Deformed and compacted fragments in the Aguas Zarcas meteorite

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Aguas Zarcas (hereafter AZ), a CM chondrite, fell on 23 April 2019 in Costa Rica. It is highly brecciated with different lithologies such as chondrule-rich, chondrule-poor, metal-rich, and CI-like ones [1-2]. These lithologies are thought to be the result of different degrees of aequeous alteration on the parent body, e.g, [3-5] rather than varying thermal alteration [6]. In the course of our ongoing study of AZ, we found evidence for deformation and compaction in several centimeter-sized fragments separated from the largest mass of AZ, FMHN ME 6112 .

An ~80 g sample was divided into 8 g aliquots in ultrapure water for freeze-thaw disintegration using alternating cycles of liquid nitrogen and 50 °C water. Typically, 30 cycles can break down a breccia like Murchison into powder. With AZ, most fragments were disaggregated within 50 cycles, however, after 112 cycles over 10 fragments showed no signs of mechanical breakdown. Under an optical microscope, these cm-sized fragments appear black and smooth like melt, and are less porous and friable than the other lithologies. We used μCT to image these compact fragments in 3D. We observed foliation fabric formed by alignment of elongated inclusions, similar to Leoville (CV3). Otherwise, the lithology appears similar to the main one. The average aspect ratios of ellipsoids fitted onto chondrules is 2.6 ± 1.5, compared to 1.54 ± 0.22 in Murchison [7], and 1.9 ± 0.4 (2D ellipses) in Leoville [8].

The petrofabric in the compact fragments of AZ demonstrates a strong degree of deformation and compaction that was likely caused by impact events.

We thank the Boudreaux family for donating AZ and the TAWANI Foundation for funding.

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