How to find an earthquake’s epicenter using triangulation!

Epicenter: spot on earth directly above the quake’s focus, site of most damage (usually).

Amplitude: length of tallest wave (mm)



Example of a seismogram:----------------------- >

Find the following and identify them to your partner:

* P-waves and the P-wave arrival time
* S-waves and the S-wave arrival time
* S-P interval (expressed in seconds)
* S-wave maximum amplitude (measured in mm)

This S – P interval is 46 seconds. ------🡪

#### How is an Earthquake's Epicenter Located?

\_\_\_ 1. you need to examine earthquake’s seismograms as recorded by three different seismic stations.

\_\_\_ 2. On each seismogram, you measure the S- P time interval (in seconds)

\_\_\_ 3. This S-P time interval will be used to find the distance (km) the seismic waves traveled from the earthquake’s epicenter to that seismograph location.

\_\_\_ 4. the actual location of the earthquake's epicenter will be on the perimeter (edge) of a circle drawn around the seismograph location

\_\_\_ 5. The radius of this circle is the epicentral distance. One S - P measurement will produce one epicentral distance: the direction from which the waves came is unknown. Three stations are needed in order to "triangulate" the location.



Let’s try it!

An earthquake happened in San Francisco, USA. Where did it start (epicenter)?

1. and 2. Find the S – P time interval (seconds) for each seismogram below.



1.

Eureka, CA seismic station. S – P time interval= \_\_\_\_\_\_\_



2.

Elko, NV seismic station. S – P time interval = \_\_\_\_

3.



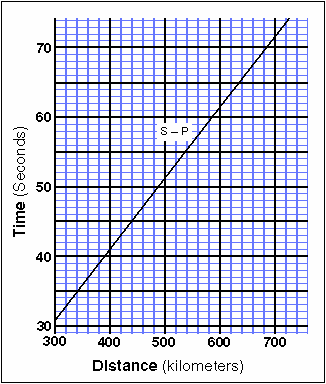
Las Vegas, NV seismic station. S- P time interval=\_\_\_\_

You can now determine the distance from each seismograph station to the earthquake's epicenter using the known times of travel of the S and P waves.

You need a graph (already prepared for you below!)

S – P Graph

S – P Graph



3. Use the S-P graph to the left and the estimates you made for the S-P time intervals (see above numbers in seconds) for the three seismograms (shown again for your convenience) to complete the table below.

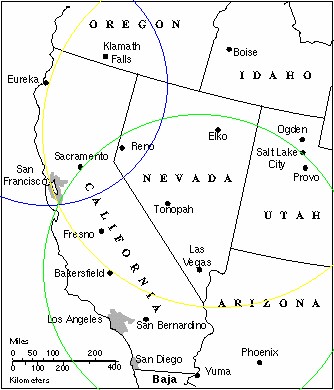
The horizontal grid is in one second intervals.

|  |  |  |
| --- | --- | --- |
| **Station** | **S-P Interval** | **Epicentral Distance** |
| Eureka, CA | \_\_ seconds | KM |
| Elko, NV | \_\_ seconds | KM |
| Las Vegas, NV | \_\_ seconds | KM |

Fill in the table below. Use the numbers from above and the graph to the right.

4. and 5. At this point you would draw the radius of the circles around the seismograph locations (using the distance in KM from above table). Notice the colours, each circle is around one of the seismograph locations (Eureka, CA, Elko, NV and Las Vegas, NV) and each location has its own colour (to differentiate the circles).

The point where all 3 circles (yellow, green, blue) meet, that is where the epicenter is! It would look like this:



**Next we find the magnitude (Richter scale)!**

We need: a seismogram ~ already found up above (#1, 2, 3)!

S-P time interval ~ already found up above in the chart!

Amplitude of wave ~ use the seismograms above to measure the tallest wave (mm)

Nomograph (scale used to relate S-P distance, Amplitude and Richter scale together)

Nomographs:

1. Eureka Seismogram Magnitude 2. Elko Seismogram Magnitude

|  |  |  |
| --- | --- | --- |
| Distance (km) | Magnitude | Amplitude (mm) |
|  |  |  |

|  |  |  |
| --- | --- | --- |
| Distance (km) | Magnitude | Amplitude (mm) |
|  |  |  |



3. Las Vegas Seismogram Magnitude

**INSTRUCTIONS FOR #1 (do the same for #2 and #3)**



- Find seismogram 1 (2, 3).

- Measure the tallest wave \_\_\_\_\_ (mm). Make a small dot on the Amplitude scale above (nomograph 1).

- Scroll to the S –P graph. Look at the table.

- Find the distance (km) for seismogram 1 \_\_\_\_\_ (km). Make a small dot on the Distance scale above.

- Using a ruler or straight edge, connect the 2 dots together so you have a diagonal straight line. Where the line crosses the Magnitude scale, this is your magnitude for seismogram 1. Fill in the chart.

|  |  |  |
| --- | --- | --- |
| Distance (km) | Magnitude | Amplitude (mm) |
|  |  |  |

What is the average magnitude for this earthquake in San Francisco? \_\_\_\_\_\_\_\_\_

Adapted from geology labs online http://www.sciencecourseware.org/VirtualEarthquake/VQuakeExecute.html