Study tip: Earthquake cycles

Background information

Earthquakes occur along faults. Faults are fractures in the rock below the Earth's surface, places where two masses of rock separate from each other, usually by sliding past each other. The Earth's crust is in motion (as explained by the theory of plate tectonics). This motion results in stresses within the Earth. Normally, a fault is locked or stuck and will not move. However, if the stresses build up high enough, the rocks along the fault will move suddenly. This makes the rocks "shiver,"—and that is an earthquake. Seismologists and geologists have a model for this. For some faults they believe that the stress must reach a certain level before it is high enough to overcome the frictional resistance to sliding in the fault rocks. If the stress buildup is continuous, the earthquakes occur at regular intervals and are part of an earthquake cycle.

Seismologists have learned that some faults are more likely to move at short intervals, and others are more likely to move at long intervals. Not all faults fit a cyclic or predictable pattern, and even very cyclical faults do not always fit a pattern. In general, however, studies of a fault's earthquake history help geologists determine how likely it is that an earthquake may occur in the future.

Parkfield background

This town in central California is located right on the San Andreas fault.

To attempt to answer the questions about when, where, how big, and how often an earthquake will happen along a fault, scientists look at the historical record of the fault. A good example of this is a segment of the San Andreas fault near Parkfield, the site of a moderate earthquake (about magnitude M6) about every 20 years. Based on the historical record and other evidence, the U.S. Geological Survey predicted in the 1980s that an earthquake near Parkfield would occur before the end of 1993. Although the expected earthquake has yet to occur, Parkfield remains the most likely site in California for a moderate earthquake. A list of the dates of recent earthquakes there is shown below. For more information, look on the web at http://quake.wr.usgs.gov/QUAKES/Parkfield/.

Earthquakes near Parkfield, California	
1.	1857
2.	1881
3.	1901
4.	1922
5.	1934
6.	1966

To understand the cycle of earthquakes at Parkfield, answer these questions:

1. What was the shortest time period between the earthquakes?
2. What was the longest time period between the earthquakes?
3. Plot these dates on graph paper and draw a straight line on the graph that best fits the data points.
4. Continue the line on your graph and use it to predict when the next big earthquake (no. 7) will hit Parkfield. What year did you get?
5. Calculate the **average** time between earthquakes. This is also known as the average recurrence interval.
6. (a). What is one of the least predictable earthquakes? (Falls farthest from the line or had a time interval farthest from average?)
   (b) In what year would you predict this earthquake should have occurred?
7. Looking at your answers to the above questions, do you think that this method of predicting earthquakes works in the Parkfield area? Why or Why not?

When it comes to determining the earthquake cycle of an area, Parkfield, is an unusual case. Most areas subject to earthquakes do not have them this often or this regularly. Oregon has not had any great earthquakes (greater than M 7.5) in historic time (since about 1800). Because of this, we used to think that Oregon did not have much risk of earthquakes.

Geologists are just beginning to learn about the Oregon earthquake cycle from the sedimentary deposits formed by great Northwest earthquakes. With this method, the dates of the earthquakes are difficult to determine, and some quakes may be missed. The table below shows the approximate dates of the last great earthquakes in Oregon.

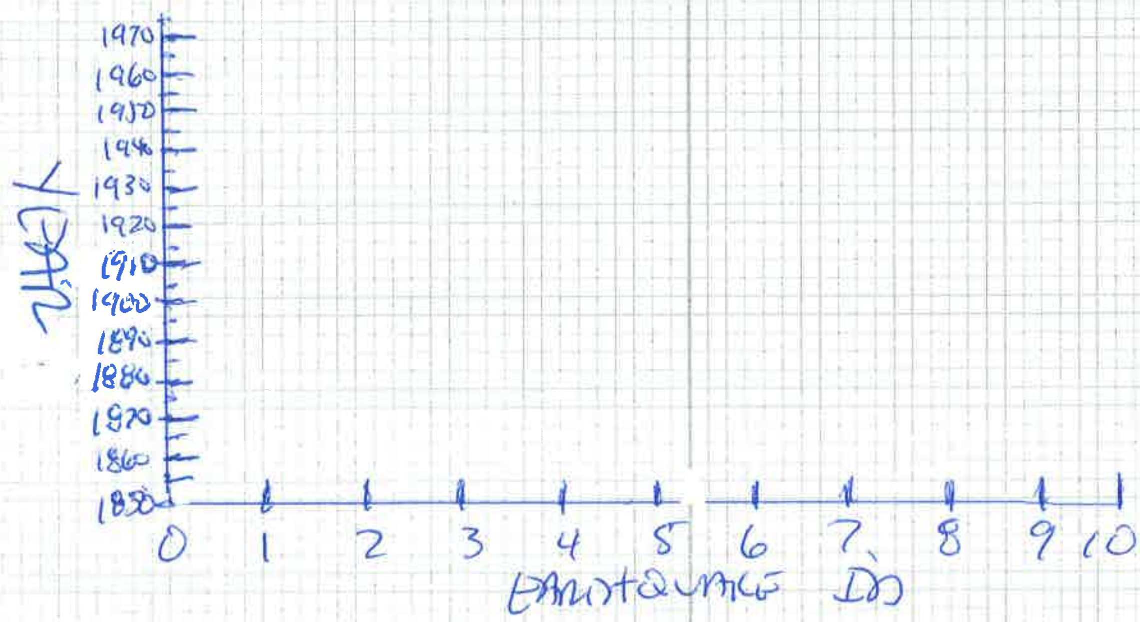
Cascadia subduction zone earthquakes	
1.	1400 BCE
2.	1050 BCE
3.	600 BCE
4.	400
5.	750
6.	900
7.	1700

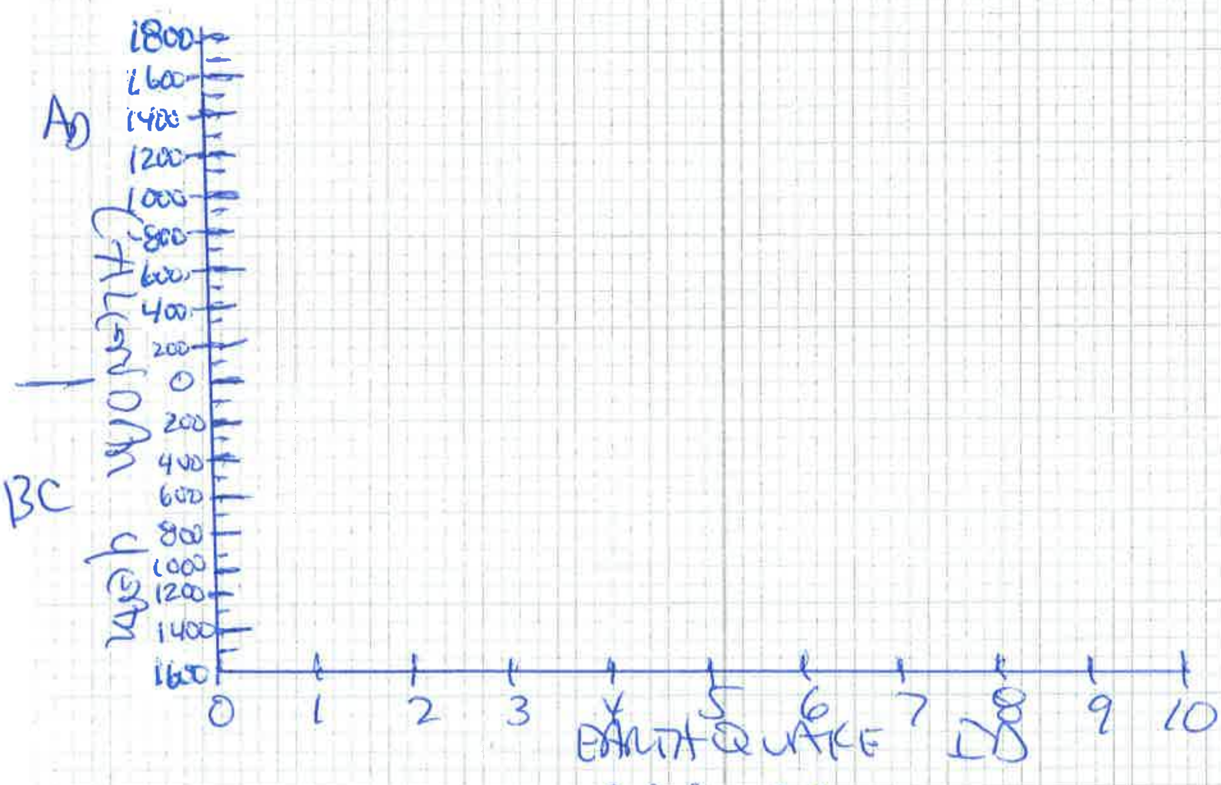
To understand the cycle of earthquakes on the Cascadia subduction zone, answer these questions:

1. What was the shortest time period between the earthquakes?
2. What was the longest time period between the earthquakes?
3. Plot these dates on graph paper and draw a straight line on the graph that best fits the data points.
4. Continue the line on your graph and use it to predict when the next big earthquake (no. 8) will hit Oregon. What year did you get?
5. Calculate the **average** time between earthquakes. This is also known as the average recurrence interval.
6. Looking at your answers to the above questions, do you think that this method of predicting earthquakes works for Cascadia subduction zone earthquakes? Is it more or less accurate than in Parkfield?
7. Based on this information, when do you think the next great earthquake will occur in Oregon? Do you think an accurate prediction can be made?

—From T. Atwill, Oregon earthquake and tsunami curriculum, grades 4–6, 1998.

PARK FIELD





CASCADIA