LA-ICP-MS STUDY OF IAB & IIIAB IRONS AND PALLASITES: SUB-SOLIDUS HSE BEHAVIOUR.

E. Mullane[1] O. Alard[2] M. Gounelle[1,3] and S.S. Russell[1] [1]Dept. Mineralogy, Natural History Museum, London, SW7 5BD, [2]Dept. Earth Sci., Open University, Milton Keynes, MK7 6AA, U.K. [3]CSNSM-Université Paris 11, Bâtiment 104, 91 405 Orsay Campus, France. (etam@nhm.ac.uk)

Introduction: The IIIAB iron meteorite group and Main Group Pallasites (PMG) are believed to be magmatically linked, although the exact crystallization history may be complex [e.g. 1]. In this work we investigate the behaviour of the HSE during sub-solidus partitioning between body centered cubic (BCC) kamacite and face centered cubic (FCC) taenite.

Experimental: LA-ICP-MS analyses employed a quintupled Nd:YAG laser delivering a 213nm UV beam (1.0 0.2 mJ beam energy, 10 Hz ablation rate and 80-120 μm spot sizes) coupled to an Agilent 7500a ICP-MS, operated in dual detector (pulse and analogue) mode, allowing Ni to be used as a major element internal standard. Internal Ni concentrations were determined using a CAMECA SX-50 EMP. Effect of matrix differences between standard and analyte signals were negligible [2].

Results: HSE distribution coefficients between kamacite and taenite ($D_{T/K}$) were calculated for Brenham (PMG), Grant (IIIAB) and Toluca (IAB). $D(HSE)_{T/K}$ for all three samples are similar and indicate a preferential partitioning into taenite over kamacite for all HSE ($D(HSE)_{T/K} > 1$). While $D_{T/K}$ for Os, Ir, Ru, Rh and Pt cluster around 1.5 (range from 1.17 to 1.82), Pd exhibits the greatest affinity for taenite ($D(Pd)_{T/K}$ 2). Cu partitions strongly into taenite ($D(Cu)_{T/K}$ 3).

Discussion: Partitioning of HSE between kamacite and taenite are relatively constant between samples and are therefore irrespective of the melt composition. Grant represents an end product of the IIIAB crystallization sequence, and is therefore more enriched in "light" elements such as S, P and C, but these have no detectible effect on the sub-solidus partitioning of the HSE. The same conclusions may be drawn for pallasites and the presence of olivine has no measurable effect on the sub-solidus HSE behaviour. Similarities between $D_{T/K}$ are not restricted to the IIIAB and PMG. $D_{T/K}$ for Toluca (IAB) are similar to those of Brenham and Grant. Sub-solidus partitioning is not dependent on the bulk composition of the melt as the composition of the starting material for IAB and IIIAB irons have been shown to be different from each other. Metallographic cooling rates derived for the different parent bodies represented here vary [e.g. 3,4]. Thus, cooling rate does not affect the sub-solidus partitioning.

Conclusions: We explain the observed sub-solidus behaviour as a function of size and symmetry of the HSE atoms. The atomic radii of the HSE are all larger than the size of the Ni or Fe atoms. All but Au (c.17%) are 7 to 10% larger. The BCC structure of kamacite has a smaller lattice than FCC taenite. Thus, the large atoms will partition preferentially into taenite. Cu (3% larger than Fe or Ni) is most strongly partitioned into taenite.

References: [1] Mittlefehldt et al., 1998, In: Planetary Materials, Papike J.J. (Ed), p.195. [2] Mullane et al. 2003 Chem. Geol. *submitted*. [3] Yang & Goldstein, 2003, LPSC #1156. [4] Buseck & Goldstein, 1969, Bull. Geol. Soc. America 80, 2141-58.