

## GLG 101 – CHAPTER 12 - EARTH'S INTERIOR

- Most of our knowledge of the deep internal structure of the Earth has come from the study of seismic waves (produced by Earthquakes) that have passed through the Earth. In general, such waves travel faster in solid elastic materials than in weaker or fluid materials. Seismic waves are bent (refracted) and reflected at boundaries between compositionally or mechanically different materials. These boundaries can be “seen” using seismic waves as “range finders”.
- The **compositional layers** of the Earth are the **crust**, **mantle**, and **core**. The crust ranges in thickness from ~3 km at the mid-oceanic ridges to over 70 km beneath large mountainous regions of the continents. The mantle is a solid (primarily) rocky shell that extends from just beneath the crust to a depth of about 2900 km; about 82% of the volume of the Earth is contained in the mantle. The core is an iron-rich sphere with a radius of 3486 km.
- The crust is of two main types: **oceanic crust**, and **continental crust**. The oceanic crust ranges from 3 to 15 km in thickness, is composed primarily of basaltic igneous rocks, and has a relatively high density ( $3.0 \text{ g/cm}^3$ ). Oceanic crust is typically less than 180 million years old. The continental crust is thicker (up to 70 km), and is composed of less-dense ( $\sim 2.7 \text{ g/cm}^3$ ) rocks having an average composition of a felsic intrusive igneous rock called granodiorite (between granite and diorite). Continental crust can be as old as 3.8 billion years or more.
- The outer core is thought to be a liquid, whereas the inner core is solid. Both layers are compositionally similar, being mostly iron with smaller amounts of nickel and other elements. It is the circulation of liquid iron in the outer core of our rotating planet that generates Earth's magnetic field.
- The outermost cool, rigid shell of the Earth is known as the **lithosphere**. The lithosphere includes both the crust and uppermost mantle. It averages ~100 km thick, but ranges from very thin (a few km) at mid-oceanic ridges, to perhaps 250 km beneath the old, cold continental shields.
- From ~100 km (the bottom of the lithosphere) to about 660 km depth, the **asthenosphere** is a portion of the upper mantle that is hot and weak, being partially molten for its upper 150 km. This is where the lithospheric plates “float” and are physically detached from the asthenosphere below.
- Temperature gradually increases with depth within the Earth. Three processes contribute to the warmth of Earth's interior: (1) heat produced by radioactive decay; (2) heat released as iron solidifies in the core; and (3) heat produced by the collision of asteroids and comets during the initial formation of the Earth.
- The **convective flow** of mantle rocks helps release this heat. This involves the upward flow of hot **mantle plumes** and the downward flow of **subducting cool lithospheric “slabs”** of oceanic plates at convergent boundaries. This convective circulation of rock in the mantle is what drives the plate motions across the globe.