In Situ Observation of the Ilmenite-Perovskite Phase Transformation in Mg2SiO3 Using Synchrotron Radiation

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Using synchrotron radiation, detail in situ observations of the ilmenite-perovskite transition in MgSiO3 were made. It was proved that because of its high brightness and small divergence, synchrotron radiation is a powerful tool to study the behavior of minerals under high pressure and temperature (Fig. 1). An accurate phase boundary is summarized in Fig. 2.

Pressure values were determined from unit cell volume of Au measured at each experimental conditions in the basis Anderson's equation of state for Au (Anderson et al. 1989). The unite cell volume was calculated from at least two diffraction lines or, in most cases, more than four diffraction lines. Temperature was recorded with a W3%Re-W25%Re thermocouple located at the beside of the capsule of the sample. The temperature reading was made without any correction for pressure.

The boundary has a negative Clapeyron slope (dT/dP) as indicated by the quench experiments and their thermodynamic studies. Our study demonstrated that the boundary is located at about 22 GPa, at 1300 K, which is about 2 GPa lower than that obtained in the earlier studies. Pressure scales might contain uncertainties. Therefore, we calculated the pressures at some experiments on the basis of volume changes in Au and MgO. Obvious discrepancy between Au and MgO pressure scales was not observed in this study.

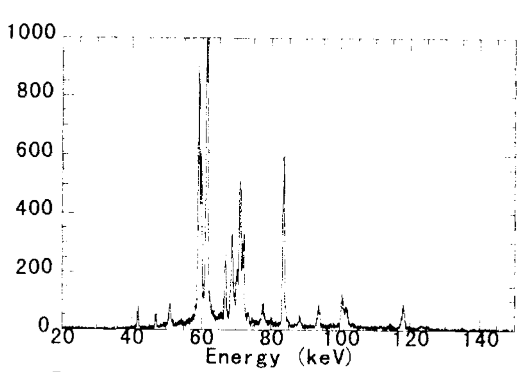

Fig. 1 The x-ray diffraction pattern.

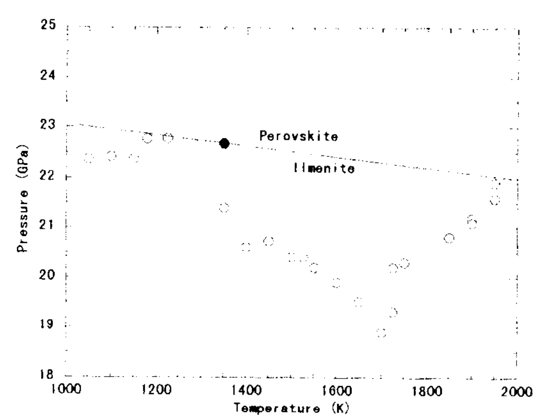

Fig. 2 Experimental conditions and results of experiments near the phase boundary.