Cluster Chondrite Accretion Temperatures Determined with Electron Backscatter Diffraction

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Methods

Thin sections of the cluster chondrite UOCs [1] NWA 5205 (LL3.2), NWA 5421 (LL3.7), NWA 5781 (LL3.3), and Tieschitz (H/L3.6) were all shock classified [2] and mapped with electron backscatter diffraction, using a Zeiss Sigma SEM at an accelerating voltage of 20 kV and a step size of 2-4 μm. Methods of Ruzicka and Hugo [3] were employed to measure temperature parameters indicating the temperature at deformation of whole maps and individual chondrules, 20 in each sample, on the basis of crystal rotation axes measured in the olivine from the EBSD data.

Results

All samples were shock classified as S1, with temperature parameters shown in Table 1.

Sample	Whole Maps	Chond Mean	Chond SD	Chond Max	Chond Min
NWA 5205	0.61	0.62	0.06	0.70	0.51
NWA 5421	0.63	0.63	0.10	0.77	0.32
NWA 5781	0.62	0.62	0.04	0.71	0.54
Tieschitz	0.61	0.61	0.06	0.68	0.41

Table 1: Table of Measured Temperature Parameters. Parameter values 0.57-0.62 are associated with temperatures >800°C, and parameter values 0.35-0.40 are associated with temperatures <800°C at deformation [3].

Discussion

As the studied samples are type 3 and S1, the measured parameters are interpreted to represent the temperatures of the chondrules during accretion. While most are hot, some chondrules have low parameters indicative of cold accretion. For the hot chondrules, the most likely heat source is the chondrule formation event. Two implications of these results are 1) chondrules must be able to accrete shortly after formation, as they are not hot for long, and 2) freshly heated chondrules must be able to mix with cold chondrules during accretion, impyling a turbulent environment.

[1] Metzler (2012) *MAPS* **47**, 2193-2217 [2] Jamsja and Ruzicka (2010) *MAPS* **45**, 828-849. [3] Ruzicka and Hugo (2018) *Geochim. Cosmochim. Acta* **234**, 115-147.