DISRUPTION EXPERIMENTS WITH AN ARTIFICIALLY HYDRATED ORDINARY CHONDRITE.
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Introduction: Meteorites are valuable for use in determining rudimentary differences among extraterrestrial materials. Of particular interest is the difference in disruption patterns between ordinary and carbonaceous chondrites, as this this may shed light on the creation of the smaller particles observed in the Solar System [1]. Hydrous meteorites are primarily present as carbonaceous chondrites. The availability of carbonaceous chondrites for disruption experiments is highly limited as they account for only 5% of chondritic falls [2].

Prior experiments have examined disruption pattern differences in terrestrial and extraterrestrial samples. The disruption of these meteorites took place at the NASA Ames Vertical Gun Range in Moffett Field, California. Foil detectors were set up inside the vacuum chamber. Penetrations in these foil detectors were measured and used along with the debris to create mass-frequency distribution diagrams. [3]. Particles in the cosmic dust as well as micrometeorite range were produced in the disruptions. The mass-frequency distributions of terrestrial and extraterrestrial samples have been shown to be significantly different [4]. However, these studies focused primarily on ordinary chondrites, and the carbonaceous chondrites studied were anhydrous [5]. Hydrous carbonaceous chondrites that have been disrupted produced dissimilar results when compared with anhydrous samples. It is necessary to disrupt additional hydrated chondrites in order to further understanding of the differences in mass-frequency distributions between hydrous and anhydrous chondrites. However, the valuable nature of the samples has led to investigation of a method of hydrating ordinary chondrites that may be used as analogues.

A method was developed to create analogues for carbonaceous chondrites using samples of NWA 869, a readily available ordinary chondrite. Samples of approximately 15 g were placed inside a pressure bomb in a solution of pH ~13 and kept in an oven at 150°C for up to two years. The samples were then cut in half to be evaluated with FTIR [6]. Preliminary scans of these hydrated samples found evidence of hydration in all samples [7].

Experimental: An alternate method was developed to create a hydrous meteorite using smaller samples of NWA 869 that may be bound together to create a carbonaceous chondrite. Fragments of NWA 869 were crushed to ensure that no particles were larger than 2 mm with the exception of sample 130708. The fragments were placed in a pressure bomb in a solution of pH ~13 and placed in an oven at 150°C for up to four months. At various points during the hydration, random fragments were removed from the bomb, rinsed with deionized water, and crushed to form a powder. This powder was scanned with a Bruker ALPHA FTIR instrument to look for a peak at 3500 cm^{-1}, indicating the presence of hydration. Once hydration was complete, the fragments were removed from the bomb, rinsed with deionized water, and placed into a metal pipe lined with plastic wrap. A metal insert was placed on top of the sample inside the pipe. The apparatus was positioned under a hydraulic press and compressed to approximately 5 tons. The sample was left at this pressure for at least 7 days. The apparatus was then removed from the hydraulic press. The samples were fragile around the edges and crumbled easily but appeared solid in the center. Two samples were chosen and suspended in the vacuum chamber at the Ames Vertical Gun Range in California. Both samples were disrupted with 1/8 inch aluminum projectiles at a speed of ~5 km/sec. As with previous experiments [3], foil detectors were set up inside the vacuum chamber and penetrations in these detectors were measured using ImageJ and the data used to create mass-frequency distribution graphs.

Results: The mass-frequency distributions of samples 130707 and 130708 had similar size ranges, and a similar mass for the largest particle. Sample 130708 showed an S-shaped curve typical of a NWA 869 mass-frequency distribution (Figure 1), while sample 130707 was missing a distinct central plateau (Figure 2). This may have been caused by a difference in projectile speed for the samples. Although the target speed for each disruption was 5 km/sec, sample 130707 was disrupted at 5.54 km/sec, while sample 130708 was disrupted at 4.13 km/sec. The samples also had different weights. Sample 130707 weighed 28.41 g, while sample 130708 only had 18.43 g. An additional factor that may have caused this dissimilarity is the extent of the hydration in the sample. Sample 130708 was left in the oven for a longer period than sample 130707. However, sample 130707 had smaller particles that may not have required as much time for hydration.

Sample 130707 shows some similarities to the mass-frequency distribution of Murchison, a carbonaceous chondrite [9]. The distributions have similar size ranges. Murchison is also missing the central plateau characteristic of ordinary chondrites.

The samples created were flat disks approximately 10 mm thick and about 40 mm in diameter. This prob-

ably caused some of the discrepancies observed between these artificially hydrated samples and an actual rock. In order to better replicate a natural hydrous meteorite, future work will consist of creating samples with similar dimensions for length, height, and width. The composition of the material created will also be characterized.

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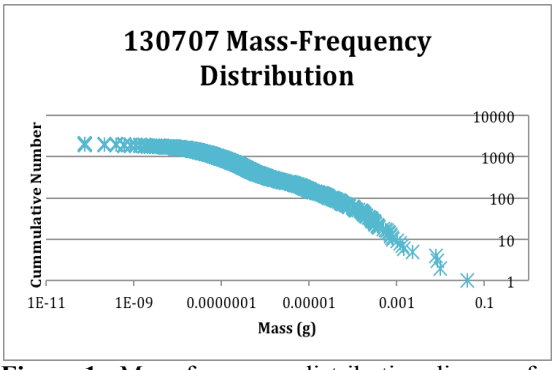

Figure 1. Mass-frequency distribution diagram for hydrated NWA 869. The crushed particles were hydrated for approximately 30 days and compressed for 7 days.

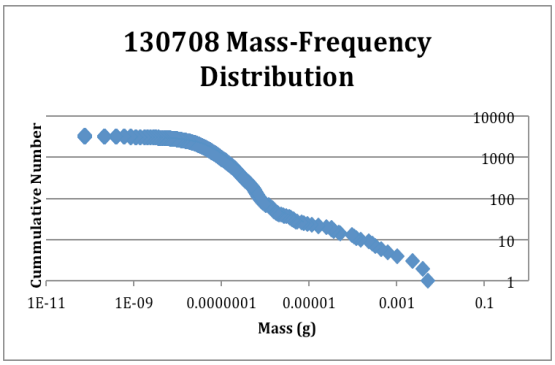

Figure 2. Mass-frequency distribution diagram for hydrated NWA 869. The crushed particles were hydrated for approximately 100 days and compressed for 7 days.