A small metallic core in the Moon? A reassessment considering siderophile elements and giant impacts.

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The issue of whether the Moon has a small metallic core is re-examined in light of new information: improved dynamical modelling, new geophysical constraints on core size, and high temperature and pressure metal-silicate partition coefficients. Although the Moon has similar Co and W depletions to the Earth, it has distinctly different Ni, Mo, Re, P and Ga depletions, consistent with the presence of a small metallic core. Because impact modelling predicts the Moon is made of mantle material primarily from the impactor, bulk Moon compositions are considered from "hot", "warm" and "cool" impactors and proto-Earths (deep, intermediate, and shallow melting, respectively). If the Moon is made of mantle material from either a "hot" impactor or a "warm" impactor or proto-Earth, a small metallic core (0.7 to 2 percent) is predicted (cases 2, 3, 4; Fig. 1). If the Moon is made from mantle material from a "hot" proto-Earth, the lunar mantle would be more depleted in W or P than is observed (case 1; Fig. 1). Some have argued recently (Khan and Mosegaard, 2001) that the Moon has no metallic core; scenarios in which the Moon is made from impactor mantle material and has no core predict larger depletions of G, Co and W than are observed (case 5; Fig. 1). Consistency of siderophile element concentrations in the lunar mantle with an impactor bulk Moon composition eliminate previous geochemical objections to an impactor origin of the Moon.

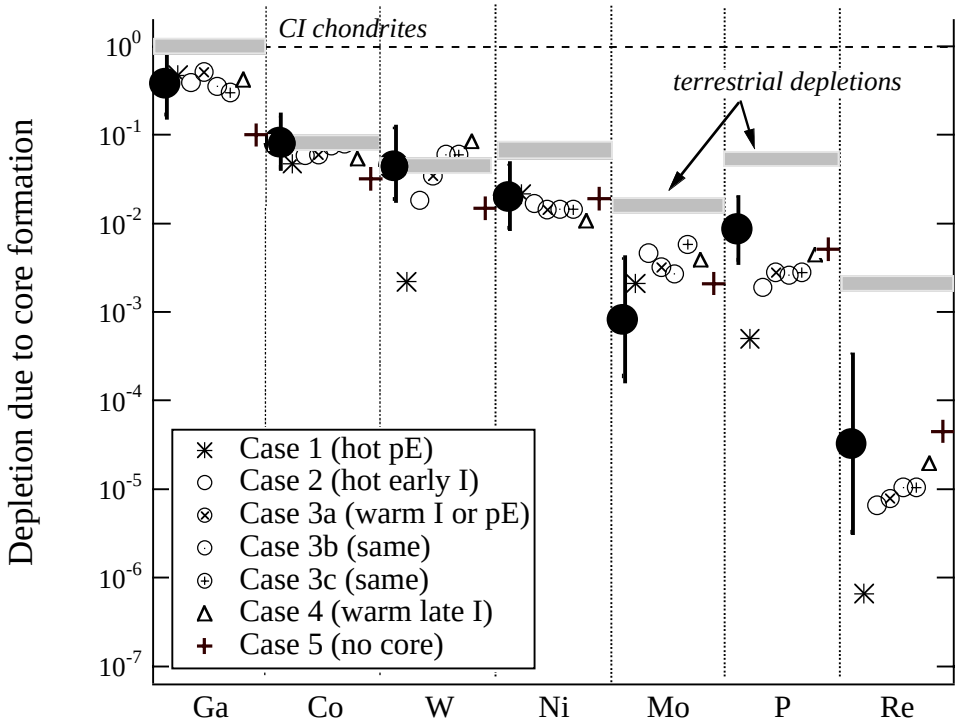

Figure 1: Depletion of siderophile elements in the lunar mantle (solid circles) normalized to chondritic values. Terrestrial mantle depletions are shown as horizontal shading.