FOSSILIZED SMELTING; REDUCTION TEXTURES IN ALMAHATA SITTA UREILITE. J.S. Herrin[1], M.E. Zolensky[1], M. Ito[1,2], P. Jenniskens[3], M.H. Shaddad[4]. [1]NASA Johnson Space Center, Houston, USA. E-mail: jason.s.herrin@nasa.gov. [2]Lunar & Planetary Institute, Houston, USA, [3]SETI Institute, Mountain View, USA; [4]Physics Dept., University of Khartoum, Sudan.

We examined four paired centimeter-sized fragments of "black lithology" from the Almahata Sitta fall, described in greater detail by [1,2]. They are ureilitic breccias made up of mm-scale clasts or enclaves of fine-grained (10-40 µm) porous olivine-dominated and pyroxene-dominated sublithologies whose boundaries are sometimes poorly defined but often separated by carbon-phase+metal+sulfide and/or voids. Mafic silicates exhibit significant mg# variation (84-99) with corresponding variation in Fe/Mn indicating reduction of Fe to metal as a controlling variable [3]. Olivine-dominated sublithologies are more homogeneous in terms of mg# than pyroxene-dominated sublithologies. Both contain abundant metal with variable Ni and P content. Pyroxene-dominated sublithologies consist of low-Ca pyroxene and/or pigeonite (hereafter referred to as pyroxene), an interstitial silica phase often associated with coarse Fe(Ni) metal and voids, and minor Fe(Cr) sulfide. In contact with silica, pyroxene exhibits 4-6 µm thick high-mg# rims with metal inclusions.

Circumstantial evidence suggests that the reduction mechanism $MgFeSi_2O_6 + C \rightarrow MgSiO_3 + Fe + SiO_2 + CO$ played a central role in producing the observed textures, since all of the products and reactants are preserved as discrete phases with the exception of CO gas. Arguably, production of CO gas could be responsible for the rock's porosity but the amount of CO produced would have greatly exceeded present pore volume [4] and some gas would have necessarily escaped the system. Pigeonite smelting temperatures are at the high extreme for ureilites, 1295 ±25°C [5] and do not differ appreciably with mg# or lithology. Cooling rates of 2-6°C/h were estimated on the basis of asymptotic modeling of Fe-Mg zoning profiles in pyroxene margins [6]. This is consistent with previous estimates of cooling rates for thicker reduced olivine rims characteristic of typical ureilites [7,8].

The fine-grained and cataclastic nature of these samples impedes direct comparison with more equilibrated ureilites, but a similar final rapid cooling/reduction event together with the presence of diamond [1], a common ureilite accessory mineral, suggests a common parent body history. Almahata Sitta is perplexing in that it combines fine-grained, porous texture with mantle residue or cumulate-like composition and high initial cooling temperatures. Shock-induced mechanical disaggregation and subsequent vesiculation of the resultant medium by gas reaction products is a possible scenario that warrants further investigation.

References: [1] Jenniskens *et al.*, 2009. *Nature* 458:485-488. [2] Zolensky *et al*., 2009 ***(this volume).*** [3] Goodrich & Delaney, 2000. *GCA* 64:149-160. [4] Warren & Huber, 2006. *MAPS* 41:835-849. [5] Singletary & Grove, 2003. *MAPS* 38:95-108. [6] Ganguly & Tazzoli,1994. *Am Min* 79:930-937. [7] Chikami *et al.*, 1996. *27th LPSC* Abs#1111. [8] Goodrich *et al.*, 2004. *Chemie de Erde* 64:283-327.