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## THE CHEMICAL COMPOSITION OF CORE

The Earth's core, located deeper than 2,900 km from the surface constitutes 32% of its mass and 16% of its volume. The core is subject to ultrahigh P-T (pressure and temperature) conditions exceeding 136 GPa and ~4,000 K. The composition and state of the core remain uncertain to a large extent, in part because experiments performed at such extreme conditions have been technically challenging.

Recent experiments on iron and alloys performed up to inner core pressure and temperature conditions have revealed phase relations and properties of core materials. These mineral physics constraints, combined with theoretical calculations, continue to improve our understanding of the core, in particular the crystal structure of the inner core and the chemical composition, thermal structure and evolution, and possible stratification of the outer core.

A large dense core can be inferred from the mean density and moment of inertia of the Earth, and this calculation was performed by Emil Wiechert in 1891. The existence of stony meteorites and iron meteorites had earlier led to the suggestion that the Earth may have an iron core surrounded by a silicate mantle. The idea of iron being the dominant component of the core has gained firm supporting evidence from cosmochemical observations, refined seismic data, high-pressure experimentation, and theories of geomagnetism. Strong support for the idea of an iron core comes from the reasonably close match between the seismologically inferred sound velocity and density of the core and the measured experimental values for iron by shock compression.

Geochemical studies suggest that the core contains ~5 wt.% nickel. This is consistent with seismic observations, as experimental measurements found that the presence of nickel has little effect on the density of iron at core pressures.

The presence of light elements in the core was first proposed by Francis Birch in the early 1950's. A large number of experimental and theoretical studies carried out in recent years have laid a solid foundation for further investigations of the presence of light element composition of the core. Several major candidates for the principal light elements in the core have been identified, including hydrogen, oxygen, carbon, sulphur, and silicon along with potassium, Niobium, platinum, rhenium and osmium as trace elements.

**Table 1**- Estimated composition (of selected elements) in the earth's core (after McDonough, 2003).

| Element | Concentration (wt.%) | Element | Concentration (ppm) |
|---|---|---|---|
| Fe | 85.5 | H | 6oo |
| Ni | 5.2 | Pt | 5.7 |
| Si | 6.0 | C | 2ooo |
| S | 1.9 | Re | 0.23 |
| Cr | 0.9 | Os | 2.8 |
| | | Ir | 2.6 |