Melting experiments in the $MgSiO_3$ –SiO_2 system under high pressures

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Melting of silicates played important roles in chemical differentiation in a deep magma ocean in the early Earth. Therefore, melting relations of the MgO–SiO_2 system have been extensively studied since a pioneer work by Bowen and Anderson (1914). Furthermore, chemical differentiation in the deep magma ocean has been simulated extensively based on results of high pressure melting experiments (e.g. Kato and Kumazawa, 1985; Ito and Katsura, 1992). However, almost all of these works have been carried out on the compositions ranging from MgO to $MgSiO_3$, assuming that the bulk mantle composition is peridotitic or close to that derived from CI chondrite. Recently, enstatite chondrite (E-chondrite) has been attracted as the bulk earth source material (Javoy et al., 2010) because the isotope systematics of the Earth and Moon are nearly identical to those of E-chondrite over O, N, Mo, Re, Os, and Cr. In E-chondrite, the silicate composition is characterized by $SiO_2/(SiO_2+MgO)$ = ˜0.6, which is substantially higher than that of the peridotitic mantle (˜0.4).

In this context, understanding of the melting relations over compositions between $MgSiO_3$ and SiO_2 is indispensable to clarify the mantle fractionation. That also relates to investigations of chemical compositions of the crust at early stage of the Earth. Nevertheless, there have been very limited works on the pressure effect on melting in the $MgSiO_3$–SiO_2 system. Available information regarding phase relations in the system has been so far limited to 5 GPa (Dalton and Presnall, 1997). In this study, we are determining the melting relations in the $MgSiO_3$–SiO_2 system at pressures 5 to 20 GPa. Here we present the results obtained at 10 GPa.

References

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