Locating Epicenters

How do seismologist determine the location of an earthquake?

Locating Epicenters

- The first seismograph was invented in 132 AD by the Chinese astronomer and mathematician Chang Heng
    - It could register an earthquake and determine direction the earthquake came from

First Seismograph

Locating Epicenters

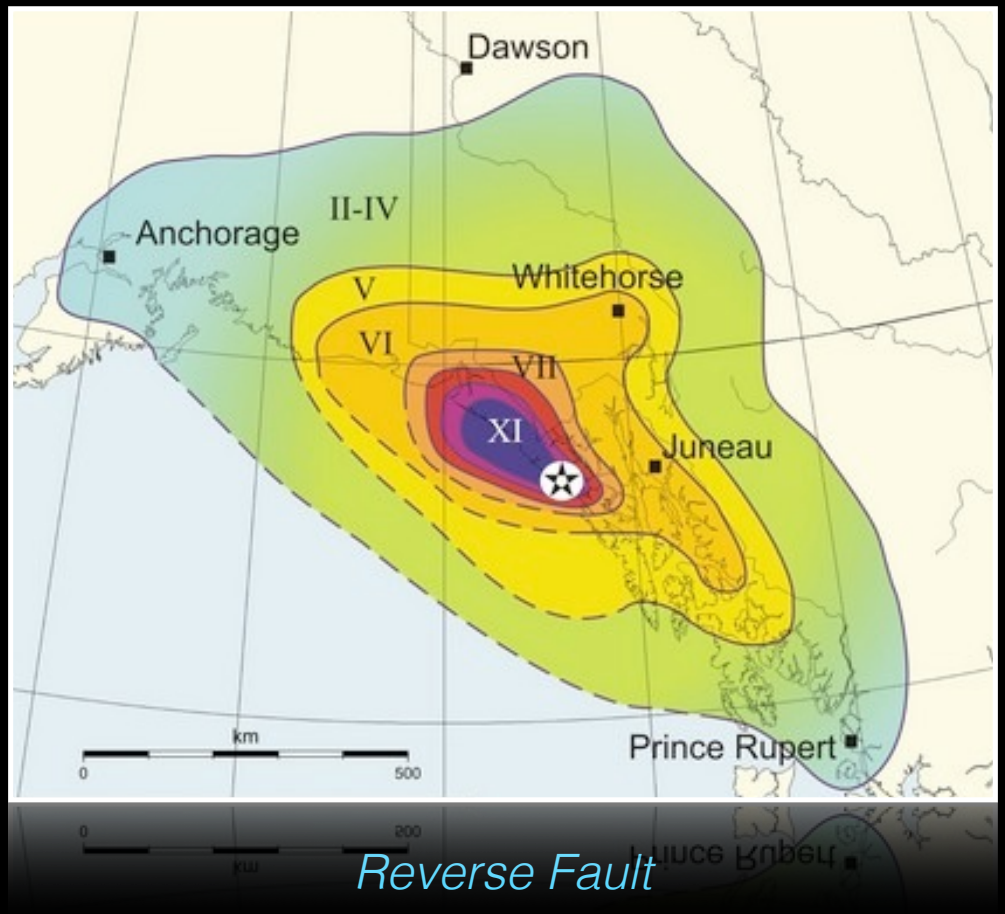
- Mercalli Scale - developed by Giuseppe Mercalli in 1902, it measured the intensity of an earthquake based on the effects to Earth's surface, humans, objects in nature and other man-made structures

Giuseppe Mercalli

Locating Epicenters

- Mercalli Scale [continued]
    - Higher values of intensities are closer to the epicenter and lower values of intensity are farther away

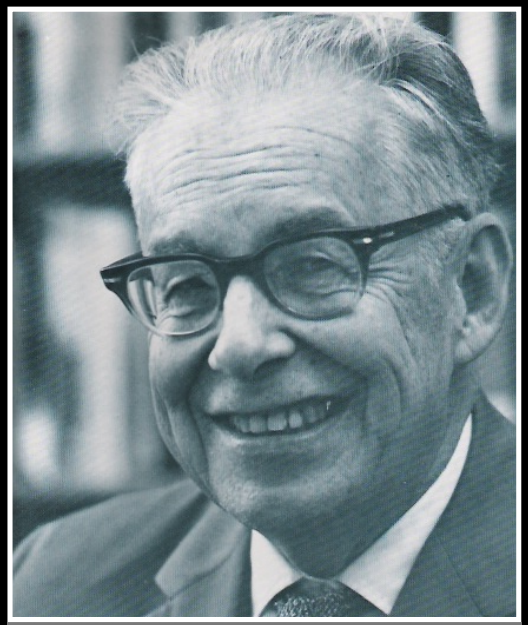
Intensity	Type of Damage
I	Instrumental
II	Feeble
III	Slight
IV	Moderate
V	Rather Strong
VI	Strong
VII	Very Strong
VIII	Destructive
IX	Ruinous
X	Disastrous
XI	Very Disastrous
XII	Catastrophic



Reverse Fault

Locating Epicenters

- Richter Scale - developed by Charles Richter, it measured the amount of energy released during an earthquake using a logarithmic scale
- Magnitude - a number to quantify the amount of seismic energy released from an earthquake



Charles Richter

Locating Epicenters

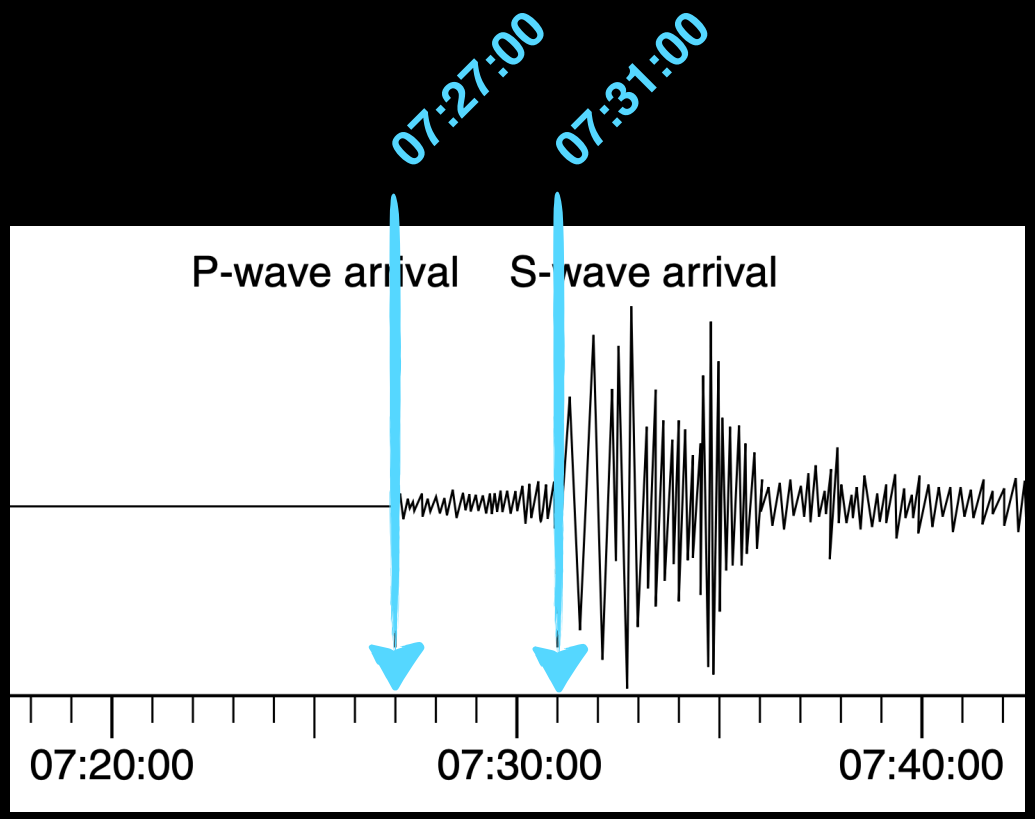
- Richter Scale [continued]
    - The Richter Scale's magnitude is determined from the following measurement:
        - Seismogram's amplitude of waves
        - Distances from other seismographs
        - Epicenter distance

Locating Epicenters

- Modern seismographs are used to accurately determine the location of an epicenter
- To find the epicenter location you need to triangulate a position using three different seismograph stations

Locating Epicenters

- Steps to Locate an Epicenter:
    1. Find the arrival time difference between the p-wave and s-wave



S-wave	07:31:00
P-wave	07:27:00
Difference	00:04:00

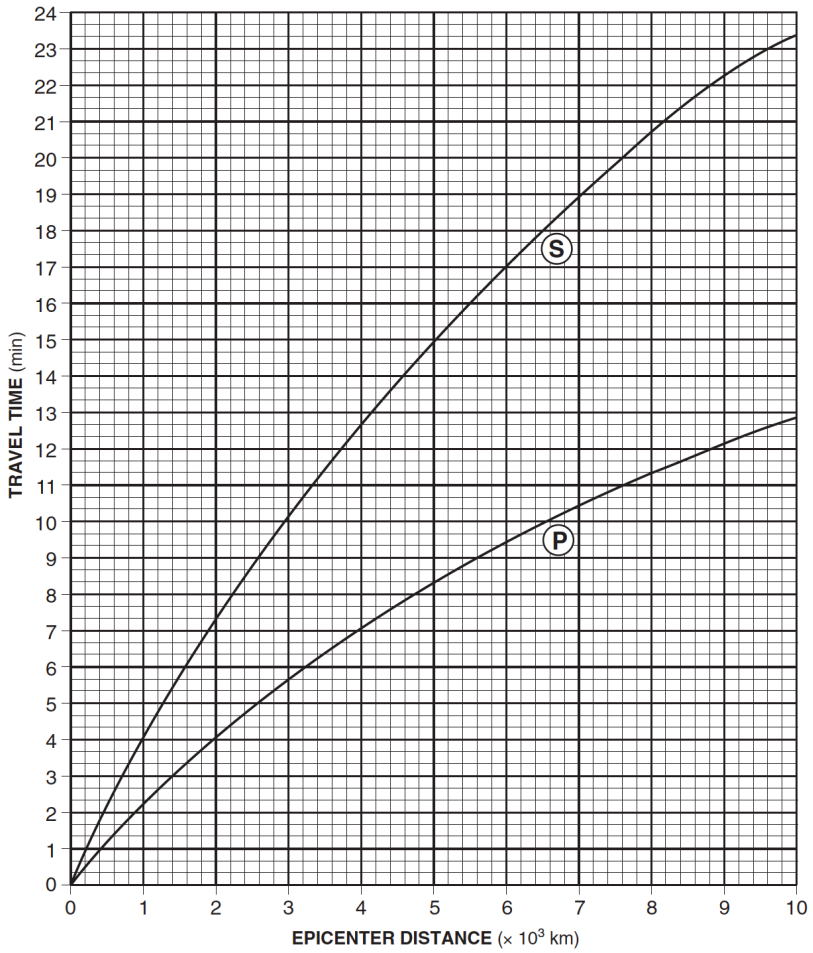
Time [h:min:sec]

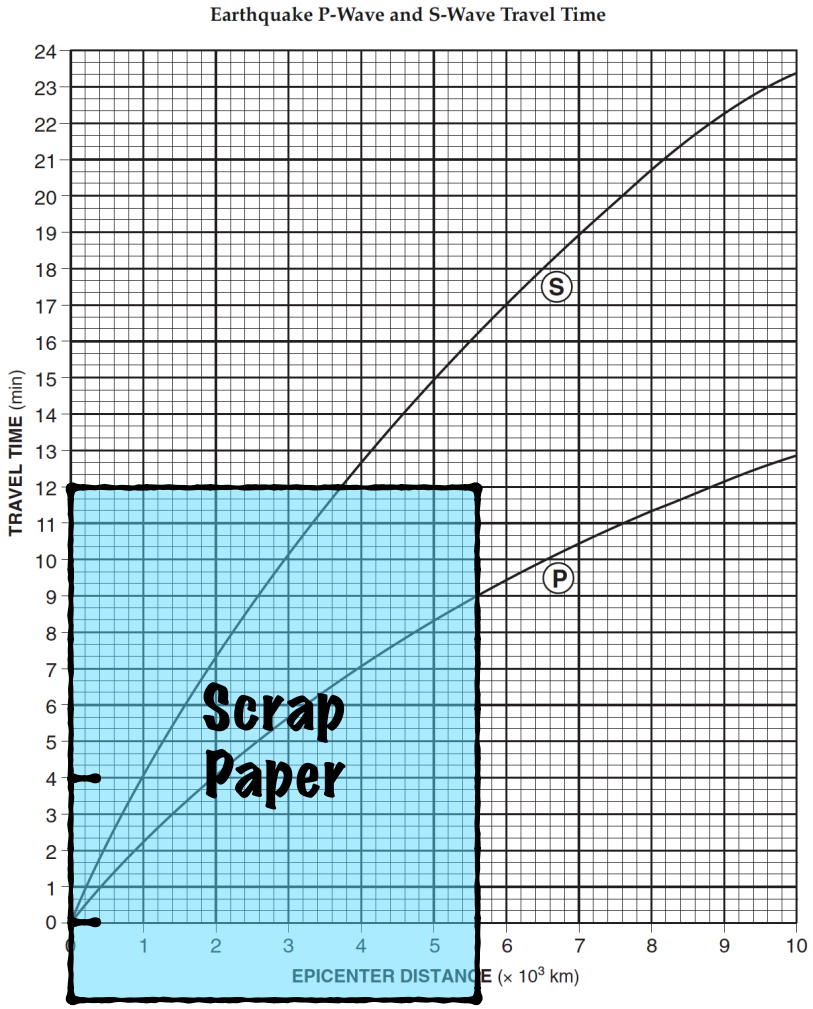
Locating Epicenters

- Steps to Locate an Epicenter [continued]:

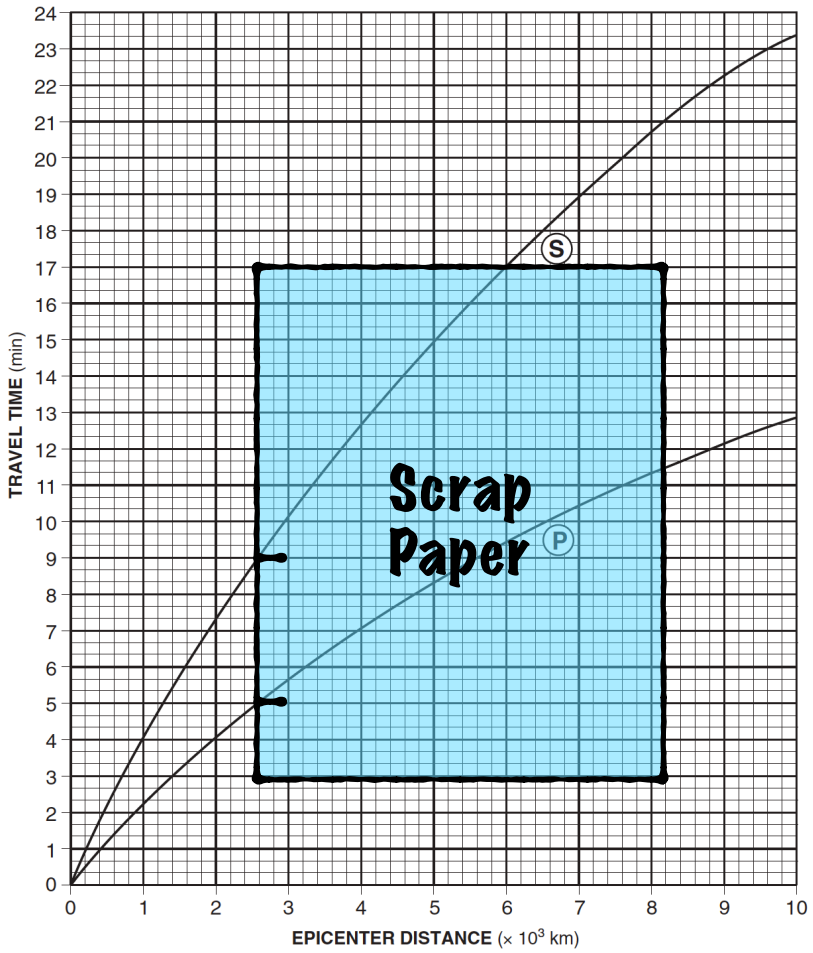
    2. Use scrap paper to mark the time difference on the "Earthquake P-Wave and S-Wave Travel Time" chart
    3. Slide the scrap paper [with the time difference marks] until it fits perfectly between the S and P lines
    4. Look straight down for the "Epicenter Distance"

Earthquake P-Wave and S-Wave Travel Time

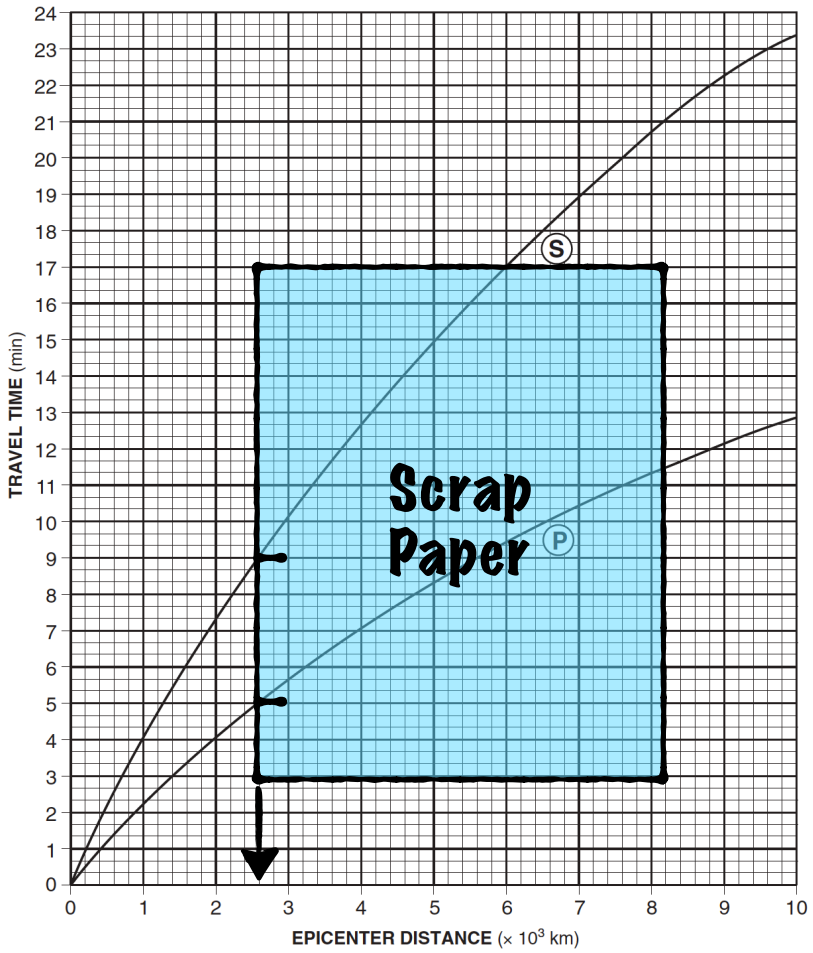



Earthquake P-Wave and S-Wave Travel Time
TRAVEL TIME (min)
EPICENTER DISTANCE (× 10³ km)
S
P
Scrap Paper

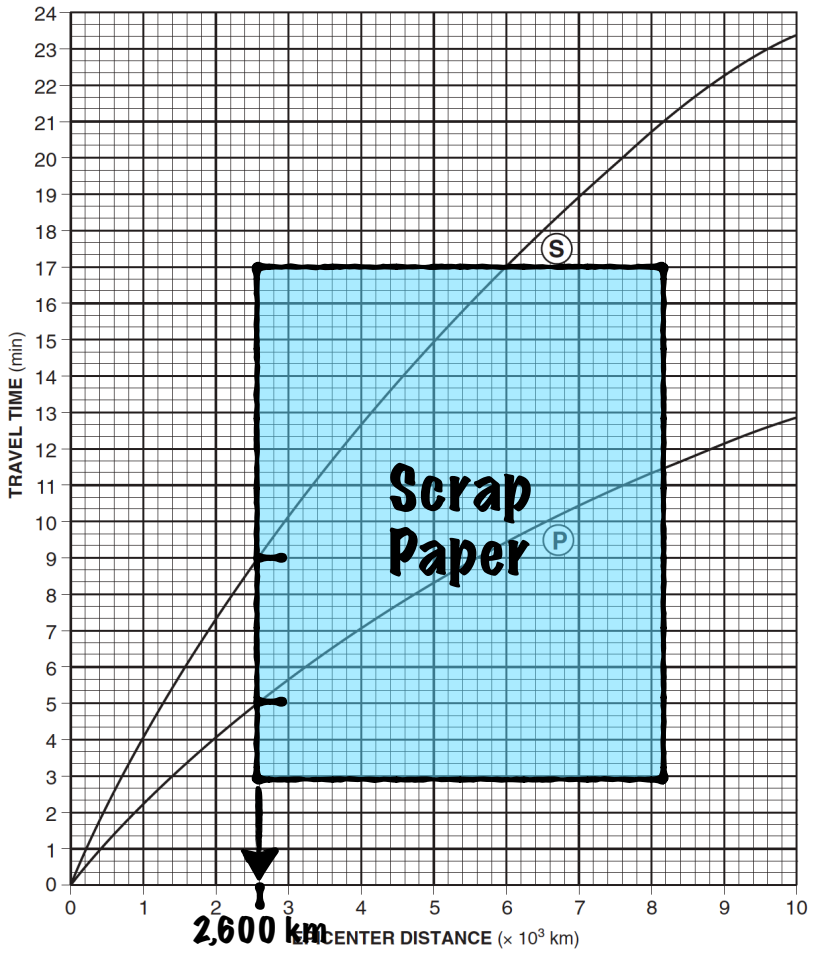
Earthquake P-Wave and S-Wave Travel Time



Earthquake P-Wave and S-Wave Travel Time



Earthquake P-Wave and S-Wave Travel Time



Locating Epicenters

- Steps to Locate an Epicenter [continued]:

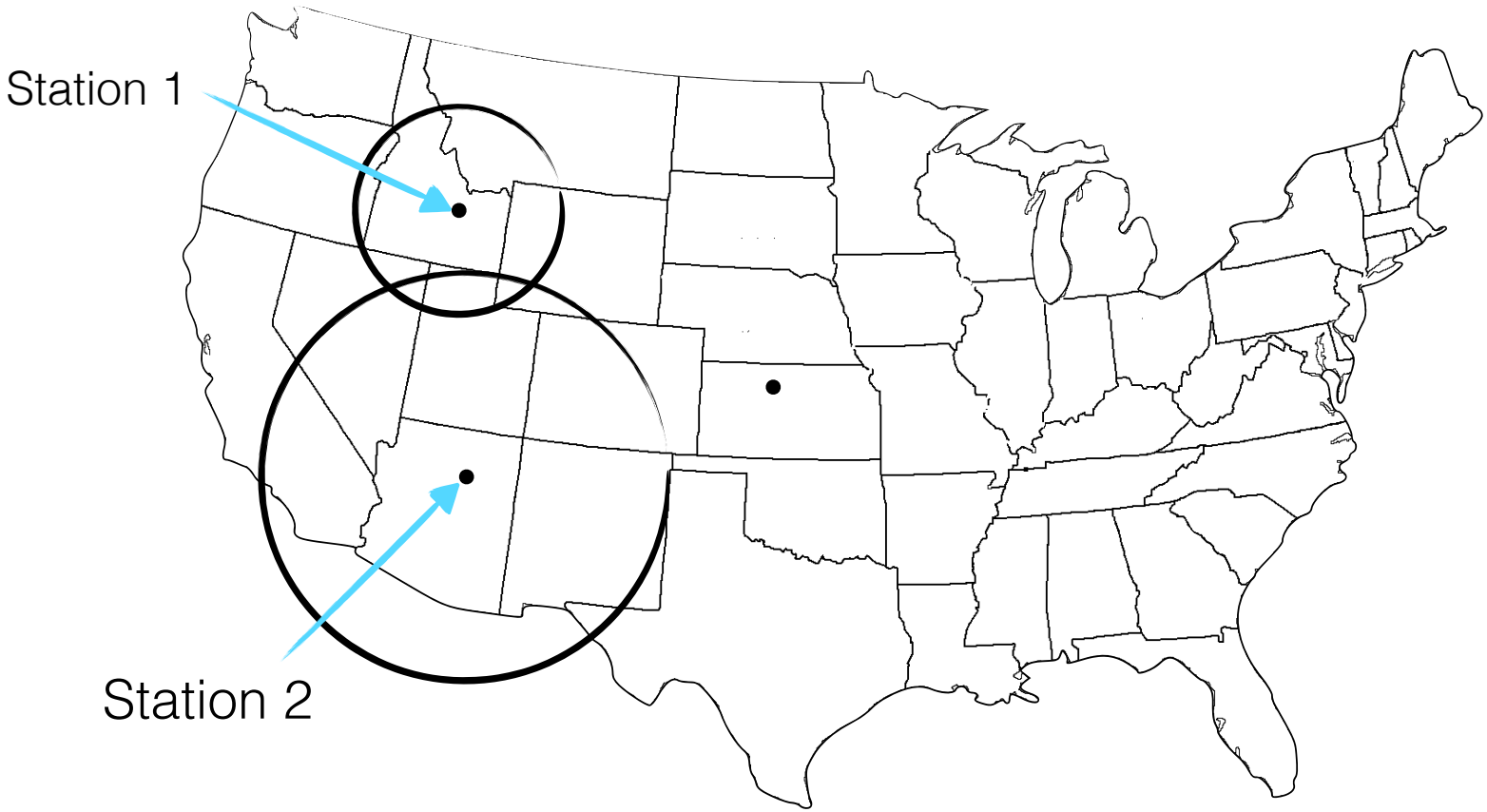
    5. Using a safety compass, draw a circle from the seismograph station for the determine “Epicenter Distance”

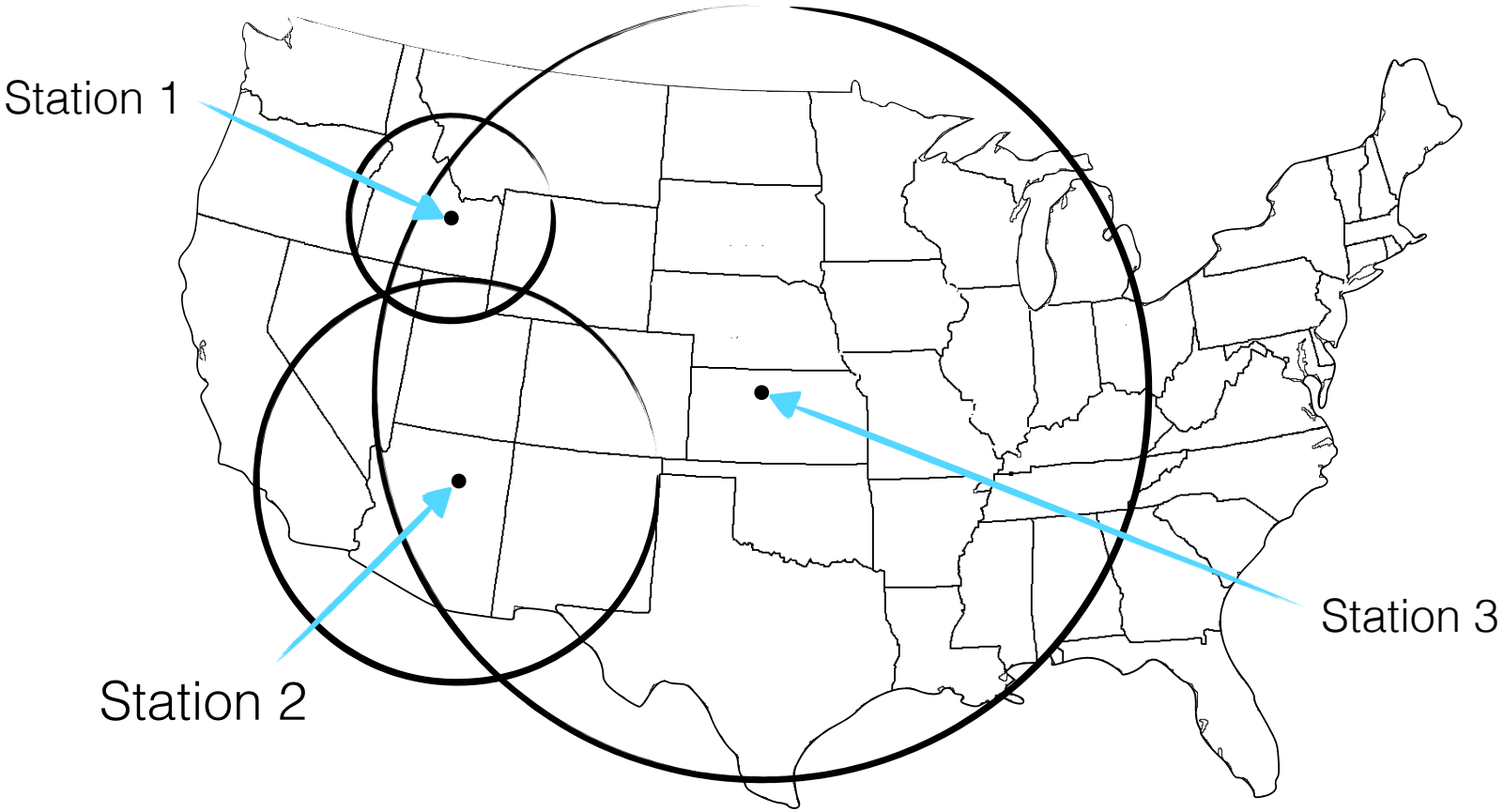

Station 1

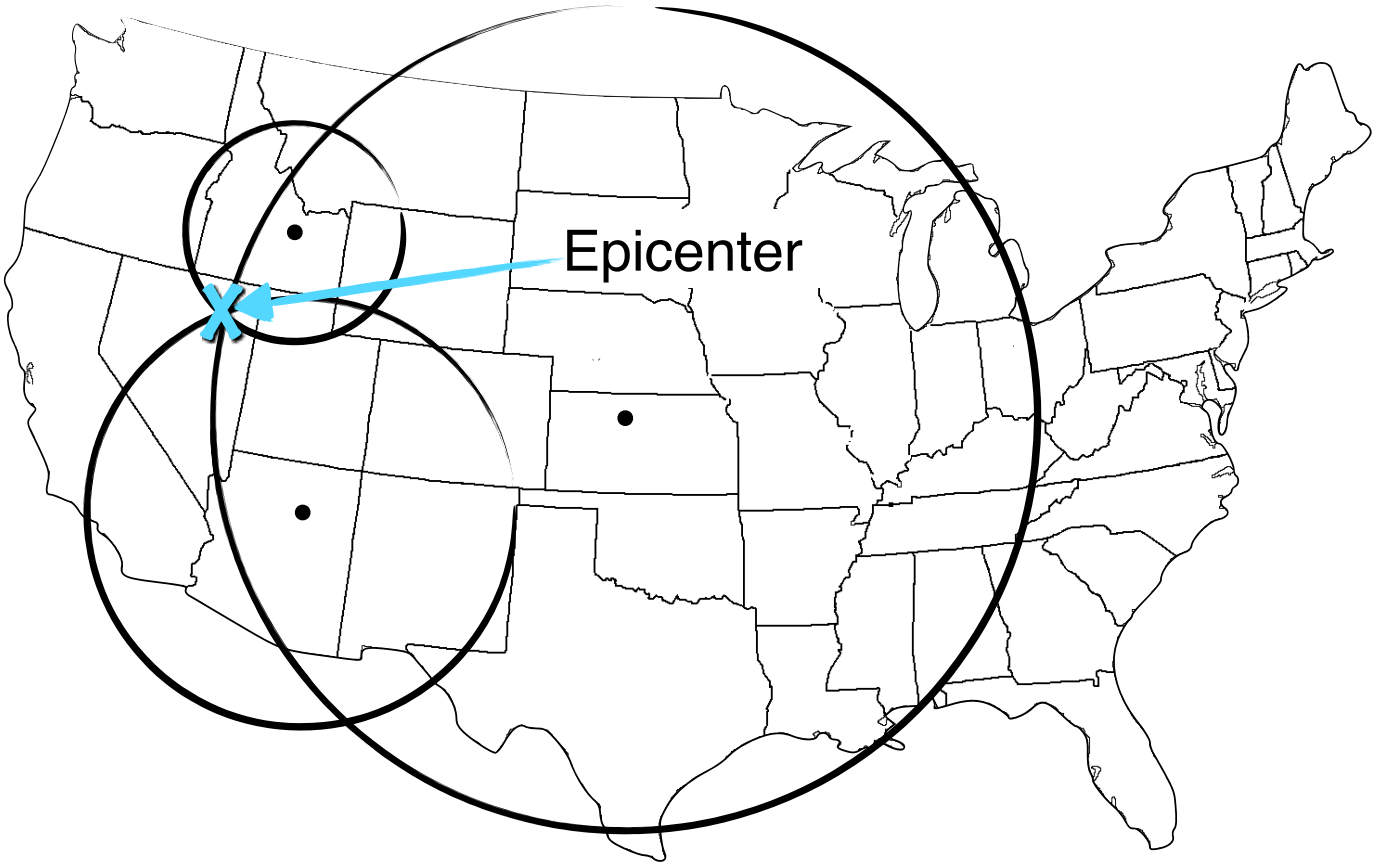
Locating Epicenters

- Steps to Locate an Epicenter [continued]:

    6. Repeat steps 1-5 for the two additional seismograms to find the intersecting point for the three circles
    7. Mark it with an “X”


Station 1
Station 2


Station 1
Station 2
Station 3


Epicenter