

6.1.38

Diamond saturation experiments: Implications for carbon in the core

J. SIEBERT¹, F. GUYOT¹, V. MALAVERGNE² AND
M. CHAUSSIDON³

¹Laboratoire de minéralogie-cristallographie et IPGP, 4 place
Jussieu, 75252 Paris cedex 05, France
(julien.siebert@lmcp.jussieu.fr)

²Université de Marne-La-Vallée, Laboratoire des
géomatériaux, 77454 Marne-La-Vallée cedex, France

³CRPG-CNRS, BP 20, 54501 Vandoeuvre-lès-Nancy cedex,
France

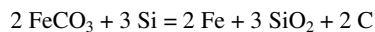
Introduction

Most accretion models of the Earth imply simultaneous presence of reduced materials and oxidized materials. A first accretion step under reducing conditions could lead to large contents of silicon in the metal that segregates to form the core. The present study provides experimental constraints on the fate of carbon, contained mostly in oxidized Earth building materials, in a primitive reduced Earth.

High pressure multi-anvil press experiments were performed on different assemblages of siderite (FeCO₃) and silicon-rich metal systems, between 10 and 25 GPa and up to 1800°C.

Results and Implications

The following reaction describe the recovered samples observations:



Euhedral diamonds have thus been synthesized using a carbonate as an unique carbon source. These experiments provide a new possible mechanism for spontaneous growth of diamond in the Earth's primitive mantle. Calculated $f \text{O}_2$ of experiments permit to discuss the stability of carbonates in the P, T conditions relevant for the formation of an Si-rich core.

Moreover, the presence of diamond embedded in metal is a proof of carbon saturation. Thus, the observed diamond saturation is a good way for estimating the carbon solubility in metal under high pressure conditions. First measurements show low, non expected, carbon content in metal at high pressures. If confirmed, this would imply a possible loading of carbon in metal at upper mantle conditions and a subsequent exsolution of diamonds (and not Fe₃C) at higher pressures. This could provide mechanisms for a primitive diamond reservoir in the mantle or for diamond formation at the core-mantle boundary.

6.1.P01

Iron isotope variations in the Earth's mantle and the terrestrial planets

S. WEYER¹, A. WOODLAND¹, C. MÜNKER²,
G.L. ARNOLD³, R. CHAKRABARTI³ AND A.D. ANBAR³

¹Inst für Mineralogie, Uni Frankfurt, Germany

²Inst für Mineralogie, Uni Münster, Germany

³Department of Earth and Environmental Sciences, University
of Rochester, NY, USA

(stefan.weyer@em.uni-frankfurt.de)

Iron isotope variations in high temperature rocks are expected to be small and most terrestrial igneous rocks seem to exhibit a range in $\delta^{56}\text{Fe}$ of only 0.3 ‰ [1]. However, some fractionation of Fe isotopes is observed between high temperatures minerals [2, 3] and planetary bodies [4].

We are assessing this question with high mass resolution MC-ICPMS, using Cu for external mass bias correction [5, 6]. With this technique, an accuracy and precision of $\delta^{56}\text{Fe}$ of 0.05 ‰ (2SD) is routinely achieved on replicates of natural samples, which allows us to resolve very small Fe isotope variations.

Mineral separates from various samples of the Earth's mantle have been measured so far and small systematic variations are observed: Spinel and cpx are about 0.1‰ heavier than olivine and opx. The total variation in $\delta^{56}\text{Fe}$ between mantle samples equilibrated at different oxygen fugacities is in the range of a few tenth of a ‰, with only weak correlation.

Samples from the Moon, Mars (SNC meteorites) and Vesta (Eucrites) were also analysed. The average $\delta^{56}\text{Fe}$ of the Silicate Moon is about 0.1 ‰ heavier than the Bulk Silicate Earth. Differences have also been observed between the various reservoirs of the Moon, with high-Ti basalts having higher $\delta^{56}\text{Fe}$ than low-Ti basalts. The average Fe-isotopic compositions of the SNC meteorites and Eucrites are indistinguishable from Bulk Silicate Earth.

References

- [1] Beard L and Johnson CM (2003) *Newsletter of the Geochemical Society*, **117**, 8-13.
- [2] Zhu et al. (2001) *Earth Planet. Sci. Let.* **220**, 47-62.
- [3] Williams et al. (2003) EAE03-A-09077.
- [4] Poitrasson et al. (2003) EAE03-A-05120.
- [5] Weyer and Schwieters (2003) *Int. J. Mass Spectr.* **226**, 355-368.
- [6] Arnold GL, Weyer S and Anbar AD (2004) *Anal. Chem.*, **76**, 322-327.