Precise determination of phase relations in the system Mg2SiO4-Fe2SiO4 at high pressures

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Since the Earth's mantle is considered to be mainly composed of Mg, Fe, Si and O, the knowledge of the precise phase relationships in the system Mg_2SiO_4-Fe_2SiO_4 is indispensable to study the Earth's interior. The previous investigations by a quenching method, however, are not reliable because the pressure cannot be directly determined and also because it is difficult to determine true stable phases. In order to fix these problems, the precise phase relations in the Mg_2SiO_4-Fe_2SiO_4 system should be investigated by means of in situ X-ray diffraction. For this purpose, we have tested new experimental techniques of high-pressure X-ray diffraction study, and phase relations of ilmenite-perovskite transition in $MgSiO_3$ have been examined to demonstrate performance of the new methods.

In the previous high-pressure in-situ X-ray diffraction study, B+epoxy or MgO was used for pressure media, and heaters are usually graphite cylinder normal to the X-ray or carbide sheets parallel to the incident and diffracted X-ray. These things are advantageous to avoid absorption of X-ray in the pressure media and heater. In the present study, we used $LaCrO_3$ cylindrical heater parallel to the diffracted X-ray, and ZrO_2 or composite MgO+ZrO_2 pressure media (Fig. 1). Although the present assembly contains materials containing heavy elements, these parts do not affect on X-ray intensity, because X-ray goes through only within the heater.

Using this pressure system, preliminary results for phase relations in $MgSiO_3$-Mg_2SiO_4 were obtained, which is shown in Fig. 2.

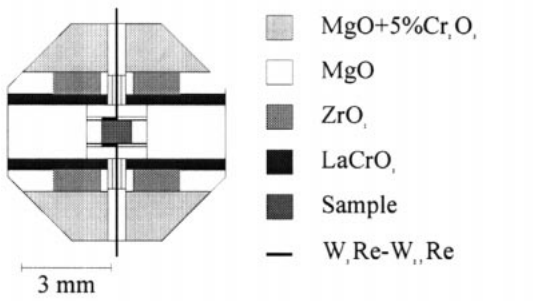

Fig.1 Schematic drawing of the sample assembly.

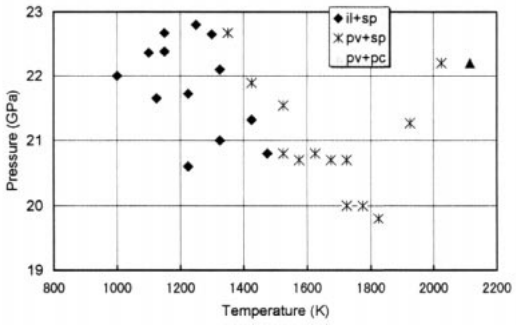

Fig. 2 Observed phases present in the $MgSiO_3$-Mg_2SiO_4 system. The diamonds, crosses and triangles denotes phase assemblage of ilmenite+spinel, pervskite+spinel, and perovskite+periclase.