A NEW METHOD FOR MEASURING THE EXTENT OF THERMAL METAMORPHISM IN ORDINARY CHONDRITES. C. A. Marsh, D. S. Lauretta, and K. J. Domanik. Lunar and Planetary Lab, University of Arizona, Tucson, Arizona 85721, USA E-mail: celinda@lpl.arizona.edu

Introduction: Thermal metamorphism in ordinary chondrites (OCs) is quantitatively defined by homogeneity of olivine and low-Ca pyroxene [1]. In meteorite research homogeneity is measured using Percent Mean Deviation (PMD) and Coefficient of Variance (CoV) [2, 3]. Measuring the degree of heating primitive meteorites experienced is a critical step in understanding the mechanism(s) that heated planetesimals in the early solar system. Also, accurately measuring the fayalite and ferrosilite abundances in meteorites is necessary before robust links between asteroid and meteorite compositions can be established, especially if those links rely on near infrared spectra [4].

Technique: We have developed a calibrated x-ray mapping technique to quickly measure ferromagnesian silicate homogeneity within individual thin sections [5]. A routine in the Cameca task language was created that allows us to collect raw x-ray intensities of Fe, Mg, Ca and Si on 16,384 discrete 10 micron diameter footprints. We are continuing to test grid spacing between analyses in order to reduce selection bias. This technique does a better job of representing the homogeneity of the area mapped than the typical selection of a couple of points.

Data: As part of our study of progressive thermal metamorphism among the L-chondrites, we selected Allan Hills 77197 for examination. ALH 77197 is a 20.3 g meteorite that has been classified as an L3.7 with an A/B weathering stage. The olivine in ALH 77197 has an average composition Fa 28,a PMD of 5, and a CoV of 7. We found the low-Ca pyroxene in ALH 77197 to have an average Fs 17, a PMD of 19, and a CoV of 23. The ratio of Olivine to Orthopyroxene (Ol/Opx) is 6.2 for ALH 77197, indicating a low abundance of orthopyroxene. The highest Ol/Opx ratio measured by similar mapping techniques is 2.6 for an LL5 [6]. A BSE image taken at the same time that the elemental abundance mapping was conducted confirms the paucity of pyroxene in the mapped region. However, visual inspection of the thin section of ALH 77197 we are studying reveals the presence of a 2mm diameter radial pyroxene chondrule nearby.

Discussion: Ol/Opx ratios, along with average fayalite and ferrosilite content, are used as a proxy for oxidation state [7]. While these three values are linked, within a sample experiencing heat they will reach equilibration at different scales at different times. The data from ALH 77197 indicate that olivine has equilibrated and is highly oxidized for an L chondrite. Preliminary results show that both the Ol/Opx ratio and low-Ca pyroxene are not in equilibrium. Understanding the kinetics of equilibration in the olivine orthopyroxene system in ALH 77197 and similar meteorites will improve our ability to constrain the intensity and duration of thermal metamorphism.

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