POST-BRECCIATION CHONDRULE FLATTENING AND PETROFABRIC FORMATION IN CM CHONDRITE KOLANG

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Introduction: Kolang is a highly aqueously altered CM chondrite breccia that fell in Indonesia in August 2020 [1]. Initial observations of back-scattered electron (BSE) images show that its chondrules are flattened and show a common alignment. Chondrule flattening and petrofabrics within carbonaceous chondrites are typically caused by impact events [2,3]. Chondrules and their alignment can help discern the impact history of the sample. Herein, we measure the aspect ratios (AR) of chondrules and their orientation in Kolang, drawing a comparison between constituent clasts to determine the relative timing of chondrule flattening and petrofabric formation.

Samples and Methods: At the ISAAC lab at the University of Glasgow, BSE images and Energy Dispersive X-ray Spectroscopy (EDS) maps of two thin sections, each ~2 cm^2 in size (Kolang_01 and Kolang_02), were collected using a Carl Zeiss Sigma Variable Pressure Analytical scattered electron microscope, equipped with Oxford Instruments microanalysis (Aztec). Clasts were identified with large area montages of BSE images and EDS maps. BSE images were processed with GIMP 2.10.6 to create black and white maps of each thin section, where the chondrules larger than 250 µm in diameter were depicted in white and the rest of the meteorite in black. This was done twice for each sample, to compare chondrules with and without their fine-grained rims (FGR). Chondrule AR and azimuthal angle (AA) relative to the images' x-axes was measured in ImageJ with the Analyze Particles function.

Results: In Kolang_01 13 clasts were identified, and 73 chondrules were measured in eight of the clasts, while in Kolang_02 seven clasts were identified, and 82 chondrules were measured in five of the clasts. All clasts showed petrographic characteristics typical for CM chondrites. Combining both thin sections, chondrules have an average AR of 1.46±0.36 and 1.55±0.44 with and without their FGRs, respectively. Chondrules in Kolang_01 have a median AA of 121±35° with their FGRs and 108±40° without their FGRs. Chondrules in Kolang_02 have a median AA of 123±36° with their FGRs and 119±39° without their FGRs. Out of the 155 chondrules measured, with their FGRs, 14% have AAs that deviate less than 10° from the median AA, while without their FGRs, 9% have AAs that deviate less than 10° from the median AA. A comparison between the clasts is shown in Fig.1 and 2.

Fig. 1. Comparison of Average AR for Clasts in Kolang

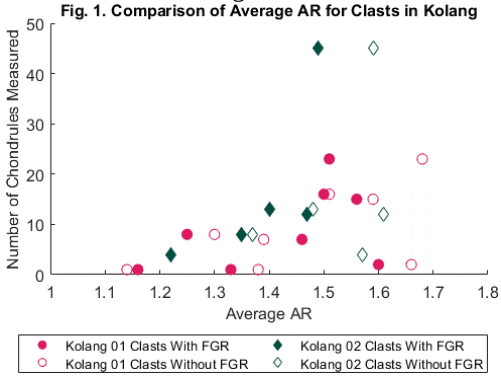
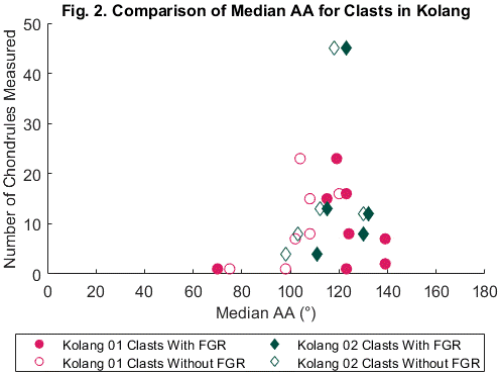


Fig. 2. Comparison of Median AA for Clasts in Kolang



Discussion: Kolang's chondrules show flattening. AR varies between the clasts, however most clasts show a similar degree of flattening with ARs in the range of 1.30-1.60. The clasts that deviate from this range contain few measurable chondrules. If chondrule flattening is caused by impacts, then the clasts have all experienced a similar, if not identical, impact history. Kolang displays a weak petrofabric that persists throughout the clasts. Most clasts have median AAs that deviates less than 10° from the median AA of the bulk sample. The clasts that deviate the most typically have few measurable chondrules. Given that the median AA for each clast is very similar, the weak petrofabric displayed by Kolang developed after brecciation and after it had formed into a solid rock.

Conclusions: Kolang has a weak petrofabric running through its clasts which show similar degrees of chondrule flattening. The event(s), likely impact-related, that caused chondrule flattening and generated the petrofabrics occurred after brecciation and after Kolang had formed into a solid rock.

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References: [1] King A. J. et al. (2021) *52nd LPSC*, Abstract #1909. [2] Lindgren P. et al. (2015) *Geochimica et Cosmochimica Acta* 158:159-178. [3] Rubin A. E. (2012) *Geochimica et Cosmochimica Acta* 90:181-194.