High-pressure and high-temperature phase equilibria of FeS

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Structure and phase boundaries of FeS polymorphs have been studied at the pressure of 15-20 GPa and temperature of 300-1350 K by in situ X-ray observation. Experiments were carried out by energy dispersive X-ray diffraction method using SPEED-1500 system at BL04B1 of SPring-8. FeS transforms from monoclinic phase to NiAs phase via hexagonal phase, with increasing temperature at about 15-20 GPa. Phase boundaries between monoclinic and hexagonal phases and between hexagonal and NiAs phases locate at 625 K and 19.5 GPa and 1275K and 18 GPa, respectively. These results confirm stability field of NiAs phase extends to higher pressure than 20 GPa.

FeS is one of the most plausible core components of the terrestrial planets. High-pressure phase relations of FeS have been studied for the last three decades. Recent in situ X-ray studies reveled the structures and phase boundaries of the high-pressure polymorphs of FeS (Fei et al. 1995; Kusaba et al., 1997; 1998). However, there are still contradictions in phase boundary between NiAs phase and hexagonal phase. Here we report the new results of in situ X-ray observation on high-T and high-P phase equilibria of FeS.

In situ observations of FeS were conducted by an energy dispersive diffraction method using SPEED-1500 system installed at BL04B1 of SPring-8. Starting samples is synthesized troilite (FeS). Temperature was measured by W3Re-W25Re thermocouple. Pressure was determined by equation of state of MgO.

FeS transforms from monoclinic phase to NiAs phase via hexagonal phase, with increasing temperature at about 15-20 GPa. Phase boundaries between monoclinic and hexagonal phases and between hexagonal and NiAs phases locate at 625 K and 19.5 GPa and 1275K and 18 GPa, respectively. Former is consistent with the previous report by Fei et al. (1995). On the other hand, our results support Kusaba's prediction of the boundary between NiAs and hexagonal phases, rather than Fei's estimation. Fei et al. (1995) predicted a steep temperature gradient for NiAs-hexagonal phase boundary based on their low temperature data, and concluded NiAs phase as a low-pressure phase. However, our results confirm stability field of NiAs phase extends to higher pressure than 20 GPa.