How do seismograph stations help determine an earthquakes epicenter?

Earthquakes can be dramatic events. Although we can sometimes see an earthquakes effect, it actually occurs in Earth’s crust.

Forces inside Earth keep its crust in constant motion. When the crust moves, it puts stress on rocks. The rocks break when the force is too great. Earthquakes are the vibrations that a break produces.

Earthquakes produce seismic waves. Primary waves, or the first waves, move through Earth by making particles in rocks move back and forth in the direction the wave is moving. Secondary wave move through Earth b making particles in rocks move at right angles to the direction of the wave.

Primary earthquake waves travel faster than secondary earthquake waves. Seismologists an use this difference in speed to determine the distance from a seismograph station to an earthquakes epicenter. Because primary waves are faster, they will arrive at a seismograph station before secondary waves. The difference in arrival ties of seismic wave increase with the distance between the epicenter and the seismograph station. Therefore, seismologists can tell how far away a seismograph station is from an earthquake epicenter by measuring the difference in arrival ties of the two seismic waves. The epicenter location can be found using three seismograph stations.

In this Virtual Lab, you will investigate the methods for finding an earthquakes epicenter.

Objectives:

* Determine the epicenter of an earthquake, using seismograph readouts and a distance graph.

Procedure: FIRST – prepare a Data Table (see below)

1. Read the news flash. Click Close to start the activity.
2. Click a station letter on the U.S. map. Open the Table and record your selection in the appropriate row and column.
3. Read the Seismograph Readout for the station. Find the difference between the arrival ties of the primary and secondary waves by subtracting P from S. Each tick on the Seismograph Readout represents 15 seconds. Round off your finding to 15 second increments. Use the calculator if you need to. In order to find the difference in arrival times, you will need to subtract the primary wave arrival time from the secondary wave arrival time To do this, may need to “borrow” a minute and add it to your seconds. For example, if the primary wave arrived at 2:12 pm and thirty seconds, and the secondary wave arrive t 2:15 pm and fifteen seconds you could re-write 2:15:15 as 2:14:75 as shown below

 2:15:15 2:14:75

 -2:12:30 -2:12:30

 2:45

 Open the Table and record your findings in the appropriate row and column.

 (NOTE: the time is always listed in Eastern Standard Time. For example, 2:00:00 is two o’clock

 exactly. “P” stands for Primary Wave Arrival Time, and “S” stands for Secondary Wave

 Arrival Time. The first major upswing or downswing is the beginning or arrival time of a primary

 wave)

1. Click the Distance Graph button. Each tick on the Y axis represents a 15 second increment. On the Y axis find the time difference you calculated and then find the corresponding X value. Round off the distance to the nearest 500 m increment. Click Close. Record your finding in the appropriate row and column on your data table.
2. Click the pencil in the compass. Drag it to the notch that corresponds with your distance finding.
3. Click the Draw Circle button to place the circle around the station. (Some circles may not be completely visible because they are larger than the map.) Click erase Circle button if your want to erase the circle of the selected station.
4. Select another station. Repeat the above steps until you have at least three circles.
5. Click Check.
6. If your circles are correct, the epicenter star will highlight. Click and drag the star to the epicenter – the intersection of the circles. Record your findings.
7. Click the Reset button to explore different stations and find another earthquakes epicenter.
8. Answer the Journal Questions.

Data Table: - Prepare a Data Table with the following headings….

|  |  |  |
| --- | --- | --- |
| Station Letter  | Difference Arrive Times (Minutes and Seconds) | Distance from the Epicenter (kilometers) |
|  |  |  |
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Journal Questions:

1. In which state was the earthquakes epicenter located? (refer to a US map if needed)
2. Why does the time difference between the arrival of primary and secondary waves grow longer at Seismograph stations that are farther away from the epicenter?
3. Based on this activity, how can the epicenter of an earthquake be accurately located?