DISRUPTION OF CARBONACEOUS CHONDRITE ANALOGS. Brian A. May[1], M. J. Molesky[1], S. J. Jack[1], M. M. Strait[1], D. D. Durda[2], and G. J. Flynn[3]; [1]Dept. Of Chemistry, Alma College, Alma MI 48801. [2]Southwest Research Institute. [3]Dept. of Physics, State University of New York – Plattsburgh.

Introduction: Understanding the fragmentation of asteroids is important for investigating the origins of meteorites and interplanetary dust. Research into asteroid impacts uses meteorites as analogs for asteroids. Nearly 50% of the main asteroid belt is predicted to be hydrated material [1]. Previous work found that anhydrous ordinary chondrites disrupt differently than hydrous carbonaceous chondrites [2, 3]. Carbonaceous chondrites and other hydrous meteorites are rare and limited access greatly impedes further research into these samples. Ongoing work attempts to hydrate ordinary chondrites to produce the mineralogy and structure of carbonaceous chondrites [4].

Analyzing the size distribution of particles after disruption events has proven to be a good technique for comparing these events [5]. All shots are done at the NASA Ames Vertical Gun Range [6].

Experimental: For hydration, we used Northwest Africa 869, a relatively abundant L3-6 ordinary chondrite. Samples were crushed to less than 2 mm using a hydraulic press, sorted in an eight-layer sieve, and weighed. Crushed material was mixed, slightly oversaturated with pH ~13 water, and placed in a Parr pressure bomb at 150º C for ~12 weeks. Hydration levels were monitored using FTIR analysis [4]. After hydration, material was removed from the pressure bomb and placed into 2 inch PVC molds with a cut down the side that is zip-tied shut. The material is again oversaturated with pH ~13 water and allowed to settle and dry. Five samples were created using this method and four were impacted at NASA Ames Vertical Gun Range in June 2016.

Removing the zip-ties and peeling back the PVC molds reveals artificially created, roughly cylindrical carbonaceous chondrite analogs. Each of the samples was hung in the gun chamber of the NASA Ames Vertical Gun with fishing line attached with a small amount of epoxy. The samples were shot with 1/16-inch aluminum projectiles at ~5 km/sec. The resulting particles were then collected from the chamber, the largest of which were individually weighed. The smaller particles were sorted with an eight-layer sieve and weighed according to their size range including a sampling of individual particles to obtain an average mass.

During shots at NASA Ames Vertical Gun Range we set up foam core detectors mounted with three different foil thicknesses. These were placed in four strategic locations around the sample to capture the sizes of ejecta [7].

The foils were scanned into a computer using a PrimeFilm 7250 Pro[3] scanner at 7200 dpi using the program CyberViewX. The resulting images were then analyzed using the program ImageJ to count and measure the holes. Microsoft Excel was used to estimate the masses from the size of holes we measured from the foils [3].

Data from the weighed particles and the foil holes were combined to produce size frequency distribution graphs. These graphs can be used to compare the analogs to known size frequency distributions of carbonaceous chondrites.

Results and Discussion: The data from the sieved particles confirms previous results showing that we are creating a new matrix material. On average ~2.1% of the recovered particles were larger than the maximum 2 mm particles that were used to create the analogs, which is consistent with past findings [8]. This percentage is likely to be an underestimate due to the fragile nature of the material. The fragility of our analogs is also a characteristic of carbonaceous chondrites.

The size distribution graph in Figure 1 compares particles from three shots: hydrated and unhydrated Northwest Africa 869 (L3-6) and ALH 83100 (CM). The graph shows that the hydrated Northwest Africa 869 has a different disruption pattern than unhydrated NWA 869, but is still not the same as a carbonaceous chondrite. Unhydrated ordinary chondrites tend to have a central plateau shape seen in Figure 1. You can see that the hydrated material has lost this characteristic shape and appears to be more similar to the distribution pattern of the CM meteorite. In the future, to better model a carbonaceous chondrite, attempts will be made to lower the density of the analogs in order to better reflect the properties of these rare meteorites.

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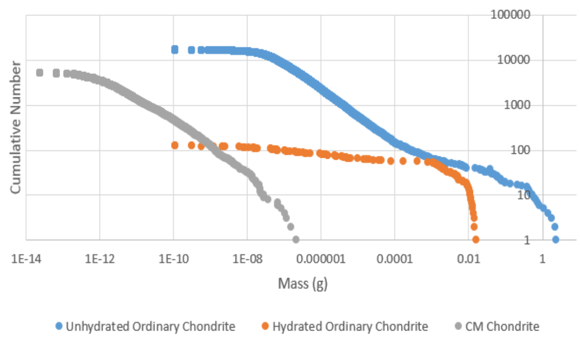

Figure 1. Size frequency distribution graphs comparing the masses and estimated masses of particles from hydrated and unhydrated L chondrite, and a CM carbonaceous chondrite. The ordinary chondrite data combines data from weighed particles and measured foil holes, whereas data from the carbonaceous chondrite is only from foil hole estimations. Both ordinary chondrites are Northwest Africa 869. The CM chondrite is ALH 83100.