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# Liquid properties in the Fe-FeS system under moderate pressure: Tool box to model small planetary cores

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## Abstract

Physical properties of liquid Fe-S alloys (from 10 to 50 at%S) under high pressure were investigated by in situ X-ray diffraction (up to 5 GPa and 1900 K) and by ab initio calculations. The local structure of Fe-S liquid alloys clearly shows how S modifies the local arrangement of the Fe atoms. Density has been extracted from the diffuse scattering by minimization of the oscillation in the short distance of the radial distribution function $g(r)$. Two different formalisms for the $P$-$V$-$T$-$X$ equation of state are presented to model density and sound velocity as a function of pressure, temperature, and sulfur content. Based on these results, Moon's core composition is discussed. This coherent data set will serve as a thermodynamically consistent ground for modeling the core of small telluric planets and large icy satellites.

**Keywords:** Iron alloys, liquid, Fe-S liquid, planetary cores