A COMPARISON OF METAL-TROILITE GRAIN SIZE DISTRIBUTIONS FOR TYPE 3 AND TYPE 4 ORIDINARY CHONDRITES USING X-RAY CT DATA. J. W. Nettles and H.Y. McSween, Jr. Department of Earth & Planetary Sciences, University of Tennessee, Knoxville, TN, 37996 (jnettle1@utk.edu)

Introduction: Average grain sizes for metal-troilite grains have been thought to coarsen with the thermal metamorphism that accompanies the transition from type 3 to type 4 ordinary chondrites. X-ray computed tomography (CT) data provide a means to quantify this coarsening for two reasons. First, the high density of metal-troilite grains relative to chondrules and matrix gives them high brightness values in CT scans, making them easy to separate using image processing routines. Secondly, CT-scans allow for true three dimensional size measurements such as volume (used in this study), rather than the apparent diameters that are measured in thin section. We have acquired X-ray CT data for three type 3 meteorites at the University of Texas at Austin's High-Resolution X-ray Computed Tomography Facility (UTCT), which we compared to the type 4 chondrite CT data of [1] (also acquired from the UTCT facility).

Methods: Type 3 meteorites used in this study are given in Table 1, while the type 4 meteorites from [1] are summarized in Table 2.

The basic methodologies in processing both sets of meteorites (types 3 & 4) were the same. After the scans are acquired and reconstructed into image stacks at the UTCT facility, the metal grains were separated from the rest of the data volumes and then the volumes of the metal grains were measured. The resolutions of the scans are different, however. Type 3 meteorites were scanned with slices thicknesses of 13.8 (Krymka) and 16.9 µm (Semarkona and Sharps), while the type 4 meteorites had slice thicknesses of 100µm. The resolution is significant not only because it determines the smallest metal grain that can be measured, but also because the lower the resolution, the more partial-volume effects occur. Partial volume effects occur when more than one type of material (e.g., chondrule and matrix) are imaged within a single voxel (3D pixel) [2].

In both sets of scans the metal grains were separated from the rest of the scans by selecting all voxels with brightness values above a certain threshold. Once a metal-troilite grain is isolated, volume is calculated by counting the voxels that comprise the grain and multiplying the voxel count by the voxel scale. For type 3 meteorites, a program called Blob3D was used for this, which was not available when the type 4 data were acquired, so the separation and measurement steps were done manually. An example of metal grains isolated from a data volume (Semarkona in this case) is given in Figure 1. In both sets of meteorites metal grains visibly associated with chondrules were excluded from the dataset.

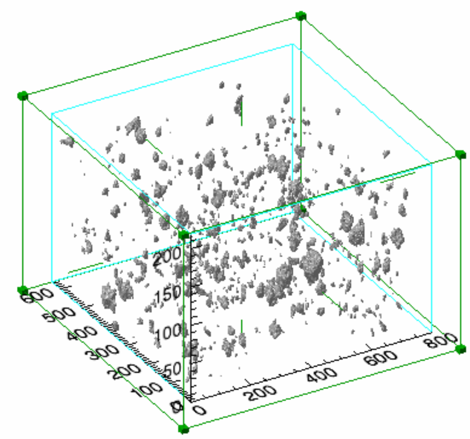

Figure 1. Semarkona CT data with chondrules & matrix removed, showing only metal grains. Axes are voxel coordinates.

Table 1: Type 3 chondrite samples used.

Sample	# Grains	Avg. Volume (mm^3)
Semarkona (LL3.0)	588	0.00215
Krymka (LL3.1)	417	0.00266
Sharps (H3.4)	1922	0.00221

Table 2: Type 4 chondrite samples used.

Sample	# Grains	Avg. Volume (mm^3)
Kelly (LL4)	1923	0.0211
Bjurbole (L/LL4)	1342	0.0213
Hammond Downs (H4)	3174	0.0232

Results & Discussion: Tables 1 & 2 list average grain volumes for both sets of meteorites. The size coarsening between the two types is almost exactly one order of magnitude. This somewhat surprising result is difficult to interpret because of the differences in resolution between the two sets of scans. However, efforts are underway to determine the significance of resolution effects that will hopefully be reported at the conference. Nevertheless, the amount of coarsening that occurs between type 3 and type 4 is an important constraint in our understanding of the formation of metal-troilite grains in ordinary chondrites.

References: [1] Kuebler K. E. et al. (1999) *Icarus.*, *141*, 96-106. [2] Ketcham R.A. and Carlson W.D. (2001) *Comp. & Geosci.*, *27*, 381-400.