METAL IN UREILITIC FRAGMENTS OF ALMAHATA SITTA

C.A. Goodrich[1], J. Goldstein[2], N.T. Kita[3], T. Mikouchi[4], M. Zolensky[5], J. Herrin[6], R.D. Ash[7], W.F. McDonough[7] and P. M. Jenniskens[8]. [1]Planet. Sci. Inst., Tucson, AZ 85719 USA. [2]Dept. Mechanical & Industrial Eng., Univ. Mass., Amherst MA 01003 USA. [3]Wisc-SIMS, Univ. Wisc., Madison, WI 53706 USA. [4]Dept. Earth Planet. Sci., Univ. Tokyo, Tokyo 113-0033 Japan. [5]ARES, NASA, JSC, Houston TX 77058 USA. [6]ESCG Jacobs, Houston TX 77058 USA. [7]Dept. Geol., Univ. Maryland, College Park, MD 20742 USA. [8]SETI Institute, Mountain View, CA 94043 USA.

Introduction: The Almahata Sitta (AHS) breccia provides fresh samples of a variety of ureilitic lithologies [1-4]. We studied metal in 2 fragments of AHS, for comparison to metal in main group ureilites [5-7]. Grain boundary metal in these fragments is unweathered, and shows features not observed in ureilite metal.

Samples and Techniques: We studied AHS #44 and AHS #15 by SEM, EMPA, EBSD, SIMS and LA-ICP-MS.

Results: AHS #44 consists of 75% olivine, 15% pigeonite, and 10% graphite + metal. It has typical ureilite texture and core mineral compositions: olivine Fo 79.2 (Fe/Mn=44.2); pigeonite Wo 11.1, *mg* 80.7. Oxygen isotopes of olivine ($\delta^{18}O$=7.6±0.5, $\delta^{17}O$= 2.8±0.4, $\Delta^{17}O$ =-1.2±0.4, 8 spots, 2SD) are consistent with those of ureilites [8]. Metal shows strong contrast variations in BEI, revealing internal crystalline textures. Compositions show little variation, despite BEI contrast (Ni=4.9±0.3, Co=0.38±0.03, P=0.35±0.09, Si=1.5±0.4 wt.%; 113 analyses), and are within the range of ureilites [5,7]. Schreibersite occurs as μm to sub-μm grains on edges of metal; metal is depleted in P (by ~0.2 %) near these grains. Metal contains many rounded pits. EBSD of one metal area shows elongated laths of kamacite with an unidentified interstitial phase. AHS #15 is an olivine-augite-orthopyroxene assemblage similar to Hughes 009 and FRO 90054 [9]. Metal contains many large (~10-60 μm) schreibersite grains. Internal textures are less pronounced than in #44 and pits are rare. Schreibersite (~2.5% Ni) and metal (1.6% Ni, 0.12% Co, 0.8% P, 0.03% Si) have compositions very similar to those in FRO 90054.

Equilibration Temperatures: We calculated equilibration T's in the Fe-Ni-P system [10,11] from coexisting metal and schreibersite. Results were 700°C for AHS #15 and 750°C for FRO 90054 from Ni and P contents. For AHS #44 and Hughes 009, P contents give ~550°C, but Ni contents are not on equilibrium tielines.

*Siderophile Elements***:** Metal in AHS #44 (9 spots) has siderophile abundances and pattern (CI-normalized Os & Ir ~23, Os/Pt=1.2, Os/Pd=6.2) typical of ureilites and similar to EET 96042 [6,7]. Metal in AHS #15 (14 spots) has abundances and pattern (CI-normalized HSE ~2.6, Os/Pd~1.7) similar to ALH 81101 [7]. Schreibersite has very low abundances of siderophiles.

Interpretation: Textures suggest that metal was shock (s)melted in AHS #44 but not in AHS #15. Differences in P and HSE between metal in the two samples are probably primary.

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