HIGHLY REDUCED METALS AND SULPHIDES IN UREILITES: REMNANTS OF THE UPB CORE? A. J. Ross[1,2], H. Downes[1,2], C. L. Smith[1] and A. P. Jones[2]. [1]IARC, Department of Mineralogy, The Natural History Museum, Cromwell Road, London SW7 5BD, UK. Email: aidan.ross@ucl.ac.uk; [2]Centre for Planetary Sciences at UCL/Birkbeck, Joint Research School of Earth Sciences, Gower Street, London WC1E 6BT, UK.

Introduction: Ureilites are ultramafic, carbon-rich achondrite meteorites, which are believed to represent mantle residues from the ureilite parent body (UPB). Approximately 10-15% are polymict (brecciated) ureilites, which contain many exotic lithic and mineral clasts [e.g. 1,2]. Whether metal and sulphide phases in ureilites are indigenous to the UPB or foreign (i.e. impact-derived) is highly controversial. We present EPMA major element data (analysed at the NHM) for metal and sulphide phases in five paired Frontier Mountains ureilites: 90036, 90054, 90168, 90233, 90228 [3].

Results: The samples contained silicide, phosphide, sulphide and Fe,Ni metal phases. Metals and sulphides occur in three different contexts: as veins (FRO 90054); closely associated with carbon (FRO 90233); or interstitial to silicates (FRO 90228). Some samples contain metals in more than one of these. We observed significant inter- and intra-sample variations in composition, abundance and size. Individual metal grains, however, appeared internally homogeneous on a micron scale. Si and P are present in metal and sulphides (tabulated below). Cr is abundant in some sulphides (up to 7 wt%); these also have minor wt% Ti, Mn and Cu. Compositions are consistent with those in other work [e.g. 4,5]. There are also rare grains that appear to be a mixtures of phases, such as high-Si and high-P kamacites and Fe,Ni metal with higher Ni than typical kamacite (up to 7.6wt% Ni) [4]. Co is also present (up to 0.5 wt%). Ranges for each phase are in wt%:

Phase	Nominal Formula	Fe	Si	P	S	Ni
Sulphides (troilite)	FeS	52.8-77.5	<dt-2.0	<dt-0.8	18.5-38.9	<dt-2.2
Silicides (unnamed)	$(Fe,Ni)_9Si$	83.9-92.7	3.5-7.7	0.2-0.4	<dt-0.4	2.0-5.8
Phosphides (schreibersite)	$(Fe,Ni)_3P$	72.1-86.6	<dt-0.7	11.6-16.8	0.1-4.0	1.8-8.1
Fe,Ni metal (kamacite)	Fe_9Ni_1 - $Fe_{9.5}Ni_{0.5}$	88.1-97.8	<dt-1.6	0.04-6.7	<dt-6.2	0.3-7.6

Conclusions: The presence of abundant metals in polymict ureilites indicates that impact processes likely have a significant role in the evolution of metal phases, even if they were indigenous to the UPB. High Cr contents in sulphide imply that they formed under very reducing conditions. Thus they most likely originated from the UPB that is known to be a highly reduced body. Current research indicates that Si could be the light element in the Earth's core [e.g. 6]. It is widely recognized that the UPB suffered catastrophic disruption [see 7] which could have mixed core and mantle material. Is it possible that the Si-bearing metals are remnants of the disrupted UPB core which were subsequently accreted to the regolith of the UPB?

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