New compositional insight on the formation of the Earth's core

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A widely held belief is that the earth's core separated from the mantle at mid-mantle conditions. In large part this idea stems from the need to explain the bulk silicate earth's (BSE) chondritic Ni/Co value and absolute Ni concentration. Estimates for the composition of the BSE, particularly the absolute and relative abundance of all of the siderophile elements, have largely provided the motivation for explaining the pressures, temperatures, and evolving oxidation state of metal-silicate equilibration during core formation.

We recently reported on the composition and formation of the terrestrial planets, Earth and Mars. To explain the presence, size, and orbital attributes of the earth's Moon, many have posited that the formation of the earth involved a giant impact event by a bolide that was about 1/10 the mass of the earth. We suggested that this bolide was an oxidized, differentiated body possessing a mars-like composition with a mild depletion in volatile elements (e.g., K, S). The addition by impact and subsequent emulsification of this bolide into the mantle of a reduced proto-Earth, produced a Moon-forming debris ring and largely established siderophile element signature of the BSE. Later, chalcophile and some siderophile elements in the silicate Earth, which were added by the Mars-like impactor, were then extracted into the core by a sulfide melt (0.5% of the mass of the Earth's mantle). Consequently, the BSE's composition was unlikely established at high pressures and temperatures, but is the product of a sequence of lower pressure metal-silicate equilibration steps on the proto-earth and its mars-like impactor.

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