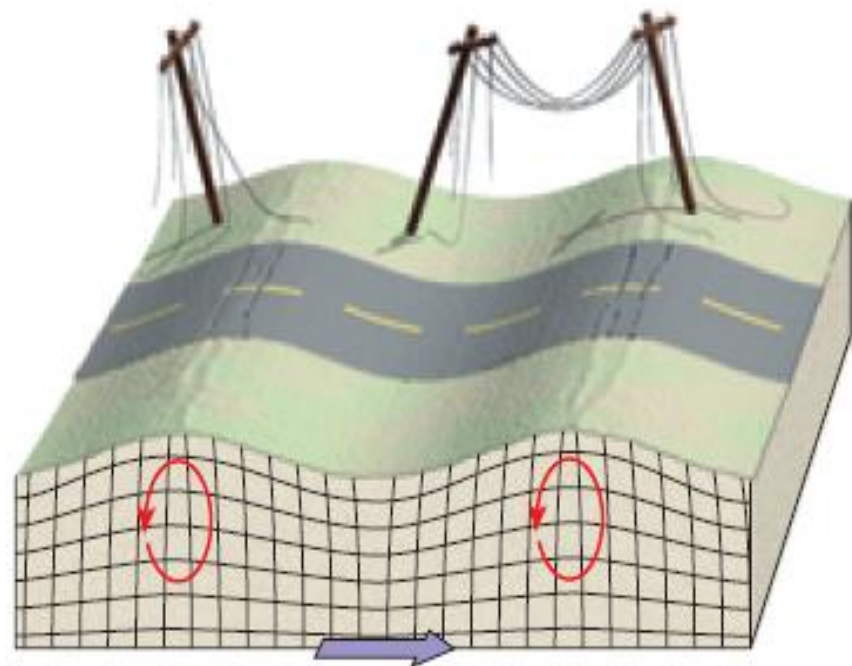
# Earthquake Waves

- **“Seismic” = ...**
- Surface waves travel along the ground and cause the ground and anything resting upon it to move
- Gases and liquids do not transmit s waves, but do transmit p waves
- A seismogram shows all three types of waves: the p waves arrive first, then the s waves, followed by the surface waves last
- The waves arrive at different times because they travel at different speeds

# Surface Waves



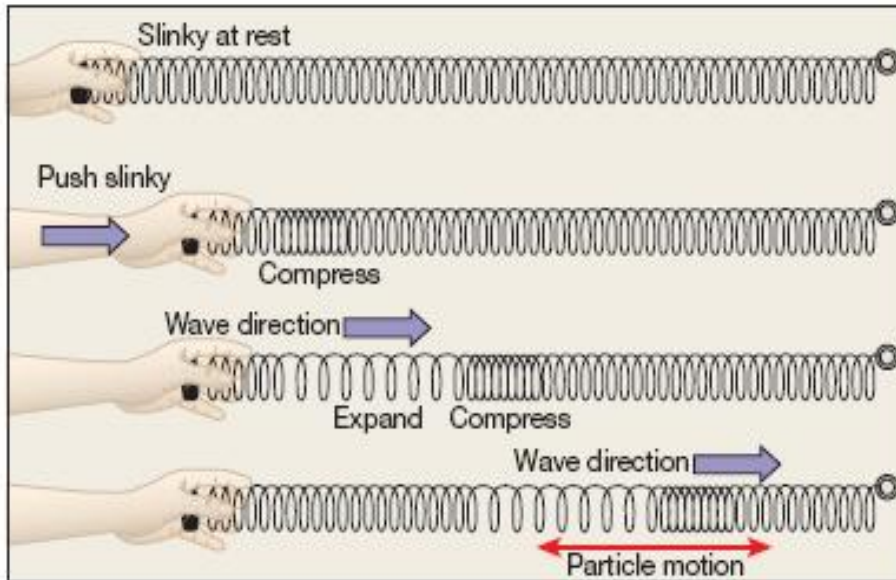
E. Surface waves that are like S waves



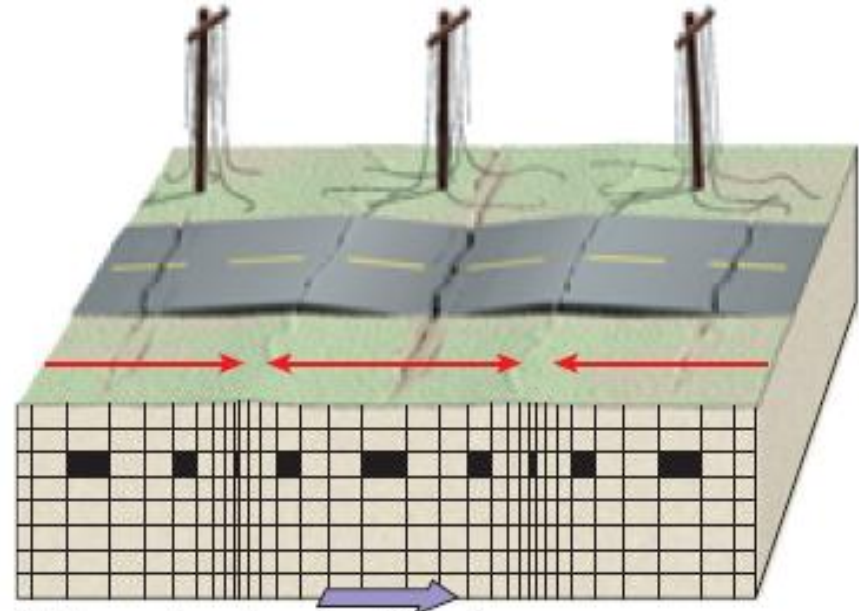
F. Surface waves that are like ocean waves

- **Waves** that travel **along** Earth's surface
- Most **destructive!** ☹️

# P Waves



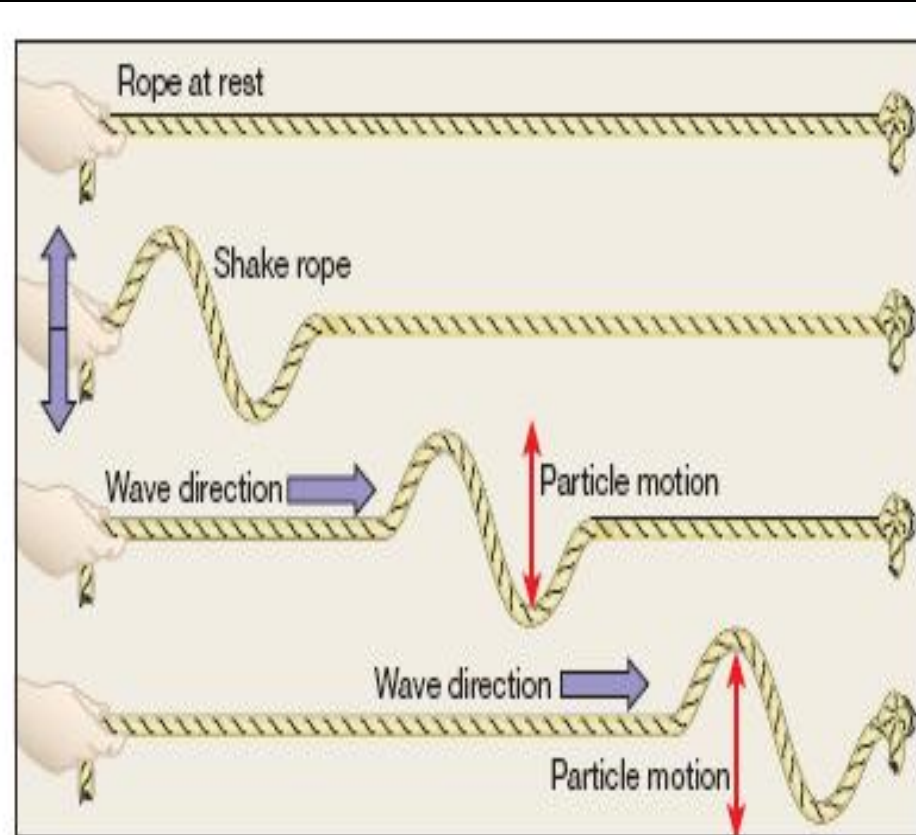
A. P waves generated using a slinky



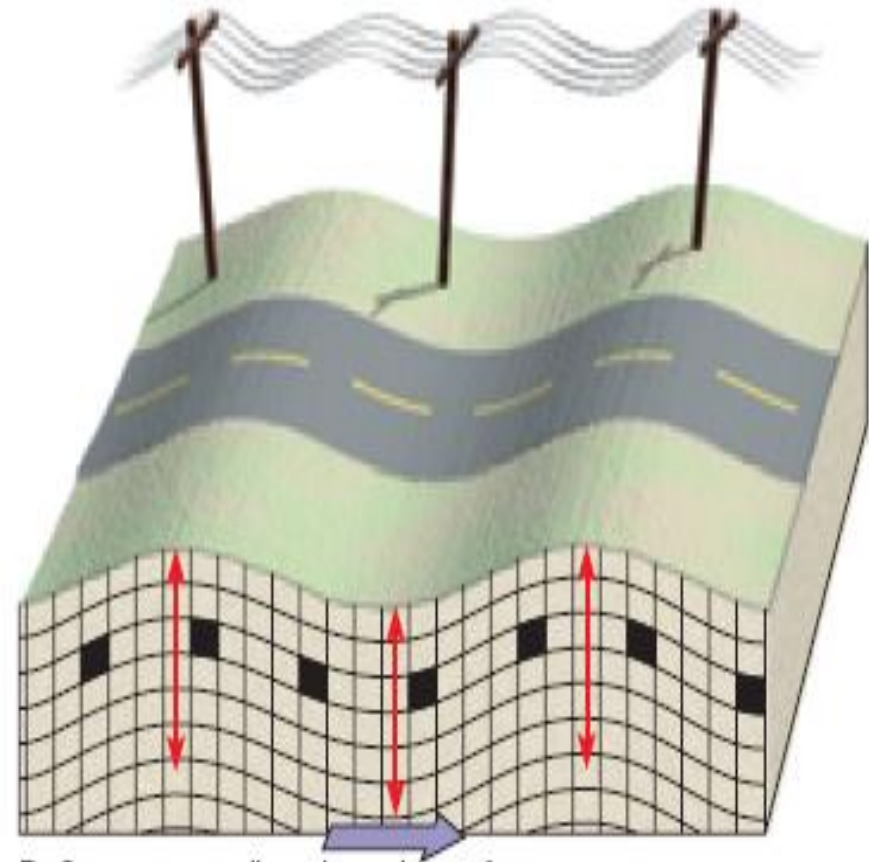
## “Push-Pull waves”

- **Compress** rocks
- **Expand** rocks
- **FASTEST** waves!

# S Waves



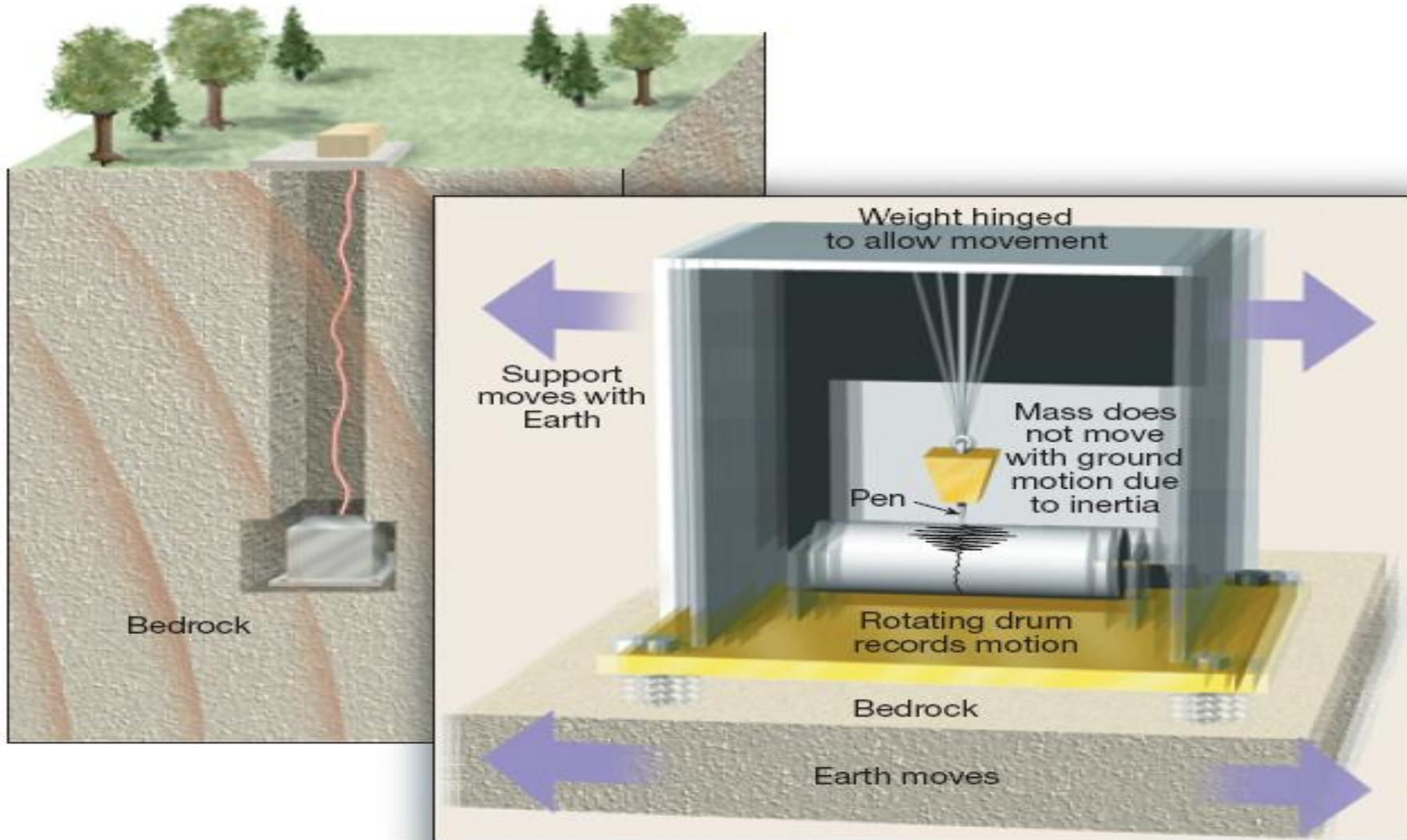
C. S waves generated using a rope



D. S waves traveling along the surface

- **Shake** the **particles** at **right angles**
- **Cannot** move through **water** or **air**.

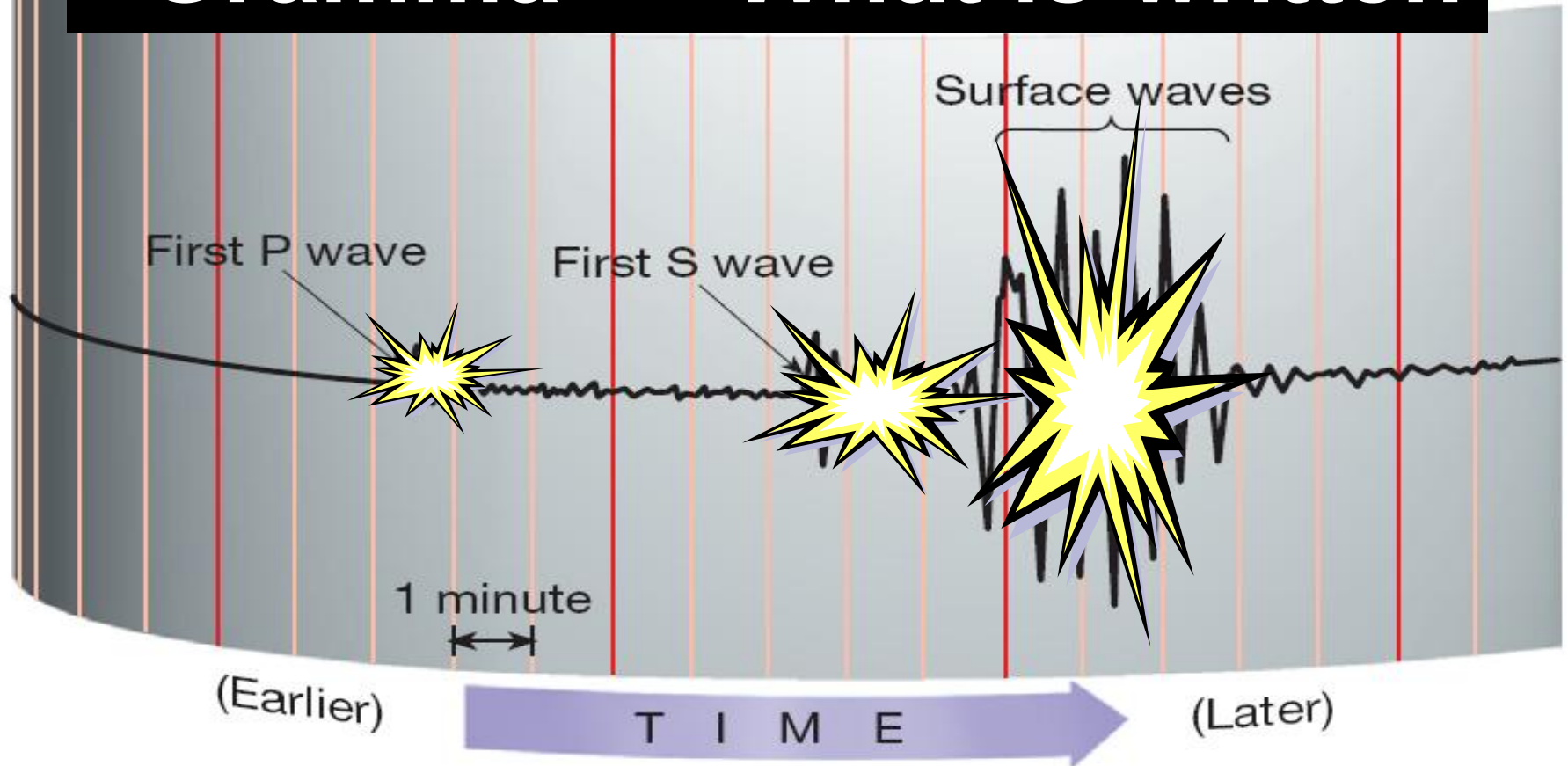
# Seismograph



**Tool** that **records** earthquake **waves**

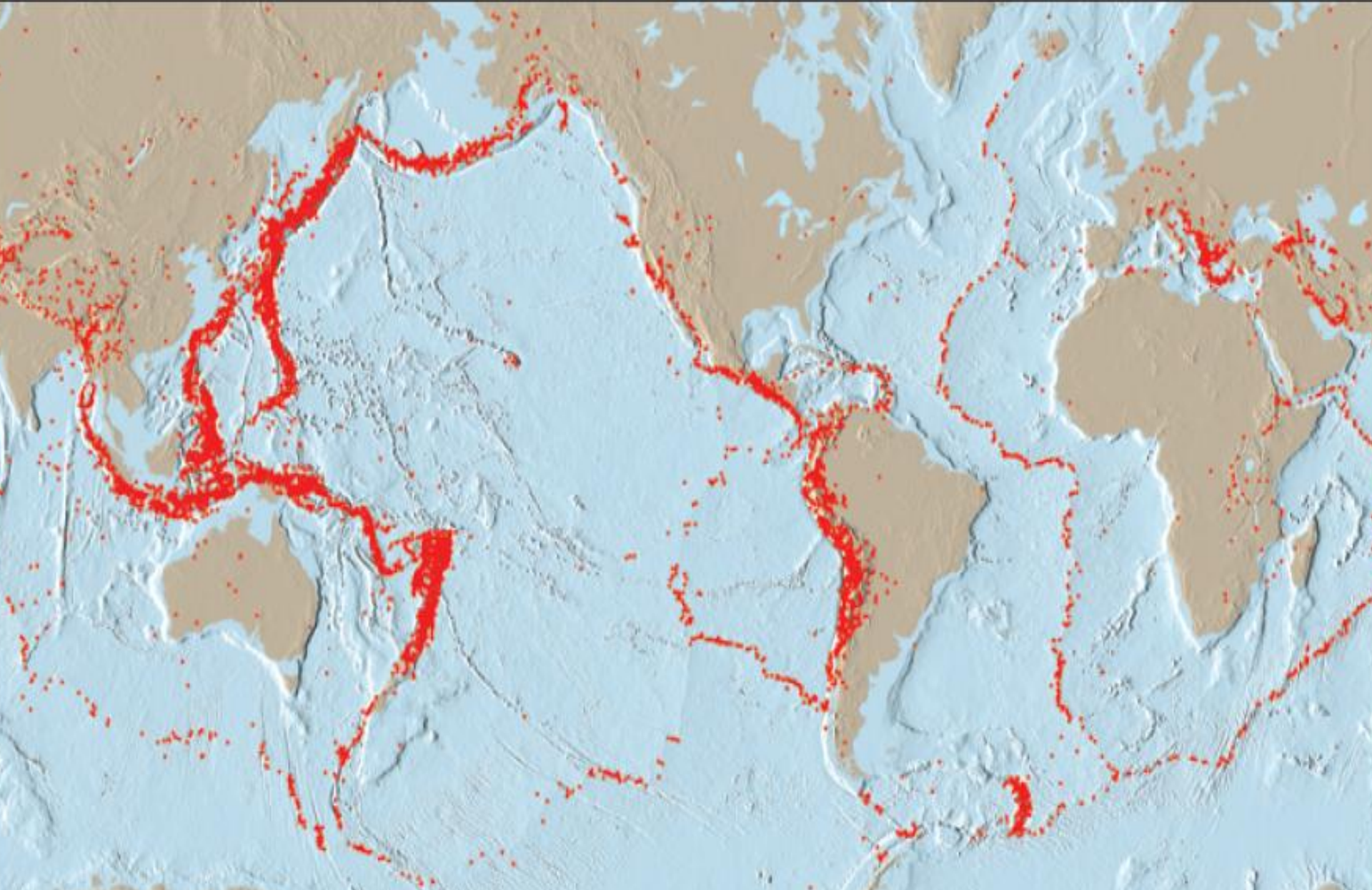
“Seismos” = Shake

“Gramma” = What is written



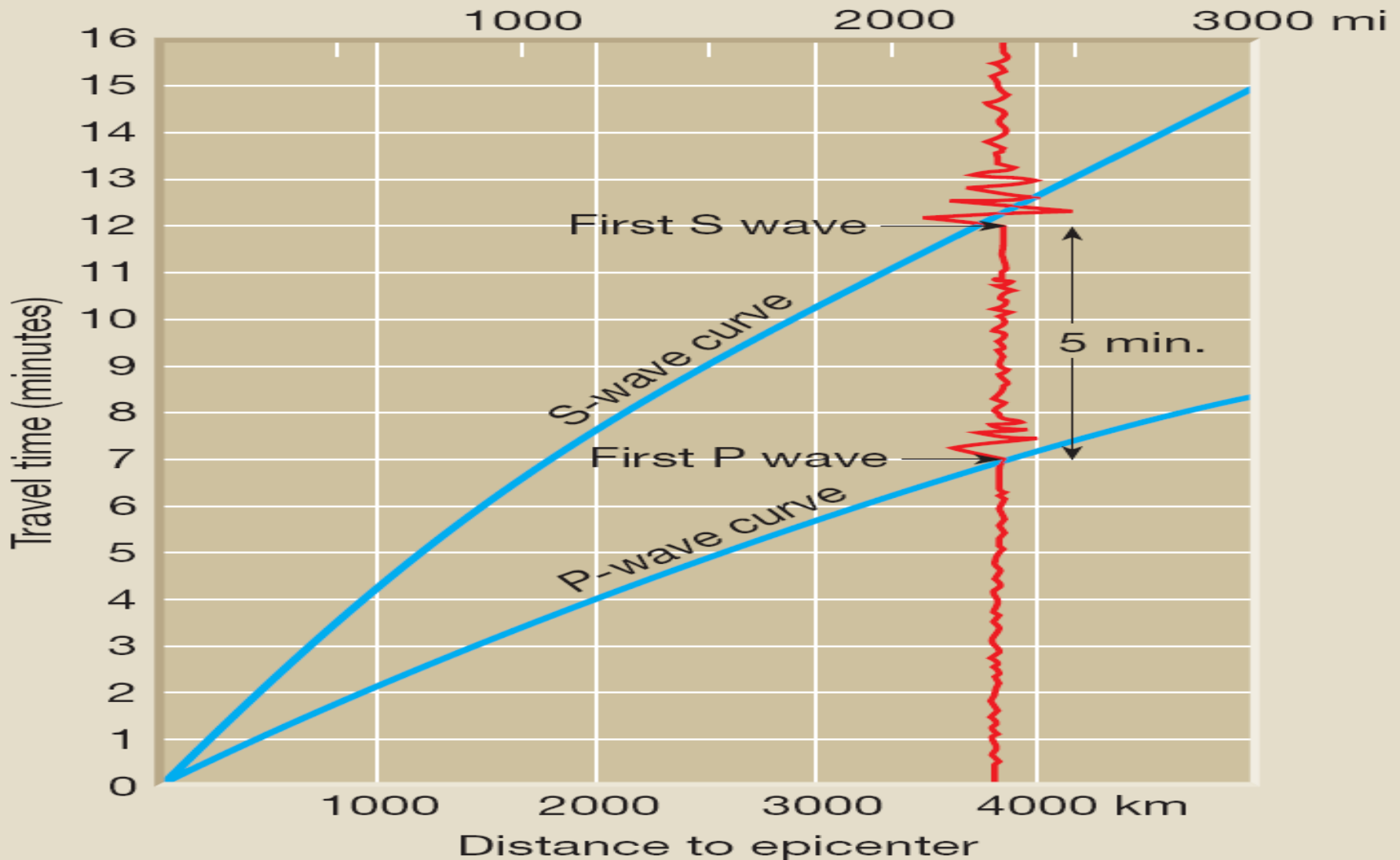
A **drawing** from a **seismograph**

# Where are they?!



# Travel-Time Graph

- Used to find **distance** to **epicenter**



# Finding an Epicenter.



## Triangulation

- Technique used to find **location** of **epicenter**
- **“Three Circles”**

# Measuring Earthquakes

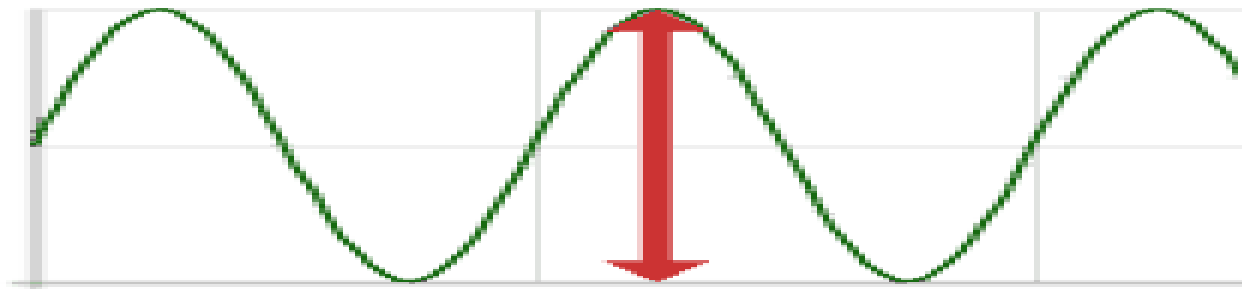
## 1. Intensity

- **Estimate** of damage to an area.

## 2. Magnitude

- **Size** of seismic wave

**Amplitude**



# 3 Scales of Measurement

## 1. Richter Scale

- Outdated ☹️
- Measures **amplitude** of the largest seismic wave (1-10).

## 2. Moment Magnitude Scale

- Widely used 😊
- **Movement at fault**
- Measures **energy** released

## 3. Modified Mercalli Scale

- Measures “**Destruction**”
- 12 steps ( I—XII )
- 1 = Gentle, 12 = Bad!

# Moment Magnitude Scale

## Earthquake Magnitudes and Expected World Incidence

Moment Magnitudes	Effects Near Epicenter	Estimated Number per Year
< 2.0	Generally not felt, but can be recorded	> 600,000
2.0–2.9	Potentially perceptible	> 300,000
3.0–3.9	Rarely felt	> 100,000
4.0–4.9	Can be strongly felt	13,500
5.0–5.9	Can be damaging shocks	1,400
6.0–6.9	Destructive in populous regions	110
7.0–7.9	Major earthquakes; inflict serious damage	12
8.0 and above	Great earthquakes; destroy communities near epicenter	0–1

# Modified Mercalli Scale

<b>I. Instrumental</b>	Not felt except by a very few under especially favorable conditions.
<b>II. Feeble</b>	Felt only by a few persons at rest, especially on upper floors of buildings. Delicately suspended objects may swing.
<b>III. Slight</b>	Felt quite noticeably by persons indoors, especially on the upper floors of <a href="#">buildings</a> . Many do not recognize it as an earthquake. Standing motor cars may rock slightly. <a href="#">Vibration</a> similar to the passing of a truck. Duration estimated.
<b>IV. Moderate</b>	Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably. Dishes and windows rattle.
<b>V. Rather Strong</b>	Felt by nearly everyone; many awakened. Some dishes and windows broken. Unstable objects overturned. <a href="#">Clocks</a> may stop.
<b>VI. Strong</b>	Felt by all; many frightened and run outdoors, walk unsteadily. Windows, dishes, glassware broken; books off shelves; some heavy furniture moved or overturned; a few instances of fallen plaster. Damage slight.
<b>VII. Very Strong</b>	Difficult to stand; <a href="#">furniture</a> broken; damage negligible in building of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken. Noticed by persons driving motor cars.
<b>VIII. Destructive</b>	Damage slight in specially designed structures; considerable in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture moved.
<b>IX. Ruinous</b>	General panic; damage considerable in specially designed structures, well designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.
<b>X. Disastrous</b>	Some well built wooden structures destroyed; most masonry and frame structures destroyed with foundation. Rails bent.
<b>XI. Very Disastrous</b>	Few, if any masonry structures remain standing. Bridges destroyed. Rails bent greatly.
<b>XII. Catastrophic</b>	Total damage - Almost everything is destroyed. Lines of sight and level distorted. Objects thrown into the air. The ground moves in waves or ripples. Large amounts of rock may move.

# “Earthquake Destruction”



# Q: What affects the amount of Destruction?

1. How **big** the seismic waves are.
2. How **long** it lasts.
3. **Composition** of ground.
4. **Design** of buildings.

# Hazard - Liquefaction



Niigata, Japan 1964

# Hazard – Ground Shaking



Northridge, CA 1994



Loma Prieta, CA 1989

# Hazard – Surface Faulting



Landers, CA 1992

# Hazard - Landslides



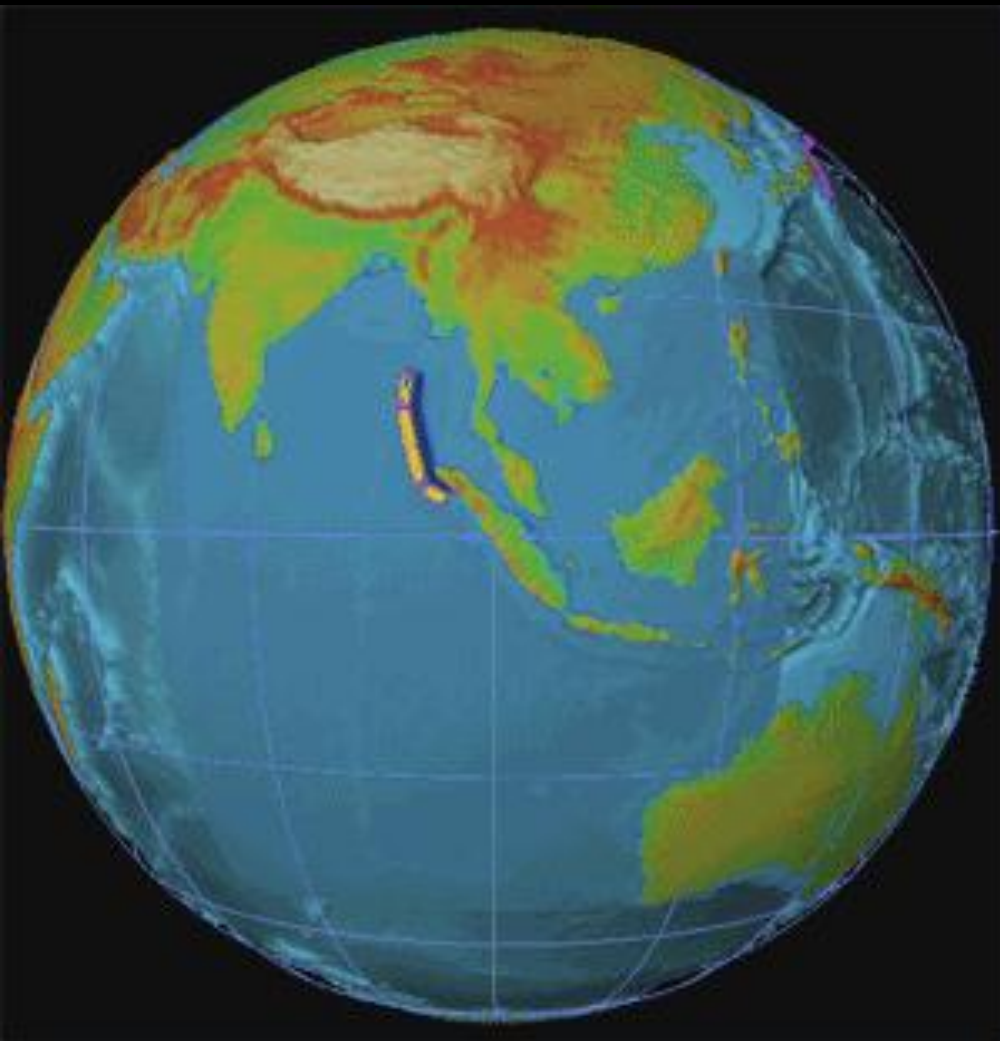
Turnnagin Heights, Alaska, 1964

# Hazard – Fires



Loma Prieta, CA 1989

# Hazard – Tsunami



# Predicting Earthquakes?

- **Goal:**
  - EARLY WARNING.
- **Success?**
  - NO. ☹️
- **Seismic gap**
  - Place along a **fault** that is “**overdo.**”

# Chance of Earthquakes Near Us...

