Essay: Tectonic plate boundaries

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Describe the main three types of the Earth's tectonic plate boundaries with examples of where they occur and explain the main cause of plate movement

There have been many theories about plate movement, one of the first theories was by geophysicist Alfred Wegener. Wegener proposed the idea that the continents used to fit together like a jigsaw puzzle, this was named Pangaea (Smithson et al, 2008). This process was called continental drift which was proposed in 1912. Wegener collected a lot of evidence to support his theory for example: the continental margins of Africa and South America fit together perfectly. Another piece of evidence was from palaeontology: fossils of dinosaurs such as the Mesosaurus were found on either side of the southern Atlantic Ocean (Mcknight et al, 2008).

Wegener later published his theories in his ground-breaking book, Die Entstehung der Kontinente and Ozeane (The Origin of Continents and Oceans), in 1915. Another theory regarding plate movement is sea floor spreading by an American geophysicist Harry Hess in 1960. Seafloor spreading is a geological course in which tectonic plates move apart from each other. This is a result of convection currents (Evers, 2011). Seafloor spreading occurs at mid-ocean ridges, where new oceanic crust is made by volcanic action and then moves from the ridge. To conclude, one part of Wegener's theory was wrong: the continents are rooted in the lithospheric plates which move by the action of seafloor spreading, therefore it is not just the continents that are drifting (Mcknight et al, 2008). By 1968 the theory of plate tectonics was being widely accepted by scientists.

There are three different types of plate boundaries. The first being divergent plate boundaries whereby the plates are moving away from each other. This happens above rising convection currents. This rising convection current pushes upwards on the bottoms of the lithosphere which causes it to lift and flow horizontally below it (King, 2015). The horizontal flow causes the plate material above to be pulled in the direction of flow. This is then followed by the plate on top being stretched thin, breaking then being pulled apart. Magma from the asthenosphere starts to rise up in the gap between the plates. This upwards movement of magma produces a line of volcanoes (Mcknight et all, 2008). Divergent plate boundaries usually produce a mid-ocean ridge, an example of this is the Mid-Atlantic Ridge. The formation of a mid-ocean ridge is also seen through figure 1. The oceanic rift which runs along the spine of the mid-ocean ridge is typical of what is known as an oceanic spreading centre. Spreading centres are connected with earthquakes that have ruptures about "75 kilometres of the surface" (Mcknight et al, 2008). According to Mcknight et al. (2008) Divergent plate boundaries can also result in a continental rift valley by developing within a continent. An example of this is the East African Rift Valley.

The second type of plate boundary is the convergent boundary. Convergent boundaries may also be referred to as "destructive" boundaries because the surface crust gets destroyed through subduction. On a convergent boundary the two tectonic plates collide as they move towards one another. Earthquakes and volcanoes are very common around convergent boundaries as a result of the pressure and friction between the plates. There are three types of convergent boundary, the first being oceanic-continental. When the oceanic and continental plates meet, the oceanic lithosphere is forced under the continental lithosphere going down into the mantle – this is called the subduction zone. The oceanic plate is forced below the continental because of its dense basaltic crust. According to Conrad et al. (2002) "slab pull" forces cause the subducting plate, in this case the oceanic plate, to the subduction zone. "Slab pull" can be argued to be the main cause of plate movement (Mcknight et al, 2008). An example of oceanic-continental plate boundary is the Nazca Plate moving towards the South American Plate. According to the Geological Society (2015) this is happening at about 79mm per year. The second type of convergent boundary is oceanic-oceanic. When this type of convergence happens one of the oceanic plates will subduct under the other. Usually the plate the subduct is the older one because of its higher density. Once the plate has been subducted, an oceanic trench is formed. As a result deep focus earthquakes happen and a chain of volcanic islands form on the ocean floor. Once the volcanic island arcs develop, they can develop to become island arcs. Examples of island arcs include Japan and St Lucia. The next example of a convergent boundary is a continental-continental convergence. Because the continental crust is buoyant none of the plates subduct. Instead when both plates collide they compress, this compression can cause widespread folding of rocks within the two plates. An active example of continental collision is the Himalaya Mountain Range. The Himalaya's started to form 35 million years ago. Shallow-focus earthquakes are very common within the conditions of continental collision (Mcknight et al, 2008).

The last type of plate boundary is the transform boundary. At this boundary the two plates go past one another horizontally. Transform boundaries may also be referred to as "conservative" because unlike at convergent and divergent plate boundaries no crust is destroyed or created. The most famous example of a transform boundary is the San Andreas Fault in California. According to King. (2015). "Transform faults are locations of recurring earthquake activity and faulting." Earthquakes on these faults are normally shallow.

Mostly all the transform faults are along the mid-ocean ridge.

Wegener's theory of continental drift and Hess' theory of seafloor spreading has helped many scientists understand plate tectonics and natural disasters such as earthquakes and volcanoes. Although according to Conrad et al. (2002) "the mechanism by which mantle convection drives plate motions has been the subject of debate" which shows there is still some uncertainty in the scientific community.

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