ON THE BEHAVIOR OF TRACE ELEMENTS IN TROILITE IN MAIN GROUP PALLASITES

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Introduction: Since sulfur is highly incompatible in FeNi metal and is mineralogically constrained as a major element in troilite, the sulfur content of the parental metallic melts to pallasites and iron meteorites cannot be determined. For pallasites, initial concentration estimates, which are model dependent, range from 6 to 12 wt% S (or 3.35 to 6.7 vol% troilite) [1]. Main Group (MG) pallasites average ~2.4 vol% troilite, however this varies from very low volumes in Pavlodar and Rawlinna (0.1-0.2 vol%), to high volumes in Glorieta Mountain (8 vol%), to extraordinary ones in Phillips County (>20 vol%) [2, 3]. Thus, with the exception of Phillips County, pallasite troilite volumes should be substantially higher if the troilite experienced the same degree of fractional crystallization enrichment (up to ~90% relative to chondritic values) as that of the siderophile elements in most pallasite metal. To investigate the reason for this inconsistency, 17 siderophile and chalcophile elements were analyzed by laser ICP-MS in troilite, schreibersite, kamacite and taenite from eight MG pallasites – Admire, Brahin, Brenham, Glorieta Mountain, Imilac, Newport, Otinapa and Springwater.

Results and Discussion: Selenium is a highly chalcophile trace element that partitions almost exclusively into troilite (though a small fraction partitions into schreibersite). Chondritic concentrations of Se range from ~8 ppm in H chondrites to 28 ppm in EH chondrites [4]. If pallasites derive from the melting of an H chondrite-like source, all of the Se concentrated in the troilite, and the troilite average volume is representative of the entire parent body, then by mass balance, the troilite should contain ~330 ppm Se. However, measured concentrations of Se in multiple troilite grains from 8 pallasites show a range of only ~65 to 100 ppm. This implies that either 1) the chalcophile elements in troilite did not concentrate from a well-mixed, asteroid-scale parental metallic melt reservoir, such as in an outwardly growing concentric core model based on fractional crystallization of siderophile elements in metal, 2) pallasites derived from a source ultra-depleted in chalcophiles, or 3) the chalcophiles in troilite were concentrated locally, perhaps during inward dendritic crystallization of metal [5, 6]. The last possibility is consistent with the chondritic siderophile abundances in FeNi metal from Pavlodar and the more fractionated levels in most MG pallasites [7].

Because sulfide is a melt until very late in the crystallization process, it is the likely reason for the small Se variations (± 3 ppm) observed in troilite in 6 of the 8 pallasites. Admire and Brahin, however, contain more variable troilite Se concentrations that span nearly the entire 65-100 ppm range measured in MG pallasites. These troilites may have experienced transport and metamorphic re-equilibration during fragmentation of their olivine. Both contain angular and fragmental olivine.

References: [1] Chabot N. and Haack H. (2006) *Meteorites and the Early Solar System II*, 747-771. [2] Buseck P. R. (1977) . *GCA* 41, 711-740. [3] Scott E. R. D. (1977) *GCA* 41, 693-710. [4] Wasson J. T. and Kallemeyn G. W. (1988) *Phil. Trans. Royal Soc. Lond.* A325, 535-544. [5] Rayleigh L. (1942) *Proc. Royal Soc. Lond.* A179, 386-393. [6] Haack H. and Scott E. R. D. (1992) *JGR* 97: 14,727–14,734. [7] Scott E. R. D. (1977) *GCA* 41, 349-360.