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Experimental constraints on the composition of the Martian core

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Estimates for the density of the Martian core indicate that it may have a significant light element content. Models for the building materials and formation conditions of Mars hinge to a large extent on the nature of this light component. Experimental studies on core formation combined with geochemical constraints from Martian meteorites indicate that the light element component may be dominated by sulphur but oxygen, hydrogen and carbon might also be present in significant proportions. It is important to understand how these light elements will affect the density of the, likely, liquid core and ultimately also the seismic velocity. To provide experimental constraints on the composition of the Martian core, we have conducted in-situ ultrasonic interferometry measurements on Fe-S and Fe-S-O liquids and X-ray absorption measurements on Fe-S liquids, up to conditions very close to those of the Martian core. We show that a more robust determination of the density and acoustic velocity of such Fe-rich liquids can be made by combining experimental data on these properties with models for the melting phase relations by developing an internally consistent thermodynamic model. The results of this model can be used to exclude certain scenarios for the composition of the Martian core.