Sulfur content of the Earth and its core

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Compositional models of the Earth are built on physical and chemical data for the planet and compositional systematics in chondritic meteorites. Chondrites, the building blocks of the terrestrial planets, do not, however, match the Earth's bulk composition. To determine the core's composition we must combine cosmochemical observations with geophysical and geochemical data for the Earth. By defining the composition of the Earth and its layers, we are better equipped to understand its origin and evolution.

At half a radius and a third of it's mass, the Earth's metallic liquid core creates a protective magnetosphere through dynamo action. The core's density does not matching that of an Fe,Ni alloy at core conditions and thus has a density deficit, meaning it contains lighter element(s) to account for its ~10% lower density.

Debate continues regarding the composition and proportion of light element(s) in the Earth's core. It is commonly asserted that the core contains only ≦2 wt% S, plus other elements. This prediction for the S abundance in the core was based upon the Earth's depletion in moderately volatile, lithophile elements, those not partitioned into the core.

Here, we characterized systematic differences between lithophile and non-lithophile (siderophile and chalcophile) elements in chondrites and predict the bulk Earth and its core contains 2.1±0.3 and 6.5±0.8 wt% sulfur, respectively. We propose a 3.3 times increase in the core's S content relative to traditional estimates, which consequently lowers the core's contents of Si (~1 wt%) and/or O (~1 wt%) to compensate for its density deficit. The mean atomic weight for this core composition (24.2) is consistent with that recommended by Birch (1968). These same systematics of siderophile and chalcophile elements in chondrites can be used to constrain the sulfur contents of other terrestrial planets.

Changes to the abundance estimates of other moderately volatile and volatile siderophile elements include the core's Pb abundance and its implications for the lead paradox of the BSE. From this we estimate that the bulk Earth and core contains 0.46±0.13 and 1.1±0.36 microg/g Pb, respectively, assuming 0.15±0.01 microg/g in the BSE.

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