

Crust and Mantle vs. Lithosphere and Asthenosphere

Why do we use two names to describe the same layer of the Earth? Well, this situation results from the different ways scientists study the Earth. Lithosphere, asthenosphere, and mesosphere (we usually don't discuss this last layer) represent changes in the *mechanical* properties of the Earth. Crust and mantle refer to changes in the *chemical composition* of the Earth.

Lithosphere and Asthenosphere

The *lithosphere* (*litho*:rock; *sphere*:layer) is the strong, upper 100 km of the Earth. The lithosphere is made of the tectonic plates we talk about in plate tectonics. The *asthenosphere* (*a*:without; *stheno*:strength) is the weak and easily deformed layer of the Earth that acts as a lubricant for the tectonic plates to slide over. The asthenosphere extends from 100 km depth to 660 km beneath the Earth's surface. Beneath the asthenosphere is the *mesosphere*, another strong layer.

Crust and Mantle

The crust is a chemically distinct layer at the surface of the Earth. Crustal material contains lighter elements like Si, O, Al, Ca, K, Na, etc. Feldspars (anorthite, albite, orthoclase) are common minerals in the crust ($\text{CaAl}_2\text{Si}_2\text{O}_8$, $\text{NaAlSi}_3\text{O}_8$, KAlSi_3O_8). The crust may be divided into 2 types: oceanic and continental. Oceanic crust is usually 5-10 km thick and continental crust is 33 km thick on average. Beneath the crust is the mantle. The mantle is made up of Si and O, like the crust, but it contains more Fe and Mg. Thus, olivine (Fe_2SiO_4 - Mg_2SiO_4) and pyroxene (MgSiO_3 - FeSiO_3) are abundant in the mantle. The mantle extends to the core-mantle interface at approximately 2900 km depth. Thus, the mantle contains the lower portion of the lithosphere, the asthenosphere, and the mesosphere. The crust is made of the upper portion of the lithosphere.

The Inner and Outer Core

The core-mantle interface is a change in mechanical properties (solid to liquid) and composition (Mg, Fe silicates to Fe metal). At the outer-inner core interface we believe there is a slight compositional change and a mechanical change from liquid to solid. Most likely, the outer-inner core transition is from a liquid to a fudge-like substance and not as solid as the mantle. Inner and outer core are used with both crust and mantle, and lithosphere and asthenosphere to describe the Earth's structure.