Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

SIT06-17 会場:303 時間:5 月 24 日 16:45-17:15

Metallic Fe and its influence on melting in the lower mantle
Metallic Fe and its influence on melting in the lower mantle

KARATO, Shun-ichiro[1*] ; GIRARD, Jennifer[1]
KARATO, Shun-ichiro[1*] ; GIRARD, Jennifer[1]

[1]Yale University, Department of Geology & Geophysics
[1]Yale University, Department of Geology & Geophysics

Melting in the deep Earth has important influence on the chemical evolution of Earth. Melting in the deep Earth is largely controlled by the availability of volatile (incompatible) elements that selectively go to the melt. In most of the lower mantle, melting will be difficult without volatiles. However, if a small amount of volatiles is present, melting becomes very easy and partial melting is expected in most lower mantle if volatiles are present.

Such a situation will be dramatically modified, if metallic Fe is present as first shown by Frost et al. (2004). These authors showed that metallic Fe is produced in the lower mantle assembly and that the formation of metallic Fe is not caused by the removal of oxygen but rather caused by the internal transfer of electrons due to the high stability of ferric Fe in bridgmanite. If this reaction occurred throughout the lower mantle, partial melting will be hard.

In this talk, we will present new experimental observations suggesting that the formation of metallic Fe is highly pressure dependent and it occurs only in the shallow lower mantle. The experimental results are the heterogeneous distribution of metallic Fe in a sample assembly in RDA where substantial pressure gradient is present. Metallic Fe is observed only in the low-pressure regions (24-26 GPa), whereas metallic Fe is not detected in the high-pressure regions (>27 GPa). We developed models to explain these observations that also explain varying results of previous studied at different pressures.

We conclude that a substantial amount (~1 % or larger) of metallic Fe is present only in the limited depth region in the lower mantle (660 to ~730 km). A possible implication of this observation to explain seismological observations by Schmandt et al, (2014) will be discussed.

キーワード: melting, lower mantle, volatile elements, metallic Fe
Keywords: melting, lower mantle, volatile elements, metallic Fe