QUANTITATIVE PETROGRAPHY OF L CHONDRITES: 3D MORPHOLOGIC VARIATIONS WITH DEGREE OF EQUILIBRATION AND SHOCK LOADING.

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The petrographic study of two-dimensional (2D) thin sections of chondrites have given us extensive insights into the post-accretionary processes that changed chondritic materials due to heating, aqueous activity, and impact-related processes [1]. Although thin section derived (2D) information such as chemical makeup or exactingly precise mineralogical composition can not be rigorously extended to three dimensional (3D) analytical methods, X-ray computed micro-tomography (XRCMT) does allow for an approximate 3D compositional examination of chondritic meteorites [2]. Combined with computer-aided 3D visualizations, XRCMT can be a useful technique for examining the physical metal dispersion in metamorphosed chondrites [3,4]. Here, we are examining and comparing the effect of thermal metamorphism and shock loading on the morphology and distribution of metal and sulfide in a large suite (n=47) of L chondrites.

We have analyzed our suite of unequilibrated and equilibrated L chondrites by XRCMT at resolutions of at least 17 µm/voxel at the GSECARS 13-BM beamline with the methods outlined in [2]. Sample sizes are between 1-3 cm^3. One of the challenges of using L chondrites as analogues for incipient planetary differentiation is quantifying the descriptive language used in petrographic studies: in this work, we augment typical XRCMT volumetric data analysis techniques [e.g. 3] with several in-house methods for the quantative 3D structural analysis of chondrites. These quantative descriptors were created to help us quantify the lumpiness of a component (metal and sulfide) or extent of a component's resemblance to a vein-like structure [5]. The metrics we calculated include textural metrics for classification [6]; model-dependent structural parameters [7]; and algebraic topological descriptors for 3D structures [8].

To date, we have verified statistical differences between the textures of 29 equilibrated (n=18) and unequilibrated (n=11) L chondrites in our current suite. Our work will increase knowledge of metal/silicate distribution and segregation in primitive solar system bodies and identify the extent to which possible mechanisms are responsible for their current distribution.

References: [1] Stoffler et. al., 1991. *Geochimica et Cosmochimica Acta* 55: 3845-3867. [2] Ebel D. S. et al. 2007. *Meteoritics and Planetary Science* in press. [3] Benedix G. K. et al. 2003. Abstract #1947 34th Lunar & Planetary Science Conference. [4] Nettles and McSween 2006. Abstract #1996 37th Lunar & Planetary Science Conference. [5] Friedrich J. M. 2007. *Meteoritics and Planetary Science* submitted. [6] Haralick R. M. et al. 1973. *IEEE Transactions on Systems, Man, and Cybernetics* SMC-3: 610-621. [7] Parfitt A. M. et al. 1983. *The Journal of Clinical Investigation* 72: 1396-1409. [8] Odgaard A. 1997. *Bone* 20: 315-328.