Shock Deformation in Reduced vs. Oxidized CV Chondrites Indicated by Chondrule Shapes and Modes

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The $CV3_{red}$ and $CV3_{oxA}$ subgroups have undergone different extents of alteration on their parent body. Raman spectra of organic matter and recrystallization of AOAs show that the $CV3_{red}$ chondrites Efremovka, Leoville and Vigarano (metamorphic type 3.1~3.4) have undergone less metamorphic recrystallization than the $CV3_{oxA}$ chondrites Allende and Axtell (>3.6) [1,2]. The $CV3_{red}$ chondrites also have lower porosities than the $CV3_{oxA}$ [3]. The lower porosities of the $CV3_{red}$ are consistent with the interpretation that they were deformed by an early impact event, which compacted the pore spaces and thus limit the amount of fluid-mineral interaction during subsequent metamorphism [4,5].

To identify evidence of deformation in the CV3 chondrites, we have determined modal abundances of object types (chondrules, matrix, CAIs,…) and shapes of chondrules in three thin sections of $CV3_{red}$ chondrites (two of Efremovka, one of Leoville) and in two thin sections of the $CV3_{oxA}$ Allende. Modes show that the $CV3_{red}$ chondrites have lower proportions of matrix (24-29%) than the two Allende thin sections (47-49%). Chondrule lengths (L) and widths (W) were determined to assess chondrule shapes. Ratios of (L-W)/L tend to be near 0-0.1 in the chondrules from Allende, indicating circular shapes in the plane of the thin section. In contrast, (L-W)/L ratios in the Leoville and Efremovka thin sections tend to be near 0.4-0.5, indicating more elongate shapes. Furthermore, the orientations of long axes of chondrules are clustered together along a common orientation in the Leoville and Efremovka thin sections.

Porous matrix would compress more easily than chondrules and CAIs, so the low abundances of matrix in Leoville and could be explained by compression during shock. The elongation of chondrules along a common orientation also could result from shock deformation. Therefore, the modes, and chondrule shapes and orientations support the interpretation that $CV3_{red}$ chondrites were deformed by shock and that $CV3_{oxA}$ chondrites were less affected by this impact event [4,5].

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