Geophysical Research Abstracts
Vol. 19, EGU2017-4083, 2017
EGU General Assembly 2017

Carbon isotope heterogeneities in deep Earth: Recycling of surface carbon or from core?

Madhusoodhan Satish-Kumar
Faculty of Science, Niigata University, Niigata, Japan (satish@geo.sc.niigata-u.ac.jp)

Subduction of crustal materials, mantle melting and upwelling of deep mantle, in addition to a potential source from the core, largely controls the Earth's deep carbon cycle. Large variations in carbon isotopic composition between different reservoirs have been used widely to differentiate the source of carbon and to understand the carbon inventories and its recycling processes. However, how far high-temperature and hign-pressure conditions can affect the carbon isotope distribution, is a question still unanswered to clearly address the deep carbon cycle. I present here a review on carbon isotope fractionation processes in deep Earth and critically evaluate whether we can easily differentiate between surface carbon and deep carbon based on isotope characteristics.

Recent experimental carbon isotope fractionation studies in the Fe-C system suggests that light carbon is selectively partition into metallic core during early magma ocean environment (Satish-Kumar et al., 2011). Furthermore, carbonate melts can be a medium for efficient crystallisation of diamonds in Earth's mantle (Palyanov et al., 2013). Rayleigh fractionation modelling based on fractionation suggests that core can be a reservoir of 12C enriched carbon and can itself form a reservoir which can cause heterogeneity in mantle carbon (Wood et al., 2013).

In addition, high pressure experiments in the carbon-saturated model harzburgite system (Enstatite-Magnesite-Olivine-Graphite), carbonated silicate melting resulted in 13C enrichment in the carbon dissolved in the silicate melt relative to elemental graphite (Mizutani et al., 2014). 13C enrichment in carbonate melt were further confirmed in experiments where redox melting between olivine and graphite produced a carbonate melt as well as carbonate reduction experiments to form graphite.

A third factor, still unconquered is the effect of pressure on isotope fractionation process. Theoretical studies as well as preliminary experimental studies have suggested that pressure effect can be important extremely high pressure conditions. It is essential to understand the effect of pressure on isotope fractionation process by equilibrium high pressure isotope experimental studies.

Thus, carbonated mantle melting by redox melting in an upwelling mantle can result in the formation of 12C enriched diamonds in the deep mantle. Primordial carbon reservoirs of 12C enriched iron carbide melt in core can also for massive light carbon reservoirs. Therefore, in contrast to widely proposed recycling of 12C enriched carbon from surface reservoirs, it is possible that deep Earth processes and early Earth fractionation can form "diamonds" of so called recycled carbon.