FE-SILICIDE PHASES IN POLYMICT UREILITES: SIDEROPHILE TRACE ELEMENT FRACTIONATION.

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Introduction: Ureilites are ultramafic achondrites composed largely of olivine and pyroxenes that are thought to be derived as residues of partial melting within the mantle of a carbon-rich parental planetesimal to ureilites [1]. Despite having undergone high temperature processes and relatively high degrees of partial melting (20–30%), ureilites retain a significant amount of iron metal and relatively high abundances of siderophile elements. Many polymict ureilites also contain iron silicides such as suessite ($(Fe,Ni)_3Si$) and rare hapkeite (Fe_2Si) [2,3,4]. The presence of such phases indicates very low redox conditions. We present EMPA and LA-ICPMS data for several polymict ureilites which contain suessite and kamacite.

Results: Suessite contains approximately 15 wt% Si and 3.5 wt% Ni. Siderophile elements in suessite are considerably fractionated, with the more compatible siderophiles (Rh, Pt, Ru, Mo, Ir, W, Os and Re) mostly strongly enriched above chondrite by approximately 10x. In contrast, the less compatible siderophile elements (Ge, As, Au, Pd, Ni and Co) are less strongly enriched (approximately 2-5x chondritic abundances). These results are very similar to siderophile element data for metals in monomict ureilites [5] with considerably lower Si contents which generally do not exceed 4 wt % Si. In contrast, Si-free kamacite in polymict ureilites show flat siderophile element patterns, parallel to chondrite but enriched by 2-10x. It shows strong variations in Ni content from 5 to 15 wt% Ni. This "chondritic" kamacite may not be indigenous to the ureilite parent body but may have been introduced to the regolith by chondritic impactors.

Conclusions: Suessite is distributed non-uniformly within the ureilite parent body, being confined to the regolith, suggesting *in situ* formation at extremely low pressures [2]. Siderophile fractionation in suessite is very similar to that seen in other ureilitic Si-bearing Fe-Ni metals [5], indicating that the suessite was probably formed from pre-existing ureilitic Fe-Ni-Si metals. The siderophile element patterns suggest a two-stage process of metallic melt formation [6] in which an initial sulfur-rich metallic melt stripped the less compatible siderophile elements from the ureilite parent body. This was followed by formation of an S-poor, Si-rich metallic melt, remnants of which can still be found within ureilite meteorites.

References: [1] Mittlefehldt D W et al. (1998) *In: Planetary Materials; Mineralogical Society of America. Reviews in Mineralogy* 36. p. 195; [2] Herrin J S et al. (2008) *Meteoritics and Planetary Science* 43 (Supp.), abst. #5327; [3] Ross A J et al. (2009) *Meteoritics and Planetary Science* 44, abst. #5269; [4] Smith C L et al. (2010). *Meteoritics and Planetary Science* 45 (Supp.), abst. #5221; [5] Goodrich C A et al. (2013) *Geochimica et Cosmichimica Acta* 112, 340-373; [6] Hayden L et al. (2011) *Geochimica et Cosmichimica Acta* 75, 6570-6583.