Partitioning of Si and S between solid and liquid in the Fe-Si-S system up to 25 GPa with implications for the distribution of Si and S in a partically solidified core

Renbiao Tao[1], Yingwei Fei[1]
1Geophysical Laboratory, Carnegie Institution of Washington, 5251 Broad Branch Road, NW, Washington DC 20015, USA. yfei@carnegiescience.edu

Planetary cooling leads to solidification of any initially molten metallic core. Both S and Si are suggested to be present in the planety's core. We conducted high pressure experiments to investigate the partiioning behaviors of Si and S in the Fe-Si-S system from 15 to 25 GPa. The liquidus in this study is ~ 150 oC lower than that in the Fe-S binary system for same S concentration in liquid at same presssure. Almost all S prefers to partiion into liquid, while the distribution of Si between solid and liquid depends on experimental P and T conditions at same time. We fitted the partition coeffcient (KDSi) of Si between solid and liquid in corelation with experimental P, T and S concentration in liquid. At same pressure, the log(KDSi) is only linearly depedent on 1/T(K). The higher temperature (lower 1/T), the higher log(KDSi). With increase of pressure, the slopes of linear corelation beteween log(KDSi) and 1/T(K) will decrease. In other words, the higher presure, the more Si will partition into solid. The S concentration in liquid has limited effect on Si partitioning between solid and liquid. Our experimental results can be derectly applied to constrain the inner and outer core compositions of small terrestrial planetary (e.g. Mercury) and large planetary with a partically solified core, a Si-rich solid inner core and a S-rich liquid out core are suggested accorting to our experimental results.