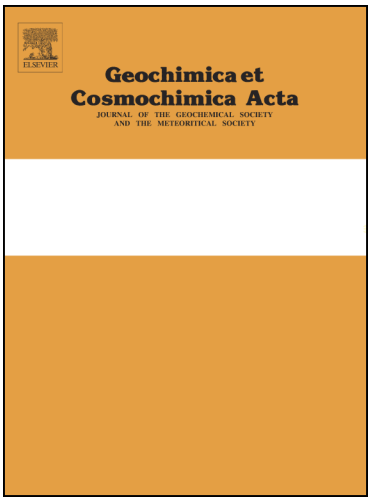

Core-mantle fractionation of carbon in Earth and Mars: The effects of sulfur

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PII: S0016-7037(18)30386-7
DOI: https://doi.org/10.1016/j.gca.2018.07.010
Reference: GCA 10841

To appear in: *Geochimica et Cosmochimica Acta*

Received Date: 28 March 2018
Revised Date: 1 July 2018
Accepted Date: 3 July 2018

Please cite this article as: Tsuno, K., Grewal, D.S., Dasgupta, R., Core-mantle fractionation of carbon in Earth and Mars: The effects of sulfur, *Geochimica et Cosmochimica Acta* (2018), doi: https://doi.org/10.1016/j.gca.2018.07.010

Core-mantle fractionation of carbon in Earth and Mars: The effects of sulfur

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ABSTRACT

Constraining carbon (C) fractionation between silicate magma ocean (MO) and core-forming alloy liquid during early differentiation is essential to understand the origin and early distribution of C between reservoirs such as the crust-atmosphere, mantle, and core of Earth and other terrestrial planets. Yet experimental data at high pressure (P)-temperature (T) on the effect of other light elements such as sulfur (S) in alloy liquid on alloy-silicate partitioning of C and C solubility in Fe-alloy compositions relevant for core formation is lacking. Here we have performed multi-anvil experiments at 6–13 GPa and 1800–2000 °C to examine the effects of S and Ni on the solubility limit of C in Fe-rich alloy liquid as well as partitioning behavior of C between alloy liquid and silicate melt ($D_{\mathrm{C}}^{\mathrm{alloy/silicate}}$). The results show that C solubility in the alloy liquid as well as $D_{\mathrm{C}}^{\mathrm{alloy/silicate}}$ decreases with increasing in S content in the alloy liquid. Empirical regression on C solubility in alloy liquid using our new experimental data and previous experiments demonstrates that C solubility significantly increases with increasing temperature, whereas unlike in S-poor or S-free alloy compositions, there is no discernible effect of Ni on C solubility in S-rich alloy liquid.