Melting phenomenon at the top of the lower mantle

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There are various igneous activities in the Earth. On the surface of the Earth, for example, igneous activities occur in island arcs, mid-ocean ridges, hot spots and petit spots. However, not only on the surface, but also in the interior, melting phenomena are also suggested (e.g., the top of the asthenosphere [e.g., Barazangi & Isacks, 1971 *JGR*; Schmerr, 2012 *Science*]; the bottom of the upper mantle [e.g., Bercovici & Karato, 2003 *Nature*; Song *et al.*, 2004 *Nature*]). In this study, we focused on the melting of hydrous peridotite at the top of the lower mantle because seismological observation indicates the low velocity anomaly [Schmandt *et al.*, 2014 *Scienc*e; Liu *et al.*, 2016 *GRL*; Liu *et al.*, 2018 *EPSL*]. The low-velocity region is expected to be caused by mantle melting due to dehydration decomposition of ringwoodite to bridgmanite and ferro-periclase with a downward flow. Here, we performed melting experiments of peridotite with 6.98 wt % H_2O at 21-26 GPa and 900-1600 ˚C. As a starting material, a mixture of several oxide powders was used. In this study, Fe_2O_3 was used instead of FeO because the lower mantle is expected to be Fe^{3+}-rich [e.g., Frost *et al.*, 2004 *Nature*; McCammon, 1997 *Nature*; Wang *et al.*, 2015 *Nature Geosci.*]. Recovered samples from 1300-1600 ˚C showed partial melting texture, and clearly demonstrate that mantle melting can be occurred under the experimental conditions. The composition of melt was SiO_2- and Al_2O_3-poor and CaO-rich. Mg/(Mg+Fe) in atomic ratio of the melt (= 0.90) is similar to that of bridgmanite (= 0.89). This result is completely inconsistent with melting experiment under dry condition [e.g., Ito & Takahashi, 1987 *Nature*; Trønnes & Frost, 2002 *EPSL*] but consistent with hydrous melting (Fe^{2+}) [Kawamoto, 2004 *PEPI*]. In addition to decrease in the melting temperature of mantle rock, hydrogen (water) can affect the melt composition such as the partitioning of FeO and MgO between crystal and melt. The density and compressibility of the magma were calculated based on the obtained melt composition. Comparing with seismological model, the melt is lighter than that of the lower mantle. This implies that the melt can be ponded at the top of lower mantle and form the seismological low velocity zone. This work was supported by the JSPS Japanese-German Graduate Externship.

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