Contrasting styles of interaction between core and mantle reservoirs in the Main-Group pallasite source

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Main-Group pallasite meteorites originate in a single early planetesimal [1] formed in the early history of the Solar System. This type of parent body may be the default end-product of silicate melt extraction (as indicated by the presence of other pallasite parent bodies, e.g. [2]) and represents the last stage before core-mantle separation. Two fundamental textural types are recognised in the rounded and euhedral olivine in Main-Group pallasites (e.g. [3]), while fragmental textures record secondary events. Additionally, some Main-Group pallasites contain phosphoran olivine [3] and low-temperature phosphates [4] formed at an intermediate point in pallasite history, between early high-temperature differentiation involving silicate melt extraction, and late slow cooling responsible for development of metallographic textures [5].

The coarse grainsize of pallasites has made representative sampling difficult, but previously published data [3] [4] [6] strongly suggest that rounded olivine in pallasites (with the remarkable exception of the Pavlodar specimen) fall into just two distinctive geochemical groupings: either low-Mn type (e.g. Brenham), or high-Fe type (e.g. Springwater). Both types of round-olivine pallasite can host low-temperature phosphates, phosphoran olivine, and perhaps high sulfide contents; these phases are almost without exception absent (in the case of P_2O_5 rich phases) or in low quantity (sulfide) in the euhedrally textured pallasites. Additionally, we report on the preliminary finding of rounded olivine in the key low-Mn pallasite Brahin, which consolidates the two groups. Pallasite geochemistry therefore indicates that olivine rounding, and therefore the probable equilibration of core and mantle, took place across two distinct reservoirs, neither of which appear to be related to metallographic cooling rates. Accessory P_2O_5-rich phases, in conjunction with olivine geochemistry, represent the missing link in pallasite history between high- and low-temperature processes.

[1] Greenwood et al. (2006) *Science* **313**, 1763-1765. [2] Clayton and Mayeda (1996) *GCA*, **60**, 1999-2017. [3] Boesenberg et al. (2012) *GCA* **89**, 134-158. [4] Buseck (1977) *GCA* **41**, 711-740. [5] Yang et al. (2010) *GCA* **74**, 4471-4492. [6] Wasson and Choi (2003) *GCA* **67**, 3079-3096.