

# PREDICTING EARTHQUAKES

*“At 5:15 A. M., April 18th, 1906, thousands and thousands of people were awakened in terror by a rushing, roaring, rumbling noise, and before any one could collect half a thought the earth began to rock, and rise, and lower, and roll like a mighty sea.*

*Terror seized every living creature within its wake. There was a slight lull for about a quarter of a second, then a mightier roll came that made all living think only of God's mercy; then the rolling stopped with a twisting, ziz-zag jerk, as though the old earth had ceased to move around on its axis and was slipping and groaning under its weight like steel rails under a train of cars. Buildings rocked, poised for a moment, then toppled and fell to the ground—some in a heap of ruins burying their inmates underneath to a terrible”* "The San Francisco Earthquake, 1906," EyeWitness to History, [www.eyewitnesstohistory.com](http://www.eyewitnesstohistory.com) (1997)

**Purpose of this lab:** To explore and learn the method used by seismologists to determine the epicenter of recent earthquakes in attempt to make predictions of the general location of future earthquakes.

## Vocabulary to use while investigating:

### Seismogram

"I see the P-wave first struck at 9:03:00, see, where the first wiggly line is on the **seismogram**"

**Definition:**

### Epicenter

"The actual earthquake occurred 345 meters underground, but the epicenter of this earthquake was located in San Francisco"

**Definition:**

### Lag Time

"Find the **lag time** by subtracting the P-wave from the S-wave time"

**Definition:**

## Directions:

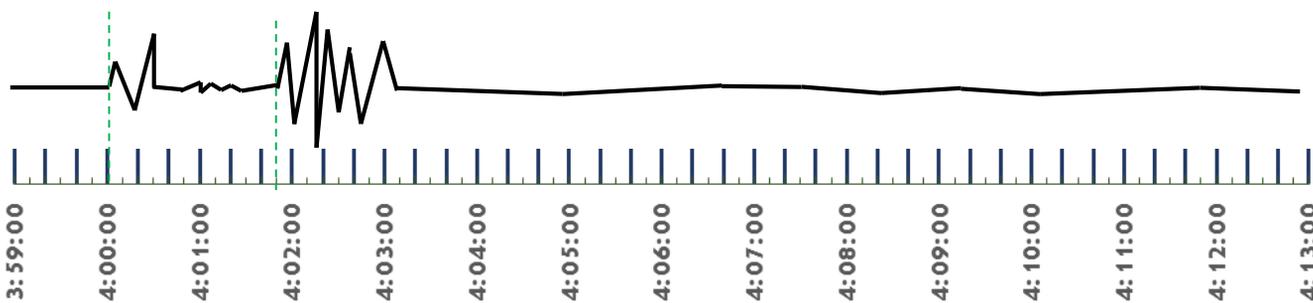
- ❑ The senior seismologist will use data set 1 and Map 1 to demonstrate how one uses seismograms to calculate the distance of the earthquakes epicenter. Using the data, the senior seismologist will use the triangulation method to determine where the epicenter of the earthquake is located geographically.
  
- ❑ After the demonstration is complete, you and your team will locate the epicenters using the three additional data sets and maps. Please follow these steps:
  - 1.) Analyze the data set for location 2.
  - 2.) Calculate missing data and record your findings
  - 3.) CHECK YOUR KEY to ensure accurate data
  - 4.) Use the triangulation method to determine epicenter location on map 2
  - 5.) CHECK YOUR KEY to ensure your using the method correctly
  - 6.) Repeat steps 1 - 5 for the last two data sets

## Conclusions:

1. Why must you have three seismogram data sets to locate an epicenter?
  
  
  
  
  
  
  
  
  
  
2. Using the final page of additional data, could the epicenters you determined be represented on the "Earthquakes in 2012" map?
  
  
  
  
  
  
  
  
  
  
3. Where do earthquakes appear to strike?
  
  
  
  
  
  
  
  
  
  
4. The triangulation method was used to locate the earthquakes displayed on the "Earthquakes in 2012" maps. Using this data, how accurately can we predict earthquakes (when and where they will happen), and is this prediction useful?

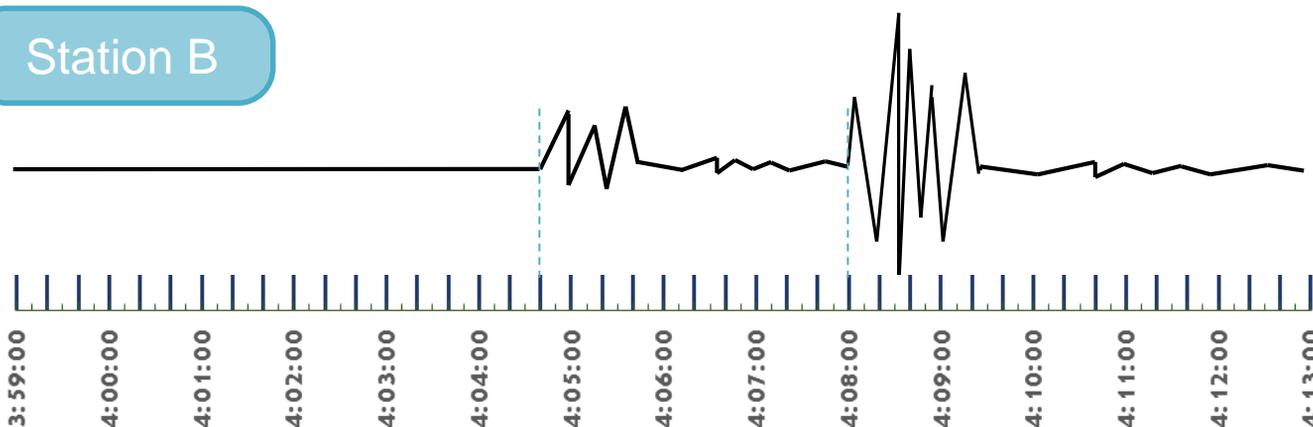
# Location 1: North America Data Set

## Station A



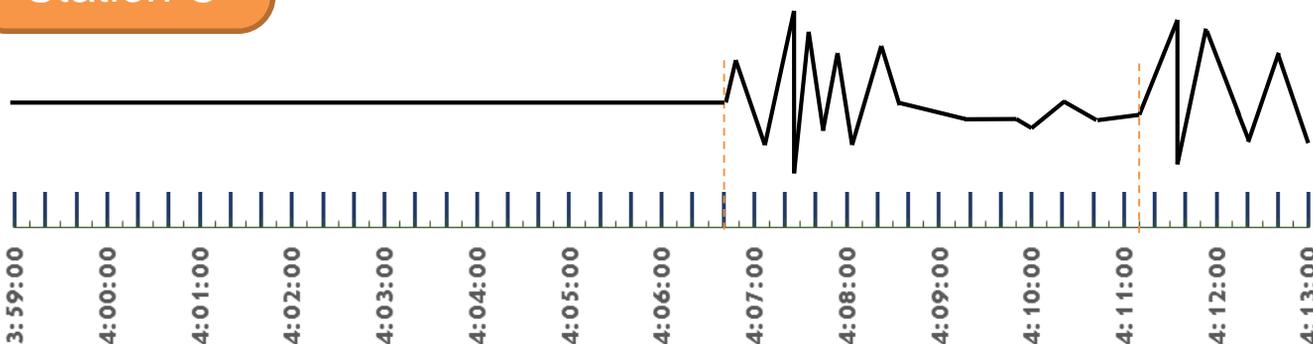
| P-Wave Arrival Time | S-Wave Arrival time | Lag Time | Epicenter Distance |
|---------------------|---------------------|----------|--------------------|
|                     |                     |          |                    |

## Station B



| P-Wave Arrival Time | S-Wave Arrival time | Lag Time | Epicenter Distance |
|---------------------|---------------------|----------|--------------------|
|                     |                     |          |                    |

## Station C



| P-Wave Arrival Time | S-Wave Arrival time | Lag Time | Epicenter Distance |
|---------------------|---------------------|----------|--------------------|
|                     |                     |          |                    |

## Location 2: South America

| Station | P Wave Arrival Time | S-wave Arrival Time | Lag Time | Epicenter Distance from Station | P-Wave Travel Time | S-Wave Travel Time | Origin Time |
|---------|---------------------|---------------------|----------|---------------------------------|--------------------|--------------------|-------------|
| A       | 1:44:50 PM          | 1:20:40 PM          |          |                                 |                    |                    |             |
| B       | 1:13:10 PM          | 1:17:40 PM          |          |                                 |                    |                    |             |
| C       | 1:10:50 PM          | 1:13:30 PM          |          |                                 |                    |                    |             |

## Location 3: Asia, Africa, Australia

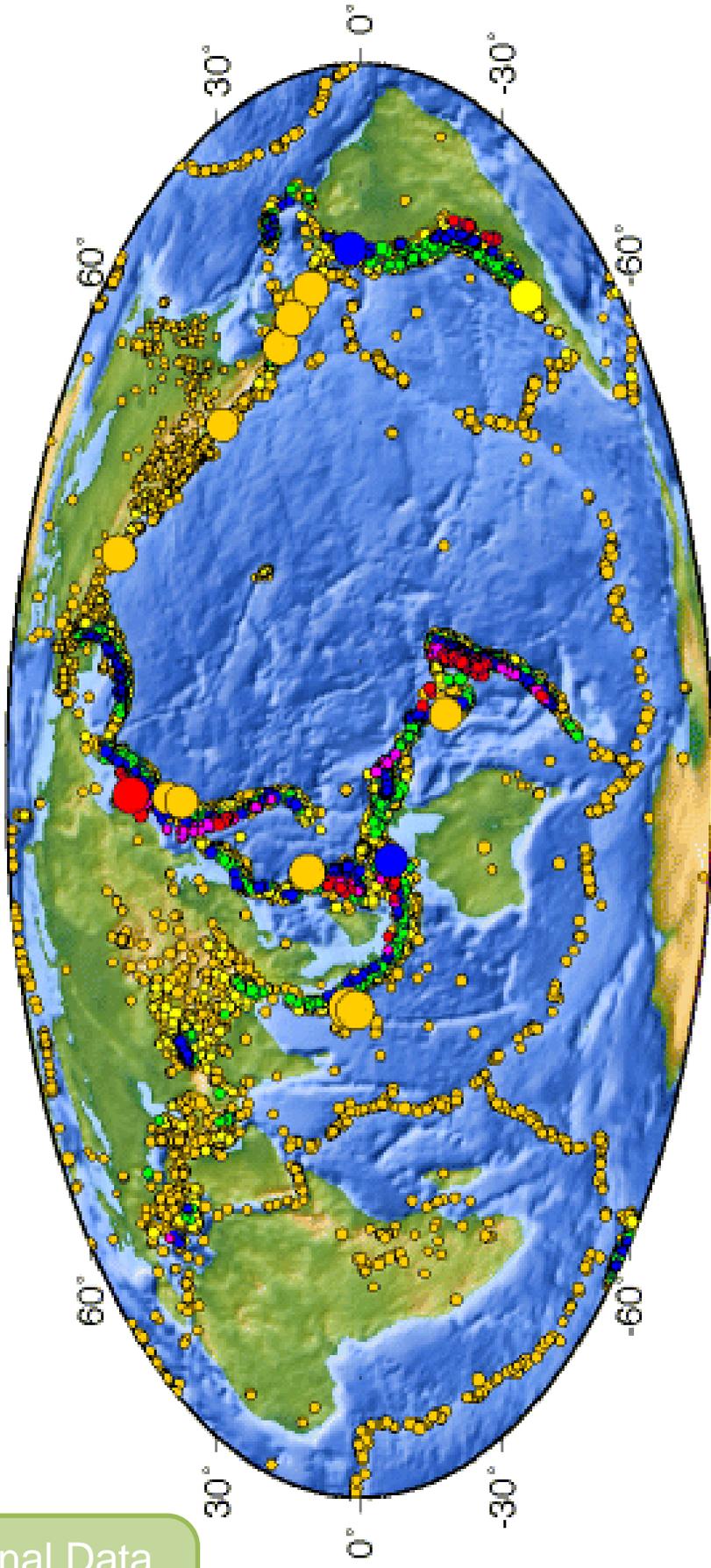
| Station | P Wave Arrival Time | S-wave Arrival Time | Lag Time | Epicenter Distance from Station | P-Wave Travel Time | S-Wave Travel Time | Origin Time |
|---------|---------------------|---------------------|----------|---------------------------------|--------------------|--------------------|-------------|
| A       | 8:03:20 AM          | 8:05:50 AM          |          |                                 |                    |                    |             |
| B       | 8:08:40             | 8:15:30             |          |                                 |                    |                    |             |
| C       | 8:06:00 AM          | 8:10:40 AM          |          |                                 |                    |                    |             |

## Location 4: Indonesia

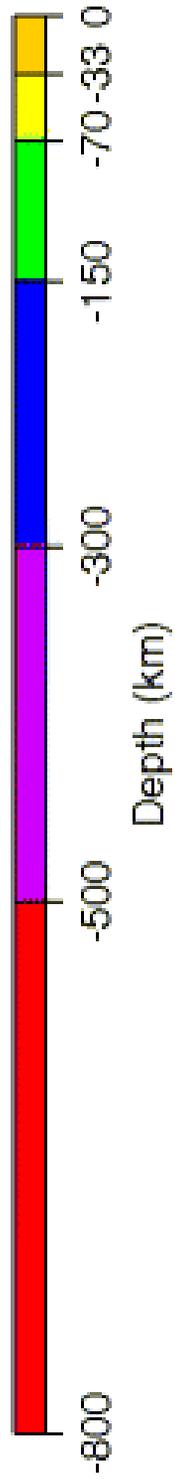
| Station | P Wave Arrival Time | S-wave Arrival Time | Lag Time | Epicenter Distance from Station | P-Wave Travel Time | S-Wave Travel Time | Origin Time |
|---------|---------------------|---------------------|----------|---------------------------------|--------------------|--------------------|-------------|
| A       | 3:41:40 PM          | 3:47:10             |          |                                 |                    |                    |             |
| B       | 3:39:50 PM          | 3:43:50 PM          |          |                                 |                    |                    |             |
| C       | 3:38:50 PM          | 3:42:10 PM          |          |                                 |                    |                    |             |

# Earthquakes in 2012, Located by the NEIC

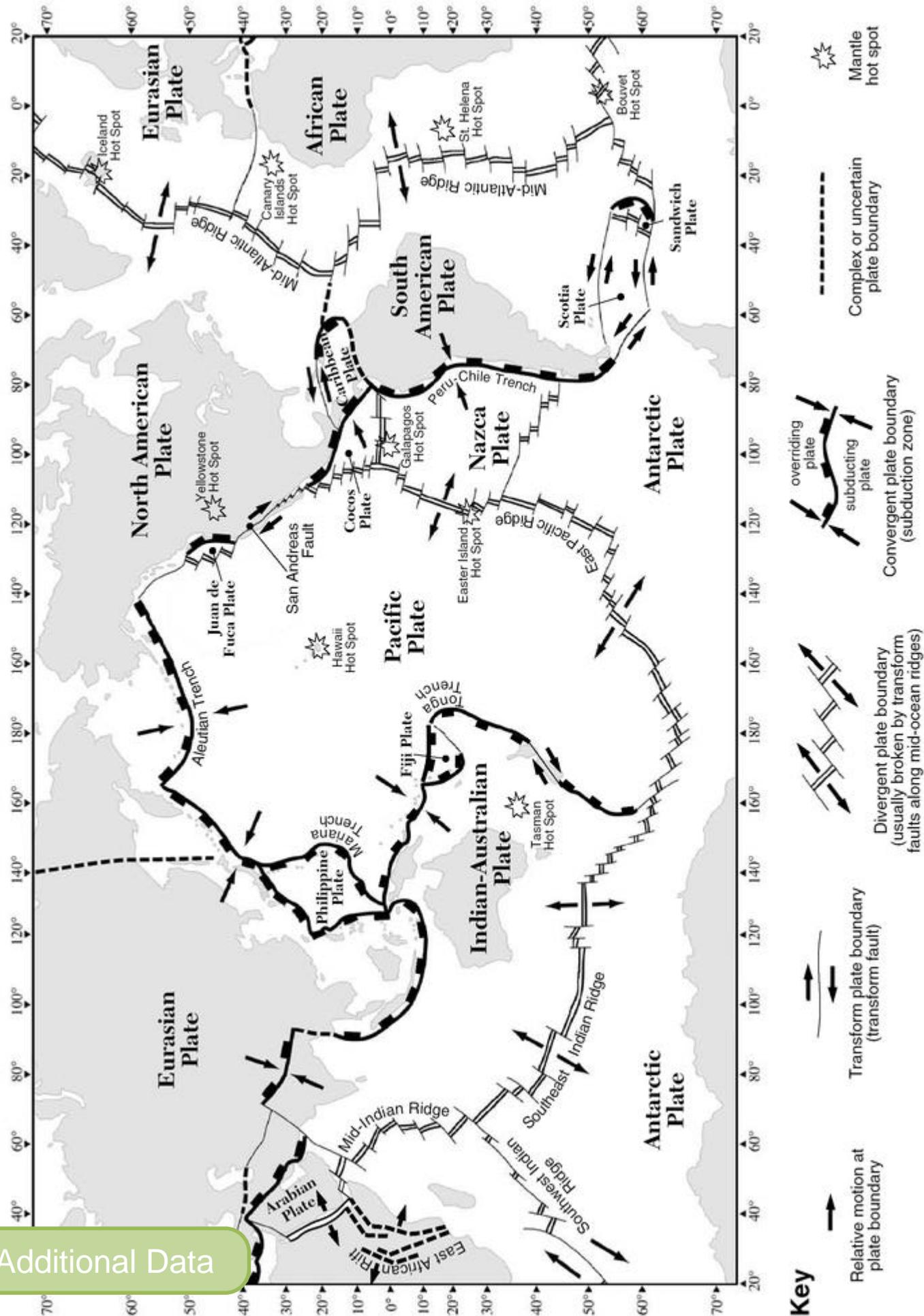
Additional Data



USGS National Earthquake Information Center Mon Aug 26 03:50:14 MDT 2013



# Tectonic Plates



Additional Data