Melting of FeO-SiO_2 system at high pressure and the fate of subducted banded iron formations

CHIE KATO[1]*, RYUICHI NOMURA[1] AND KEI HIROSE[1,2,3]

[1]Department of Earth and Planetary Sciences, Tokyo Institute of Technology, Tokyo, Japan (*Correspondence: kato.c.ab@m.titech.ac.jp)
[2]Earth-Life Science Institute, Tokyo Institute of Technology, Tokyo, Japan
[3]Institute for Research on Earth Evolution, Japan Agency for Marine-Earth Science and Technology, Yokosuka, Japan

Large amount of banded iron formations (BIFs) is thought to have subducted into the deep mantle. Because of their high density, BIFs may have fallen down toward the core mantle boundary (CMB) region and might cause the ultra-low velocity zones (ULVZs) [1]. BIFs would be composed of FeO and SiO_2 in the mantle because its oxidation state is close to iron-wustite. FeO and SiO_2 form a simple binary eutectic system above 16 GPa [2]. Its eutectic temperature must be lower than the melting temperature of FeO, which is estimated to be about 3,500 K at the CMB pressure [3]. Since temperature at the CMB is most likely over 3,500 K, subducted BIFs may have melted there. In order to understand the fate of the subducted BIFs, we have conducted high-pressure melting experiments on FeO-SiO_2 binary system, using laser-heated diamond-anvil cell techniques. Results at 47 GPa demonstrate that eutectic composition is extremely FeO-rich only with < 3 wt% SiO_2. Dense FeO-rich melt should have segregated downward, while buoyant SiO_2-dominant solid residue may have recycled upward. Such FeO melt accumulating between the core and mantle could have formed Fe-rich lowermost mantle and O-rich topmost core.

[1] Dobson & Brodholt (2005) *Nature*, **434**, 731-734. [2] Kato *et al*. (1984) *J. Phys. Earth*, **32**, 97-111. [3] Boehler (1992) *EPSL*, **111**, 217-227.

Experimental studies of partial melting at the contact between limestone and pelitic gneiss

M. KATO[1]*, Y. HIROI[2] AND M. ARIMA[3]

[1]Chiba University, Chiba 263-8522, Japan (*correspondence: andkysil@gmail.com)
[2]Chiba University, Chiba 263-8522, Japan
[3]Yokohama National University, Yokohama 240-8501, Japan

Continental crust is much more diverse than oceanic crust in composition. To evaluate the significance of partial melting for interaction between such diverse lithologies during high-grade metamorphism, we performed high-pressure experiments of partial melting at the contact between limestone and pelitic gneiss, which are characteristic lithologies in Gondwana fragments such as the Highland Complex of Sri Lanka and the Lützow-Holm Complex (LHC) of East Antarctica [1].

The rock fragments of limestone from Japan were loaded in a sealed Pt capsule with powdered garnet-sillimanite gneiss from the LHC. H_2O or NaCl aqueous solution were also added to the capsule. Experiments were performed at 900 °C, 800 MPa, and 100 hours with a piston-cylinder, high-pressure apparatus at the Yokohama National University.

At the contacts between limestone and partially molten garnet-sillimanite gneiss (garnet + spinel + peraluminous liquid), different mineral assemblages are formed depending on the composition of solution as follows.

H_2O: Wollastonite, clinopyroxene, plagioclase, biotite, and subaluminous to peraluminous liquid.

NaCl aqueous solution: Clinopyroxene, plagioclase, scapolite, and metaluminous liquid.

The results show that clinopyroxene, scapolite, plagioclase, and metaluminous liquid could be formed by the melting reaction between limestone and garnet-sillimanite gneiss when NaCl aqueous solutions are involved. We attempt to disuss the origin of clinopyroxene-scapolite-bearing calc-silicate granulites that have been reported from many high-grade metamorphic terrains including Antarctica [2], Sri Lanka [3], southern India [4] based on our experimental results.

[1] Shiraishi *et al*. (1994) Jour. Geol **102**, 47-65. [2] Satish-Kumar *et al*. (2006) Polar Geoscience, **19**, 37–61. [3] Mathavan and Fernando (2001) Lithos **59**, 217-232. [4] Satish-Kumar and Harley (1998) Lithos **44**, 83-99.

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