Do Fe-bearing minerals control the deep carbon cycle in the interior of the Earth?

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The redox conditions of the Earth's upper mantle are determined through the use of oxy-thermobarometers, i.e. chemical equilibria involving iron-bearing silicate/oxide end-member minerals that are representative of peridotite and eclogite mantle rocks [1,2]. The use of oxy-thermobarometers requires the determination of the Fe oxidation state in spinel and garnet equilibrated with minerals such as olivine, orthopyroxene and clinopyroxene. The knowledge of the iron speciation allows the variation of the mantle redox state to be modelled, which likely controls the speciation of carbon in the form of graphite (diamond) and carbonate (either solid or fluid) as a function of pressure and temperature. Similarly, other mantle minerals such as wadsleyite, ringwoodite, bridgmanite and ferropericlase, can incorporate ferric iron into their structure, suggesting their important role in controlling the carbon speciation at transition zone and lower mantle depths [3].

The aim of this study was to investigate the iron oxidation state of spinel, garnet, cpx, wadsleyite, ringwoodite, ferropericlase and bridgmanite and their textural features when coexisting with both carbonate and graphite/diamond. Experiments were performed using synthetic mixtures of Fe-bearing minerals and carbon/carbonate bearing assemblages, between 3 and 50 GPa and 900-1700 °C. Additional runs were performed by loading the capsules with layers of Fe-bearing minerals in contact with graphite or carbonate layers. The quenched products were analyzed by both electron microprobe and Mössbauer spectroscopy.

Preliminary results from these experiments allow a better understanding of processes such as redox melting, redox freezing and diamond formation that significantly affect the deep carbon cycle.

[1] Stagno et al. (2013) *Nature* **493**, 84-88. [2] Stagno et al. (2015) *CoMiPe* **169**, 16. [3] McCammon C.A. (2005) *Geophys. Monogr. Ser.*, **160**, 221-240.