Rocky planetary interiors: Pressures, compositions, and evolution

Linda T. Elkins-Tanton[1]

[1]*Massachusetts Institute of Technology, Cambridge, MA, USA, ltelkins@mit.edu*

Deep planetary interiors, including the Earth's, are difficult to observe and sample and remain topics of intense research. The solid portions of rocky planets in our solar system consist of an iron-nickel metallic core surrounded by a silicate mantle. As pressure increases with depth in the mantle compression forces atoms in crystalline solids into closer proximity and eventually changes in crystal lattice structure become energetically favorable, producing new mineral assemblages with different thermochemical characteristics. Phase transitions influence radial mantle composition and convective patterns and therefore rates of planetary heat loss and maintenance of a magnetic field, both of which affect planetary atmosphere and habitability.

Radial layering within the Earth can be detected in some cases with seismic waves, and can be investigated in the laboratory using piston-cylinder, multianvil, diamond anvil, and shock experiments, though with increasing pressure experiments become more difficult to produce and to interpret. Composition is also critical, and often over-simplified in models: The silicate mantles of the Earth, Mars, and the Moon consist to greater than 98% by weight of oxides of silicon, magnesium, iron, calcium, and aluminum, though planets in other solar systems may well have different bulk compositions.

Here we will present the state of knowledge of phase changes on Earth, where the pressure at the bottom of the mantle reaches almost 140 GPa, and discuss extrapolation to the far higher pressures appropriate for super Earths, possible alternative interior structures of large planets, major unanswered questions, and experimental techniques.

8th International Conference on High Energy Density Laboratory Astrophysics
March 15-18, 2010
California Institute of Technology
Pasadena, California, USA
http://hedla2010.caltech.edu/