

TRUE (3D) CHONDRULE SIZE-FREQUENCY DISTRIBUTIONS IN ORDINARY CHONDRITES

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In order to characterize the relation between apparent chondrule sizes (2D) and true chondrule sizes (3D) three ordinary chondrites (OCs) of the H, L, and LL group have been analyzed. The diameters of a large number of chondrule cut faces in thin sections (2D) and of separated chondrules from the same meteorites (3D) have been measured [1]. The data show that there is a cut-off for small chondrule sizes in each sample and possibly characteristic minimum sizes exist for the various groups, increasing in the (3D) sequence H (~90 μm) <L (~180 μm) <LL (~240 μm). No systematics was found for the maximum chondrule sizes. The investigated samples show very similar chondrule volume (mass) distributions relative to the mode (peak) of their size-frequency distributions. In all samples only 2.6-2.9% of the total chondrule volume (mass) is present in chondrule sizes smaller than the mode. It was found that 2D sectioning consistently results in a shift of the true 3D size-frequency distributions toward smaller sizes. This effect leads to the underestimation of the values for (1) the true mean chondrule size by 8-18%, (2) the true chondrule median value by 12-21%, and (3) the true mode value of the size-frequency distributions by 12-17%. This is the opposite of what popular 2D/3D correction models predict [1].

For comparison, chondrule size-frequency distributions (2D: thin sections; 3D: μ -CT) have been determined in two cluster chondrite clasts from NWA 5205 (LL3). Cluster chondrites are characterized by very low amounts of interchondrule matrix and mutually indented chondrules, taken as evidence that these chondritic rocks accreted in a hot state [2]. Although situated side by side in their host meteorite, chondrule sizes in both clasts differ dramatically. One clast shows the largest mean chondrule size ever measured in any chondrite (beside CBs) with a true (3D) mean size of 1500 μm and a minimum size of 360 μm . The other clast shows a true (3D) mean chondrule size of 590 μm and a minimum size of 200 μm . Compared to the positively skewed H, L, LL distributions the values for both cluster chondrite clasts are closer to a normal distribution. Furthermore, compared to the OCs described above, significantly larger mass fractions are present in chondrule sizes smaller than the modes. Obviously, different or additional pre-accretionary processes caused differences in the frequency distributions of chondrule sizes in “normal” ordinary chondrites and cluster chondrites.

References: [1] Metzler K. 2018. *MAPS* 53: in press ; [2] Metzler K. 2012. *MAPS* 47: 2193-2217