

TRACE ELEMENT FRACTIONATION IN KAMACITE AND TAENITE IN IVA IRONS. R. D. Ash¹, M.V. Luong¹, R.J. Walker¹, W.F. McDonough¹ and T.J. McCoy², ¹Department of Geology, University of Maryland, College Park, MD 20742 USA ²Department of Mineral Sciences, National Museum of Natural History, Smithsonian Institution, Washington DC 20560 USA. (rdash@geol.umd.edu).

Introduction: The subsolidus fractionation of siderophile trace elements, between kamacite and taenite, in iron meteorites has been the subject of several studies through both analysis of meteorite samples [1-5] and through laboratory experiments [6,7]. However little systematic *in situ* work has been done within a single iron meteorite group. This may enable the avoidance of complications associated with disparate chemistry resulting from the analysis of unrelated groups.

We have chosen to analyse the IVA irons as many exhibit well developed Widmanstätten patterns with a range of band-widths reflecting a variety of cooling rates.

Samples and Technique: To date we have analysed five IVA irons with a range of nickel contents and cooling rates *viz* Alvord, Duchesne, Duel Hill 1854, Gibeon and La Grange.

Probe mounts of the samples were viewed by optical microscope and areas of kamacite and taenite identified. We used a New Wave UP213, quintupled NdYAG ultraviolet laser (213nm) to ablate appropriate material into a stream of He. The He flow was mixed with Ar and introduced into a Thermo Finnigan Element 2 single collector magnetic sector ICP-MS. Ablation spots ranged from 80 to 150µm with an output power of *ca.* 2-2.3Jcm⁻². Iron meteorites Coahuila, Hoba, Filomena and metals SRM 1158 and SRM 1263a were used as standards. Co and Ni were used for internal normalization with the values for individual spots being determined, post ablation, by electron microprobe (JEOL-8900 superprobe). Data reduction was carried out using a modified version of Lamtrace.

Isotopes measured were: P, ⁵¹V, ⁵³Cr, Mn, Co, ⁶²Ni, ⁶³Cu, ⁶⁹Ga, ⁷¹Ga, ⁷³Ge, As, ⁹⁵Mo, ¹⁰¹Ru, Rh, ¹⁰⁵Pd, ¹⁸²W, ¹⁸⁵Re, ¹⁸⁹Os, ¹⁹⁴Pt, ¹⁹⁵Pt and Au.

Results: Most elements show little fractionation between kamacite and taenite, giving Element_{kamacite}/Element_{taenite} values very close to 1. Figure 1 shows the mean concentration in the kamacite divided by the mean composition of the element in taenite. Phosphorus, V and As show a preference for partitioning into kamacite whereas Cu, and the Platinum Group Elements (PGE) partition preferentially into taenite (obviously along with Ni).

In general the fifth period PGEs (Ru, Rh and Pd) have a stronger preference for taenite than the sixth period PGEs (Os, Ir, Pt).

Within a given meteorite both kamacite and taenite concentrations of most elements show a positive correlation between Ni abundance and trace element abundance (for example see Figure 2). The one clear exception is tungsten which shows no systematic variation in any of the meteorites for either kamacite or taenite. Insufficient data were obtained for Ge in taenite for any correlations to be apparent, and only Duel Hill 1854 gave enough data to hint at a positive correlation between Ni and Ge.

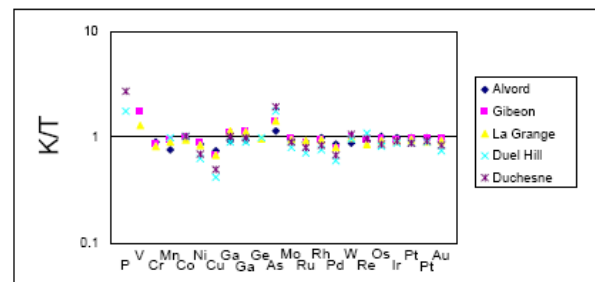


Figure 1. The mean kamacite/taenite partitioning for trace elements in five type IVA irons.

In general the variation in trace element concentration in kamacite is less than that seen in taenite.

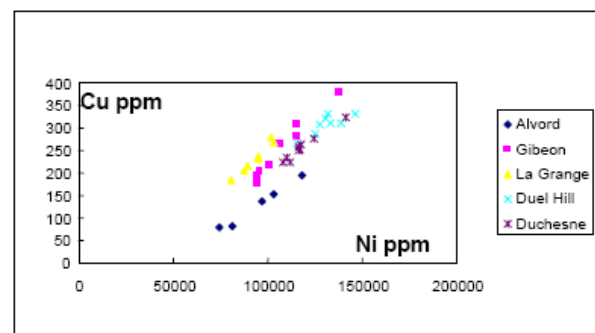


Figure 2. Cu vs Ni concentration in taenite in analysed IVA irons.

Discussion and conclusions: The analysis of trace elements in kamacite and taenite in IVA irons shown that, as in previous studies, there is potential for the fractionation of elements during subsolidus exsolution. Positive correlations between Ni content of a given

ablation spot and trace element content is best explained by diffusion across the boundary mimicking that observed for Ni. This phenomenon has been observed for analyses across the kamacite/taenite boundary for Cu and Au [3].

The observation of the different systematics of the 5th and 6th period PGEs has been made before [2].

The apparent fractionation between Re and Os between kamacite and taenite suggests that, for samples where physical separation is possible, isotopic dating of the closure of diffusion between may be possible.

The high distribution coefficient for phosphorus between kamacite and taenite is due to the presence of phosphides in the kamacite.

References: [1] Campbell A.J. and Humayun A.J. (1999) LPS XXX Abstract #1974 [2] McDonough W.F. et al. (1999) LPS XXX Abstract # 2062 [3] Watson et al. (2005) LPS XXXVI Abstract # 2141 [4] Rasmussen et al. (1988) *Meteoritics* 23 107-112. [5] Hirata T. and Nesbitt R.W. (1997) *Earth Planet. Sci. Lett.* 147, 11-24. [6] Chabot et al. *Meteoritics & Planet. Sci.*, 32, A74 (submitted) [7] Righter K., Campbell A. J. and Humayun M. (2005) *Geochim. Cosmochim. Acta* 69, 3145-3158.