Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

MIS002-10 Room:104 Time:May 27 17:15-17:30

Carbon isotope fractionation during the formation of the Earths core

Satish-Kumar Madhusoodhan[1*], Hayato So[1], Takashi Yoshino[2], Mutsumi Kato[3], Yoshikuni Hiroi[3]

[1]Shizuoka University, [2]Okayama Univeristy, [3]Chiba University

Carbon, the fourth most abundant element in the solar system, is believed to be an important light element constituent in the Earths core. The high carbon content of CI chondrites (3.2 wt.%) compared to bulk earth estimates, the presence of graphite/diamond and metal carbides in iron meteorites, the high solubility of carbon into iron melts in the Fe-C system suggests the plausible presence of carbon in the Earths core. However, the distribution of carbon isotopes in the core is not understood. We present here new experimental data in the Fe-C system and results on the equilibrium carbon isotope fractionation between graphite/diamond and iron carbide melt at 5 GPa and 10 GPa at a temperature range of 1200 to 2100 ^{o}C. Our results suggest that iron carbide melt will preferentially gather ^{12}C than ^{13}C, which is temperature dependent. It is intriguing that our results are consistent with the carbon isotope distribution observed between graphite and cohenite (Fe_3C) in iron meteorites. The temperature dependent fractionation between iron carbide melt and graphite/diamond finds potential application in determining the temperature of formation of meteorites and metallic core of planetary materials. Furthermore, we anticipate that the temperature dependent fractionation of carbon isotopes between iron carbide melt and graphite/diamond is an effective mechanism that created a ^{12}C enriched core with large scale differences in the distribution of the carbon isotopes in the metallic core and bulk silicate Earth during the accretion and differentiation of early Earth. Our findings also have implications on the deep carbon cycle of the Earth, where the light carbon from the core might have transported to the mantle and crust through deep mantle plumes.

Keywords: core, carbon isotope fractionation, iron carbide, graphite, diamond