

3-DIMENSIONAL CHONDRULE SIZE MEASUREMENT

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Introduction: The difficulty in measuring chondrules stems from their small size, mostly spherical morphology, and lithification in matrix. This study investigates a new technique that utilizes digital tomography data for direct measurement.

Sample: Semarkona is an LL3.0 [1] ordinary chondrite. A parallelepiped sub-sample of Semarkona [2] was imaged by synchrotron x-ray microtomography (μ CT). The outlined sub-volume (136 mm^3 , $8 \times 8.5 \times 2 \text{ mm}$) consists of $17 \mu\text{m}$ voxels [3].

Method: We manually outlined ~ 330 Chondrules in 95 alternating slices using a side-by-side comparison technique. Data sets were “eroded” by resetting outline stroke widths to 5 pixels, to determine the center of mass coordinates of each chondrule. Using a code written in IDL, the centers of mass were overlaid on the 0 pixel outline stack and then individually built upon until they reached either matrix material or another chondrule. The program then calculated each chondrule’s volume, in voxels.

The IDL code prevents deletion of by over-thick outlines and from being artificially connected with other chondrules, and thus miscounted by other software. After a 5 pixel dilation, a chondrule with an original diameter of 12 pixels has a diameter of 2 pixels. It is unlikely that a chondrule smaller than 12 pixels in CT data could be manually outlined with accuracy; therefore, there is no significant data loss with a 5 pixel outline.

Results and Discussion: Chondrules in this sample of Semarkona are well below the 1 mm accepted diameter [4-7]. In this Semarkona sample, the average volume is 0.07742 mm^3 with a standard deviation of 0.1725 mm^3 , using our technique. The average radius is 0.2216 mm with a standard deviation of 0.0940 mm. The diameter is an approximation calculated from the volume by assuming each chondrule is a perfect sphere.

Accuracy depends on the resolution of the tomography data, outline thickness and manual outlining itself. Accuracy is increased by outlining every slice. Additionally, outlining and calculating the size of individual chondrules is more accurate since it eliminates the need to use thick outlines to separate chondrules.

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