THE CHONDRULE SIZE DISTRIBUTION OF BJURBOLE. Karla E. Kuebler and Harry Y.
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For more than two decades scientists have acknowledged that chondrite groups have distinct size-
frequency distributions of chondrules and have inferred a process of aerodynamic (or mass) sorting
in the presolar nebula prior to accretion [1, 2, 3, 4]. Data acquisition inevitably requires the
observation of the apparent chondrule size distribution in thin section because disaggregation is not
always convenient, and is therefore subject to the biases of chondrule sampling during thin
sectioning. These biases include: 1) non-equatorial thin sectioning of chondrules, 2) the non-zero
thickness of thin sections, and 3) the disproportionate probability of sampling large chondrules.

Because the evaluation of chondrule sorting depends upon the successful conversion of the
apparent size distribution to the true size distribution (that achieved by disaggregation), all of these
biases must be corrected. While previous models correct for one or another of these biases ([5] for 1,
[2] for 1 & 3) a model presented by [6] incorporates all of the above. The aim of the current
research is to compare the results of the Eisenhour model with previous models.

By the disaggregation of the Bjurbole (L4) chondrite, Hughes [5] was able to create a histogram
showing the percentage of droplet chondrules lying within specific size ranges (or bins) (see Fig.
1, bold histogram). He then attempted to convert the apparent diameters of chondrules measured in
thin section into percentages comparable to the disaggregation percentiles. To do this, all chondrules
within a specific bin (as measured in thin section) were assumed to sample chondrules whose actual
diameters were 0.5 mm larger than the bin. From this it was possible to calculate the expected
abundance of chondrules within a given bin. By repeating the procedure for various bin sizes the
dashed histogram in Fig. 1 was produced. This was referred to as the "expected thin section data." The percen
t difference between the disaggregation and expected values (the difference between the
solid and dashed histograms) was then used to calculate those values that, when multiplied by the ratio
between the disaggregation and expected thin section mean and median yield the "true" values which
should have been obtained upon disaggregation. From this Hughes [5] determined that the average
diameter (D) of a chondrule measured in thin section is \(4213\) and the median diameter is \(4314\).

However, the assumption that all chondrules are sectioned randomly is not valid because larger
chondrules are preferentially sampled relative to small. Dodd [2] applied empirical correction factors
originally derived for terrestrial sandstones to chondrites and obtained mean and median chondrule
diameters 10 to 20 \% smaller than the diameters measured in thin section. The application of this
method, however, is limited because it preserves the functional form of distributions. The method
used by Dodd effectively narrows the range of sizes and decreases the mean. With the procedure
described by [6], the functional form of distributions is allowed to change, and means may increase
or decrease.

The observed diameter of a chondrule varies according to the light used when the measurements
are made. When the surrounding matrix is opaque, measurements made in transmitted light represent
the smallest diameter of the chondrule in the thin section. Measurements made in reflected light
represent the chondrule diameter at the upper surface of the thin section. This difference will be
greater for thick sections than thin. Furthermore, the error for small chondrules will be more
significant than for large chondrules. For this reason, [6] suggests that all chondrule measurements
be made in reflected light.

The thin-section derived chondrule size data from Bjurböle were corrected according to the
procedures outlined in [6], where the corrected number of chondrules, \(N_o^i\), within each size bin is

\[
N_o^i = \frac{2}{(d_u + d_i)} \left[ \frac{d_u}{d_u^2 - d_i^2} \right]^{1/2} \left[ N_o \left( \frac{D_i^2 - d_i^2}{D_i^2 - d_i^2} \right)^{1/2} \right] \tag{1}
\]

where \(N_o\) is the uncorrected number of chondrules in a bin; \(D_i\) and \(N_i\) are the mean diameters and
corrected abundances, respectively, of larger bins; and \(d_u\) and \(d_i\) are the upper and lower boundaries,
respectively, of bin \(N_o\). The data were corrected bin by bin starting with the largest size bin and
proceeding to the smallest. All summations were truncated at \(i = 5\).

A histogram of the results is presented (total chondrules measured=210), where the black
columns represent the apparent thin section size distribution, and the Hughes [5] and Eisenhour [6] corrected distributions are represented by the shaded and clear columns, respectively (Fig. 2). Cumulative frequency curves of the apparent size distribution, the Hughes, and Eisenhour corrections are also presented (Fig. 3).

In reality, the correction procedures differ from one thin section to another, depending on variables such as section thickness, relative chondrule sizes, and ease of chondrule observation. Results from Bjurböle indicate that the method of [6] provides better agreement with disaggregation data than previous methods. However, the resulting chondrule size distribution is not in complete agreement with the disaggregation data and may reflect difficulties associated with chondrule identification.