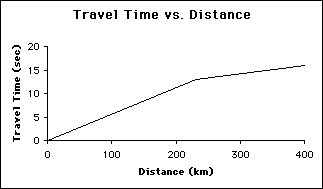
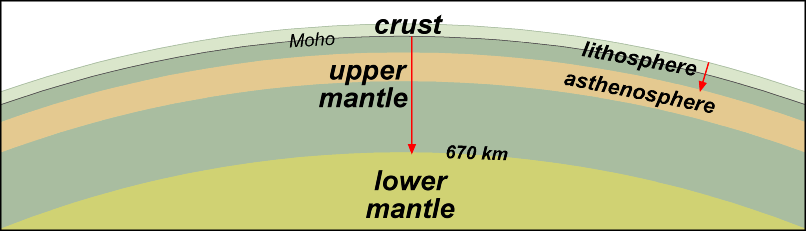
**EVIDENCE FOR INTERNAL EARTH STRUCTURE AND COMPOSITION**

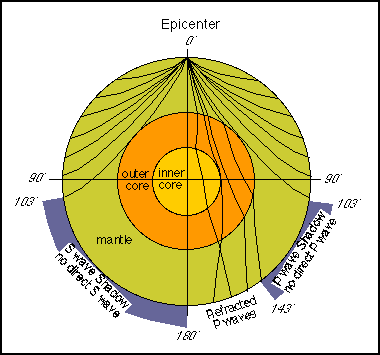
<http://www.columbia.edu/~vjd1/earth_int.htm>

(Text Adapted)

When an earthquake occurs, seismic waves spread out in all directions through the Earth's interior. Their velocities depend on the material properties such as composition, mineral structure, temperature and pressure of the media through which seismic waves pass. Seismic waves travel more quickly through denser materials and therefore generally travel more quickly with depth. Anomalously hot areas slow down seismic waves. Seismic waves move more slowly through a liquid than a solid. Molten areas within the Earth slow down P waves and stop S waves because their shearing motion cannot be transmitted through a liquid. Partially molten areas may slow down the P waves and attenuate or weaken S waves. When seismic waves pass between geologic layers with contrasting seismic velocities, reflections, refraction and the production of new wave phases often result. Sudden jumps in seismic velocities across a boundary are known as ***seismic discontinuities***.

Seismic stations within about 200 km of a continental earthquake report travel times that regularly increase with distance from the source. But beyond 200 km the seismic waves arrive sooner than expected, forming a break in the travel time vs. distance curve. Mohorovicic (1909) interpreted this to mean that the seismic waves had passed through a lower layer with significantly higher seismic velocity. This seismic discontinuity is now know as the **Moho** (much easier than ***"Mohorovicic seismic discontinuity"***) It is the boundary between the felsic/mafic crust with seismic velocity around 6 km/sec and the denser ultramafic mantle with seismic velocity around 8 km/sec. The depth to the Moho beneath the continents averages around 35 km but ranges from around 20 km to 70 km. The Moho beneath the oceans is usually about 7 km below the seafloor.

In the mantle, seismic velocities tend to gradually increase with depth due to the increasing pressure, and therefore density. However, seismic waves recorded at distances corresponding to depths of around 100 km to 250 km arrive later than expected indicating a zone of low seismic wave velocity. Furthermore, while both the P and S waves travel more slowly, the S waves are attenuated or weakened. This is because there is a partially molten zone.  It is a zone of weakness in the upper mantle. This zone is called the **asthenosphere** or "weak sphere." It separates the strong, solid rock of the uppermost mantle and crust above from the remainder of the strong, solid mantle below.  The combination of uppermost mantle and crust above the asthenosphere is called the **lithosphere**.  The lithosphere is free to move over the weak asthenosphere. The tectonic plates are, in fact, ***lithospheric plates***.

Below the low velocity zone are other seismic discontinuities at which seismic velocities increase.  A discontinuity at around 670 km depth is particularly distinct. It results from the change of spinel structure to the ***perovskite*** crystalline structure. The 670 km discontinuity represents a major boundary separating a less dense **upper mantle** from a denser **lower mantle.**

Finally, at arc distances of between about 103° and 143° no P waves are recorded and no S waves are record beyond about 103°. Gutenberg (1914) explained this as the result of a molten core beginning at a depth of around 2900 km. Shear waves could not penetrate this molten layer and P waves would be severely slowed and refracted. Between 143° and 180° from an earthquake another refraction is recognized (Lehman, 1936) resulting from a sudden increase in P wave velocities at a depth of 5150 km. This velocity increase is consistent with a change from a molten outer core to a solid inner core.