ISOTOPIC AND CHEMICAL VARIATIONS ON THE NANOSCALE OF DISTINCT LITHOLOGIES FROM THE TAGISH LAKE METEORITE.

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Introduction: The ungrouped Tagish Lake carbonaceous chondrite contains several distinct lithologies, including carbonate-rich and carbonate-poor material [1], as well as matrix-rich and matrix poor lithologies [2]. All of these lithologies contain abundant insoluble organic matter (IOM) with similar bulk ^{15}N enrichments but significantly variable H/C and D/H ratios [3]. Tagish Lake IOM also contains organic nanoglobules, which have been shown to be discrete carriers of D and ^{15}N isotopic anomalies [4]. Based on studies of other carbonaceous chondrites [5], it is likely that nanoglobule abundance and chemistry for these distinct Tagish Lake lithologies may follow the chemical and isotopic trends for bulk IOM.

Methods and Results: IOM residues from two Tagish Lake lithologies were analyzed: 5b (a matrix-poor lithology) and 11v (a disaggregated, matrix-rich lithology). H, C, and N isotopes were measured in ultramicrotomed sections of the IOM residues with a Cameca NanoSIMS 50L ion microprobe. Additional sections were imaged in a 200 keV JEOL 2200F transmission electron microscope (TEM) to locate nanoglobules. The functional group chemistry of these TEM samples was then analyzed by X-ray absorption near-edge structure (XANES) spectroscopy at beamline 5.3.2 at the Advanced Light Source.

Isotopic Compositions. As observed previously in other Tagish Lake samples [4, 6], both IOM residues contain abundant µm-scale and sub-µm-scale D and ^{15}N isotopic hotspots. Some ^{15}N-depleted "coldspots" were observed as well. Consistent with bulk results, sample 5b contains significantly higher D/H, including more D hotspots with more extreme D/H values than seen in sample 11v. In contrast, the N isotopic distributions are similar except that 5b contains about twice as many ^{15}N hotspots.

Nanoglobule Chemistry. Organic nanoglobules are ~3-5x more abundant in sample 5b than in 11v. Ten of 15 (67%) analyzed nanoglobules in 5b exhibit organic chemistry similar to the surrounding bulk IOM, but with slightly elevated abundances of oxidized functionality. The remainder (33%) exhibits distinct highly-aromatic chemistry. In 11v, six of 12 (50%) analyzed nanoglobules are highly-aromatic, and the remainder are IOM-like.

Discussion: Bulk observations indicate that sample 5b may have undergone less hydrothermal alteration than sample 11v [3]. Our results suggest that this parent body processing has significantly mobilized D, reducing both the number of hotspots and their D/H values. In addition, it appears that aqueous processing destroys nanoglobules rather than creating them, and that IOM-like nanoglobules may be preferentially destroyed.

References: [1] Zolensky M. E. et al. 2002. *M&PS* 37:737-761. [2] Blinova A. et al. 2009, *LPSCXL*, 2039. [3] Herd C. D. K. and Alexander C. M. O'D. 2009, *M&PS* 72:A88. [4] Nakamura-Messenger K. et al. 2006, *Science* 314:1439-1442. [5] De Gregorio B. T. et al. 2010, *LPSCXLI*, 2108. [6] Herd C. D. K. et al. 2009, *LPSCXL*, 1818.