

EVIDENCE FROM CHONDRULE SHAPES AND MODES FOR SHOCK DEFORMATION IN REDUCED CV3 CHONDRITES LEOVILLE AND EFREMOVKA

T. J. Fagan^{1*} and R. Aoki¹. ¹Waseda University, Tokyo, Japan.
*fagan@waseda.jp.

Introduction: The oxidized CV3 chondrite Allende has undergone greater recrystallization than the reduced CV3 chondrites, as indicated by Raman spectra from organic matter [1] and greater abundances of FeO-bearing secondary minerals that apparently formed during fluid-assisted metamorphism [e.g., 2,3]. It has been proposed by [4] that the low extent of metamorphism of the reduced CV3 chondrites (CV3_{red}) was due in part to an early impact event, which simultaneously reduced porosity [5] and expelled ices from the part of the CV parent body represented by CV3_{red}. One test of this early impact model is to compare chondrule shapes and matrix modes of CV3_{red} vs. the CV3_{oxA} Allende. Shock due to an impact event would be expected to deform chondrules and reduce the modes of matrix, which is likely to be more compressible than chondrules and refractory inclusions.

Methods: Photomosaics in plane-polarized transmitted light and reflected light were collected from two polished thin sections (pts) of Efremovka (F01-34, CGI-10), one pts of Leoville (F10-11) and two pts of Allende (slab4, F07-07). Back-scattered electron (BSE) images and X-ray elemental maps (Na, Mg, Si, S, Ca, Ti, Fe, ±P, ±Cl, ±K, ±Cr, ±Mn, ±Ni) were collected from the same thin sections using a JEOL JXA-8900 electron microprobe at Waseda University at step sizes from 5 to 11 μm. The photomosaics, BSE and elemental maps were overlain in a graphics program. Overlying layers were used to (1) draw lengths (L) and widths (W, at 90° to L) on chondrules, and (2) create grids for determining modes of the following chondrite components: chondrules, Ca-Al-rich inclusions (CAIs), amoeboid olivine aggregates (AOAs), opaque nodules, matrix domains and weathering veins. Aspect ratios of chondrules were calculated from (L-W)/L, for which a value of 0 is perfectly round and a value of 1 is a line in the plane of the thin section.

Results: Aspect ratios of the Allende chondrules cluster near 0 to 0.15, though values range up to 0.7. In contrast most aspect ratios of the Leoville and Efremovka chondrules fall in the range from 0.25 to 0.55, reflecting greater elongation of chondrules in the plane of the thin section. Within each Leoville and Efremovka thin section, the long axes of chondrules cluster around a common orientation.

Matrix abundances in the two Allende thin sections are near 50% (by mode), whereas modes of matrix in our Leoville and Efremovka pts are lower than 40%. The high ratios of modal matrix vs. chondrules in our samples of Allende are similar to results of [6], though our Allende matrix abundances are not quite as high as those of [6]. In any case, the relatively elongate shapes of chondrules and the low modal abundances of matrix in Leoville and Efremovka support the early impact model of [4].

References: [1] Bonal L. et al. 2006, *GCA* 70:1849–1863. [2] Krot A.N. et al. 1998, *MaPS* 33:1065-1085. [3] Krot A.N. et al. *Antarct. Meteorite Res.* 17:154-172. [4] MacPherson G.J. and Krot A.N. 2014, *MaPS* 49:1250-1270. [5] Macke R.J. et al. 2011, *MaPS* 46:1842-1862. [6] Ebel D.S. et al. 2009, *LPSC* 40:#2065.