

TUNGSTEN MICRODISTRIBUTION IN ORDINARY CHONDRITE METAL. M. Humayun and A. J. Campbell, Dept. of the Geophysical Sciences, University of Chicago, Chicago, IL 60637, USA (hum8@midway.uchicago.edu).

Introduction: We showed that individual metal grains in equilibrated ordinary chondrites (EOC) exhibit large variations of Re/Os and Re/Ir ratios, with chondritic Os/Ir ratios [1]. This was found to be the result of a greater depletion of Os and Ir relative to Re in such metal. This distribution was postulated to represent a redox signature rather than solid metal-liquid metal fractionation proposed by [2]. We have added tungsten, an element that strongly reflects redox and subsolidus metamorphic processes, to our microanalytical procedures. Here we report interelement ratios of W, Re, Os, and Pt to Ir determined on individual metal grains from Allegan H5 (EOC), and from Tieschitz H3 (UOC).

Experimental: Prior to laser ablation, a thin section of Tieschitz H3 and a polished slab of Allegan H5 were mapped by SEM, and metal grains were selected for trace element microanalysis by laser ablation ICP-MS [1,3]. The analytical procedure of [1] was modified to include W. Each point was analyzed twice: first, a 50-pulse laser burst was used to measure the isotopes ^{182}W , ^{185}Re , ^{190}Os , ^{193}Ir , and ^{195}Pt ; then, an additional 5-pulse burst was used for ^{57}Fe , ^{59}Co , and ^{60}Ni measurements for metal phase identification. Analyzing these two mass ranges separately improved precision of the interelement ratios (typically 5%, 1σ), at the expense of precision in the absolute abundances. The laser-ablated pit produced was $\sim 30\ \mu\text{m}$ in diameter and $\sim 25\ \mu\text{m}$ deep.

Results and Discussion: In kamacite grains from Tieschitz, the W/Ir ratios vary by over two orders of magnitude, mostly to subchondritic values. In kamacite from Allegan, there is little variation with $\text{W/Ir} = 0.53 \pm 0.08$ (1σ), compared with $\text{W/Ir} = 0.33$ in H chondrites [4]. Further W/Ir ratios both in kamacite and in taenite from Allegan are correlated with Re/Ir ratios, with chondritic W/Re. In Allegan, W preferentially concentrates in kamacite by a factor of about 3 relative to taenite, consistent with the bcc structure of metallic W. This data indicates the complete control of both W and Re distribution in OC metal by metamorphic processes, since W is known to enter EOC chondritic metal with increasing degrees of metamorphism [5]. It is conceivable that Ir and Os were present as refractory metal nuggets in UOC, and in Fe-Ni alloy. During metamorphism, reduction of FeO from the silicates contributed further Fe to pre-existing metal grains, resulting in dilution of Ir and Os abundances. The presence of W and Re in chondritic relative proportions is possibly related to their original presence in an oxidized form in silicates, which either directly contributed to their abundances during reduction, or facilitated the diffusive transport of these elements to the sites of

incorporation into metal. The Ir-Os deficiency in OC metal ranges from chondritic to about a factor of two lower than chondritic.

The direct implication of these findings to ^{187}Re - ^{187}Os dating of EOC metal is that the observed variations of Re/Os occurred during metamorphic processes affecting the OC parent body and not during nebular processes. A $\Delta T = 60$ m.y. of metamorphism is independently established from U-Pb systematics of EOC phosphates [6]. A paradox exists as to how OC metal could have retained distinct $\epsilon^{182}\text{W}$ [7] from OC silicate phases, given the degree of reequilibration observed here.

References: [1] Humayun and Campbell (2000) *LPSC XXXI*, #2032. [2] Chen J. H. *et al.* (1998) *GCA* **62**, 3379-3392. [3] Campbell A. J. and Humayun M. (1999) *Anal. Chem.* **71**, 939-946. [4] Wasson J. W. and Kallemeyn G. W. (1988) *Phil. Trans. R. Soc. Lond.* **A325**, 535-544. [5] Rambaldi E. R. and Cendales M. (1977) *EPSL* **36**, 372-380; Kong P. and Ebihara M. (1997) *GCA* **61**, 2317-2329. [6] Göpel C. *et al.* (1994) *Earth Planet. Sci. Lett.* **121**, 153-171. [7] Lee D. C. and Halliday A. N. (1996) *Science* **274**, 1876-1879.