RELATIONS BETWEEN ACCRETIONAL DEFORMATION AND TEMPERATURE IN CLUSTER CHONDRITE CHONDRULES.

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Introduction: Cluster chondrites are ordinary chondrites that consist of 88-92 vol% of chondrules [1]. Chondrules in these rocks are highly shape-deformed compared to non-cluster chondrites, which has been interpreted to be a result of plastic deformation at elevated temperatures [1]. We used electron backscatter diffraction (EBSD) methods [2] to analyze chondrule deformation, crystalline deformation, and deformational temperatures of cluster chondrite chondrules to test for relations between deformation and temperature within cluster chondrites.

Methods and Samples: Samples used are cluster chondrite clasts in NWA 5205, NWA 5421, NWA 5781, and Tieschitz. All are type 3 and shock classified in this study as S1, suggesting they were little-affected by post-accretion thermal or shock metamorphism. Whole chondrule deformation was determined using the chondrule shape deformation parameter of Metzler [1]. Grain orientation spread (GOS) and temperature parameter metrics, measuring olivine intracrystalline deformation and codeformational temperature respectively, were measured as per the methods of Ruzicka and Hugo [2]. Two EBSD maps were made of each sample, and from each 10 chondrules representing a full spread of deformation extents were selected for measurement of deformation parameters, mean GOS, and temperature paramters. For each meteorite, each metric was compared to each of the others and trendlines were fitted to the resulting datasets. Correlations between the metrics were tested using ANOVA so as to determine if the metrics are related.

Results: Probabilities of there being no correlation between measured metrics in each meteorite are listed in the table below.

Table 1. ANOVA Statistics of Temperature and Deformation Metrics in Sample Meteorites. Probabilities displayed represent the probability of there being no relationship between the two given metrics within a sample.

Meteorite	Deformation Parameter vs. Temperature Parameter	Mean GOS vs. Temperature Parameter	Deformation Parameter vs. Mean GOS
NWA 5205	40.47%	64.58%	6.81%
NWA 5421	0.25%	73.38%	8.22%
NWA 5781	13.97%	12.39%	1.23%
Tieschitz	68.76%	66.24%	0.94%

Conclusions: The calculated statistics indicate that there is no strong relation between condeformational temperature and either chondrule deformation or crystal deformation within the studied samples. However, the consistently low probabilities of a lack of relation between the metrics representing chondrule and intracrystalline deformation suggest that these two scales of deformation are linked – indicating that observations derived from the deformations of chondrule olivine grains can be interpreted to represent the deformation of the chondrule as a whole. This allows temperatures interpreted from olivine deformation, such as those from Ruzicka and Hugo's temperature parameters [2], to represent chondrule deformational temperatures.

References: [1] Metzler K. (2012) *Meteoritics & Planetary Science* 47:2193–2217. [2] Ruzicka A. M. and Hugo R. C. (2018) *Geochimica et Cosmochimica Acta* 234:115-147.