Goldschmidt2017 Abstract

Solar Nebular concept of Earth formation

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Many planetary scientists accept that the condensed planetesimals in the solar nebula eventually led to accretion of the earth. From the metallurgical experience, it is assumed that Earth's core may have formed by density differentiation with iron sinking to the core and the slag forming the mantle The problem with this hypothesis is that the seismic density profile of the core does not match the density of iron and requires the addition of a light element. Many elements such as Si, O, C and s have been proposed as diluents to decrease the density of a purely iron core. Since the planetesimals formed in a well stirred nebula, a variety of condensed solids and fluids may have accreted and compressed without differentiation and the core does not necessarily contain mainly the differentiated iron. It is a matter of accumulating the condensate composition that would result in a density of 12 to 13 g/cm^{3}in the inner core. Therefore, we need a thermodynamic database that extends to 6000 K over the pressure range of ambient to 360 GPa. The development of such a database is currently in progress. It is a database with multicomponent solutions (C-Fe-Ni-S-Si) and all the major elements in the solar gas. Thermodynamic calculations using a preliminary dataset reveal that the solid species condensed at a temperature of ~650 K and a pressure of 1E-3 bar pressure, when self-compressed to various pressures and temperatures, yield densities that are appropriate for the mantle and core. Depending on H2/O of the escaping fluid, the formation of hydrous minerals, carbides, carbonates and iron melts with significant silicon have been found.