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Geochemical constraints on Earth's core composition

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The density of the core as measured from seismic-wave velocities is lower (by 10–15%) than that of pure iron, and therefore the core must also contain some light elements. Geophysical and cosmochemical constraints indicate that obvious candidates for these light elements include silicon, oxygen, and sulfur. These elements have been studied extensively for the past 30 years but a joint solution fulfilling all the requirements imposed by cosmochemistry and geochemistry, seismology, and models of Earth's accretion and core formation is still a highly controversial subject. Here are presented new experimental data in geochemistry used to place constraints on Earth's core composition. Metal-silicate partitioning experiments were performed at pressures and temperatures directly similar to those that prevailed in a deep magma ocean in the early Earth. The results show that core formation can reconcile the observed concentrations of siderophile elements in the silicate mantle with geophysical constraints on light elements in the core. Partitioning results also lead to a core containing less than 1 wt.% of sulfur, inconsistent with a S-rich layer to account for the observed structure of the outer core. Additionally, isotopic fractionations in core formation experiments are presented. This experimental tool merging the fields of experimental petrology and isotope geochemistry represents a promising approach, providing new independent constraints on the nature of light elements in the core.