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LETTER

High-pressure study of FeS, between 20 and 120 GPa, using synchrotron X-ray powder diffraction

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ABSTRACT

Iron sulfide (FeS) has been examined in a diamond anvil cell to 120 GPa pressure using an in situ angle-dispersive X-ray diffraction technique. The transformation from a monoclinic phase (FeS III) to a newly described orthorhombic phase (FeS VI) was observed at 35–40 GPa and high temperatures. This phase remained stable during the temperature quench. After the decompression, however, the recovered sample was transformed to the troilite structure (FeS I). The relative volume change that accompanies this transformation is ~1%. No further phase transformations were observed at higher pressures up to 120 GPa, even when the sample was laser-heated to ~2000 K. There are four molecules in a single unit cell ($Z = 4$) of the orthorhombic phase. The isothermal bulk modulus (K_0) of the orthorhombic phase is 156(6) GPa, with $V_0 = 99.5(7)$ Å^3 when K_0' is fixed at 4. The a axis of the unit-cell parameter is more compressible than the b and c axes. Our study indicates that the phase transformation from NiAs-type (FeS V) to orthorhombic (FeS VI) phases could occur in the Martian core.

Keywords: iron sulfide, diamond anvil cell, phase transition, FeS