

Seconde International – Earthquakes

Earthquakes occur due to the shifting around of tectonic plates that makes up the Earth's crust. The tension that can build up between two plates produces a rupture and sudden abrupt motion, releasing vast amounts of energy that travel around and through the globe in the form of waves.

There is some specific vocabulary you will need to understand. Look these up and define them. A diagram may come in useful.

Focus: The focus is also called the hypocenter of an earthquake. The vibrating waves travel away from the focus of the earthquake in all directions. The waves can be so powerful they will reach all parts of the Earth and cause it to vibrate like a tuning fork.

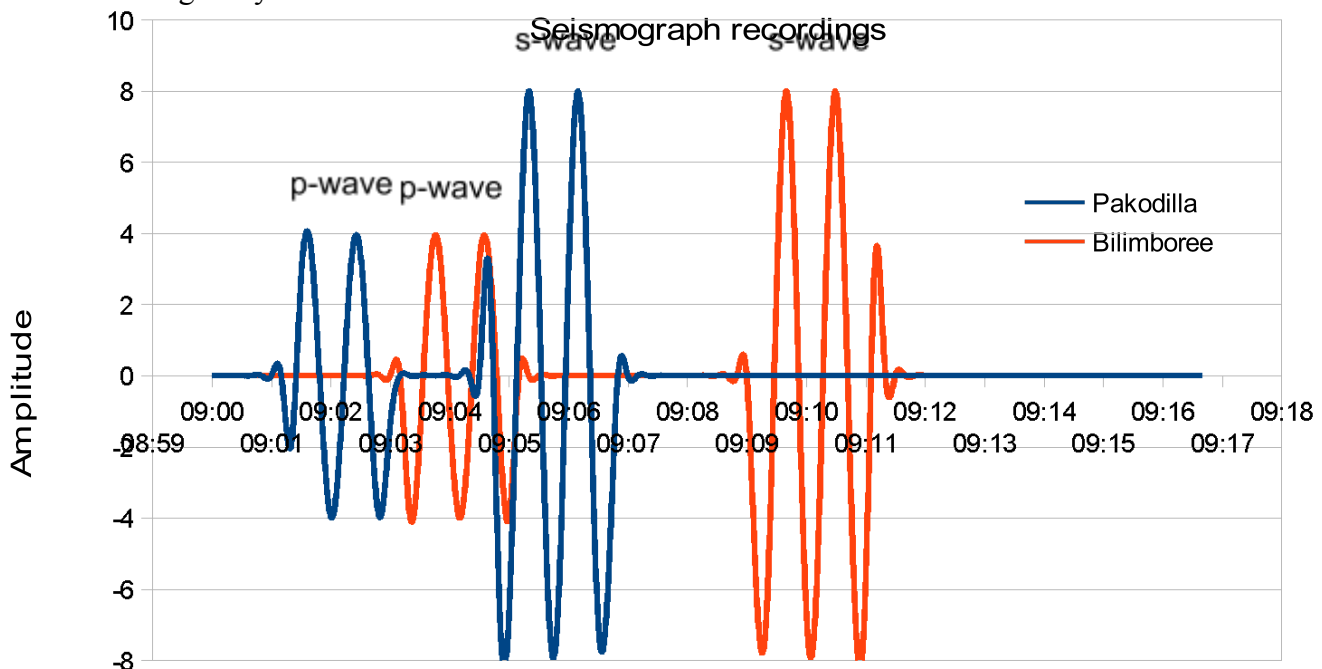
Epicenter: Directly above the focus on the Earth's surface is the earthquake epicenter. Earthquake waves start at the focus and travel outward in all directions. Earthquake waves do not originate at the epicenter.

The waves produced travel in two forms – primary (p-waves) and secondary (s-waves). Explain what each wave is and the differences between p and s-waves:

P-waves (P stands for primary) arrive at the detector **first**. They are longitudinal waves which mean the vibrations are along the same direction as the direction of travel.

S-waves (S stands for secondary) arrive at the detector of a seismometer **second**. They are transverse waves which mean the vibrations are at right angles to the direction of travel.

Two scientific bases, Bilimboree and Pakodilla, are equipped with seismographs and record the waves that arrive at their respective locations every day. On one particular morning, these are the recordings they make:



The speed of primary waves is roughly 12km/s. The speed of secondary waves is roughly 6 km/s

Annotate primary and secondary waves on the graph.
Describe what the graph is showing:

The graph above records the **amplitude** of earthquake waves at different time, thus reflecting the motion of both waves during the impact of an earthquake.

Write up a timetable of arrival times at each location for both primary and secondary waves:

	P-wave	S-wave
<i>Bilimboree</i>	9:01	9:04
<i>Pakodilla</i>	9:03	9:09

The waves have travelled a certain distance from the focus of the earthquake. However, we do not know at what time the earthquake occurred. Using the table above, find a way to calculate the distance of the focus from both Bilimboree and Pakodilla. Find a way to calculate the time at which the earthquake occurred.

Bilimboree

We assume that x is the time it takes the p-wave to travel from the focus to Bilimboree.

Hence S-wave spent $x + 4 \times 60 = x + 180$ seconds.

As they travel the same distance from the focus to Bilimboree,

we can establish that $12x = 6(x + 180)$

$\Rightarrow x = 180$ seconds

In the same way we can get $x=360$ for **Pakodilla**.

180 seconds = 3 minutes before 9:01 is 8:58.

360 seconds = 6 minutes before 9:03 is 8:57

Distance away from the focus

Bilimboree = $180 \times 12 = 2160$ km

Pakodilla = $360 \times 12 = 4320$ km