THREE-DIMENSIONAL IMAGING OF ORDINARY CHONDRITE MICROPOROSITY.

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Introduction: Examining the locations of porosity present in ordinary chondrites informs about the physical processes experienced by the meteorites and their parent asteroids [1-3]. Typically, ordinary chondrites possess porosities slightly below 10% [1], unless they are unusually porous [e.g. 2 and 3]. Earlier work using thin sections and SEM [see 4 and references therein] has suggested that much of the porosity of a chondrite is located within microcracks due to shock waves experienced by the sample during hypervelocity impacts. In this work, we have used synchrotron x-ray microtomography (μCT) to examine the microporosity within a suite of ordinary chondrites. μCT has the advantage of yielding data that is free from potential sample preparation artifacts such as mineral plucking or scratching during preparation inherent to thin section-based methods.

Methods and Samples: We collected μCT data at the GSECARS beamline 13-BM at the Advanced Photon Source at Argonne National Laboratory at a monochromatic energy of 40 keV. Typical data collection procedures can be found in [5 and 6]. We used a resolution of 2.4 μm/voxel for our μCT measurements. To extract information data from our image stacks, we used a software suite called BLOB3D [7] combined with the 3D visualization capabilities of ImageJ [8].

We examined two small (6 - 12 mm^3) chips of each of the ordinary chondrites (in order of both increasing shock stage and compaction) Baszkówka (L5, S1), ALHA 77258 (H5, S2), Moorleah (L6, S3), and Kyushu (L6, S5). These samples were chosen because of their diversity of shock stages and degrees of compaction as evidenced by the common 3D orientation of metal and sulfide grains in the samples [see 4].

Results and Conclusions: The location of microporosity varies with the shock stage and degree of compaction of the samples. Microcracks are readily apparent within silicate grains of the more stongly shocked samples Moorleah and Kyushu and occasionally appear in ALHA 77258. These appear as sheet-like networks in 3D. Minor amounts of microporosity are noticeable at grain boundaries. In Baszkówka, and to a lesser extent ALHA 77258, microporosity is abundant as both intragranular and intergranular voids, but intragranular voids are not in the form of microcracks. While a majority of microporosity in our compacted samples is present as microcracks, some degree of primordial porosity is present within the lesser compacted and shocked equilibrated ordinary chondrites.

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