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Earth's core may have segregated at low pressure

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The current, widely accepted model of terrestrial accretion is that proto-Earth began as a small reduced inner solar system body and grew by adding a mixture of reduced, metal-rich and oxidised (outer solar system) metal-poor bodies with overall oxidation state increasing during planetary growth. Core segregation took place simultaneously with accretion at pressures which increased as the planet grew, reaching values of 40 GPa, equivalent to >800 km depth (e.g.,[1]; [2]). These extreme pressures are required to explain the estimated partitioning of siderophile ('iron-loving') elements between core and mantle.

Here we challenge this model and present an alternative based on low pressure core segregation (0-3GPa) in the presence of the most abundant mantle mineral, olivine. Olivine is a major mantle reservoir for Ni, the element whose core-mantle partitioning behaviour best constrains the pressures of core segregation. We construct our model Earth from a mixture of oxidised and reduced bodies all of which segregate their cores at low pressure and show that, with the addition of olivine we can explain the current core-mantle partitioning of Ni, Co, V, Cr, W, Mo and Nb. This low-pressure model of core-formation also successfully replicates the observed mantle abundances of these elements in both Mars and Vesta. Importantly, we also propose tests that would invalidate our low-pressure model and confirm the high-pressure nature of planetary core-formation.

1. Wade & Wood, EPSL, 236, 78-95 (2005)
2. Rubie, *et al*, Icarus, 248, 89-108 (2015)