Phase equilibria of a S- and C-poor lunar core

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The composition of the lunar core can have a large impact on its thermal evolution, possible early dynamo creation, and physical state [1]. Geochemical measurements have placed better constraints on the S and C content of the lunar mantle [2,3]. In this study we have carried out phase equilibrium studies of geochemically plausible S- and C-poor lunar core compositions in the Fe-Ni-S-C system, and apply them to the early history of the Moon.

We chose two bulk core compositions, with differing S and C content based on geochemical analyses of S and C trapped melts in Apollo samples [2,3], and on the partitioning of S and C between metal and silicate [4,5]. This approach allowed calculation of core S and C contents - 90% Fe, 9% Ni, 0.5% C, and 0.375% S by weight; a second composition contained 1% each of S and C. Experiments were carried out from 1473K to 1973K and 1 GPa to 5 GPa, in piston cylinder and multi- anvil apparatuses. Combination of the thermal model of [6] with our results, shows that a solid inner core (and therefore initiation of a dynamo) may have been possible in the earliest history of the Moon (~4.2 Ga ago), in agreement with [7]. Thus a volatile poor lunar core may explain the thermal and magnetic history of the Moon. [1] Wieczorek et al., (2006) *RiMG* 60, 221-364. [2] Wetzel, D.T. et al. (2014) *LPSC* XLV, 2238.[3] Bombardieri, D.J. et al., (2005) *MaPS*, 40, 679-693. [4] Boujibar, A. et al. (2014) *EPSL* 391, 42-54. [5] Chi, H. et al. (2014) *GCA* 139, 447-471. [6] Spohn, T. et al. (2001) *Icarus* 149, 54-65. [7] Garrick-Bethell, I. et al. (2009) *Science* 323, 356-359.