METEORITE POROSITIES AND DENSITIES: A REVIEW OF TRENDS IN THE DATA. D. T. Britt[1] and G.J. Consolmagno[2], [1]Dept. of Physics, University of Central Florida, P.O. Box 162385, Orlando, FL 32816-2385, britt@physics.ucf.edu, [2]Specola Vaticana, V-00120 Vatican City State, gjc@as.arizona.edu.

Introduction: Among the most fundamental physical characteristics of any planetary body are its density and porosity. These data provide insight into the body's accretion, evolution, impact history, mineralogy, internal strength, and structure. The density and porosity of meteorite groups are fundamental "ground truth" for the composition and structure of asteroids. We have complied a data base of meteorite and density measurements [1] published up to 2001 and these data have some interesting implications for future meteorite and asteroid studies.

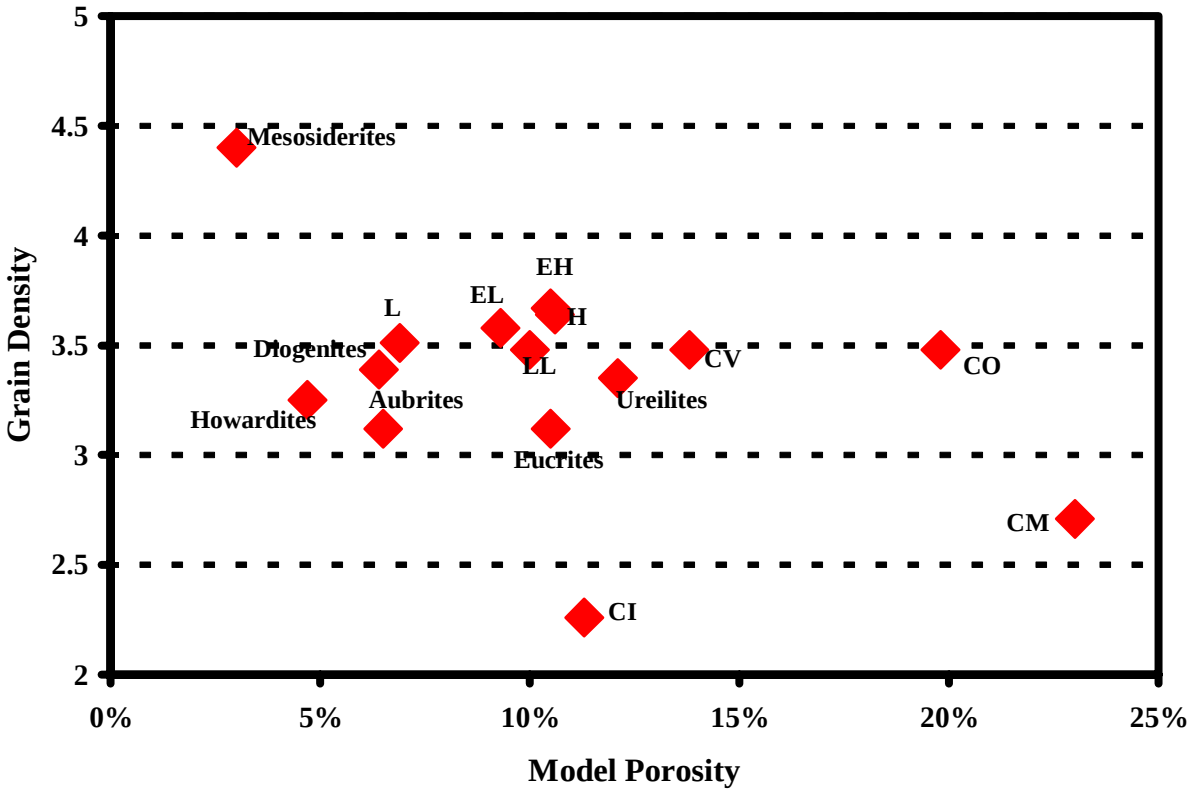

Figure 1: The porosities of meteorite groups.

Porosity Definitions: Shown in Table 1 are the density and porosity data for the major meteorite groups. Some of these data are summarized in Figure 1. The porosity of a rock is the percent fraction of the volume of a sample that is empty space. Most simply it can be represented as the volume of the rock plus pores (bulk volume, V_b), minus the volume of just the minerals in the rock (grain volume, V_g), normalized to the bulk volume; equivalently, one can subtract the density of the sample plus pores (bulk density, ρ_b) from the density of the minerals alone (grain density, ρ_g), normalized to the grain density. The average porosity is calculated from the difference between the average grain and average bulk densities. The model porosity adjusts the average porosity for the degree to which terrestrial weathering has altered the original porosity by assuming a theoretical grain density based on the composition of the meteorite or meteorite type. Large differences between average, measured, and model porosities indicate either high degrees of heterogeneity or the need to improve the accuracy of some measurements.

Discussion: Shown in Figure 1 are the model porosities of the meteorite groups. When no model porosities were available (as in the case of the carbonaceous chondrites) the average porosity was used. Stones tend to cluster between 5-15% porosity. Interestingly, there are significant differences between L and H ordinary chondrites with L's having a 6.9% model porosity while H's are much more porous at 10.6%. The CI and CM carbonaceous chondrites show their high components of hydrated minerals in their low grain density values, typically much lower than other stony meteorites. Data in Table 1 expand on these trends. The grain densities of the other carbonaceous chondrite groups, the CV, CO, CH, CV, and even the volatile-rich CR's meteorites, tend to be above 3.0 g/cm3 and are much more like the ordinary chondrites and the HED's than the CI's and CM's. In fact the HED's generally are composed of lower-density minerals than those found in the anhydrous carbonaceous chondrites.

On the other end of the scale, some mesosiderites are actually quite porous which may relate to their impact history of brecciation and lithification. Pallasites, as expected, show little porosity and what porosity they do have my be associated with terrestrial alteration. These, and other aspects of the meteorite data set will be discussed in depth.

References:

[1] Britt D.T. and Consolmagno G.J. (2003) MAPS 38, 1161-1180.

	Number	Grain Density	Bulk Density	Measured Porosity	Model Porosity	Average Porosity
Diogenites	8	3.39±0.12	3.26±0.17	2.5%±2.2%	6.4%±4.8%	2.50%
Eucrites	18	3.12±0.09	2.86±0.07	7.8%±6.8%	10.5%±2.0%	8.6%±4.6%
Howardites	8	3.25±0.08	3.02±0.19		9.9%± 5.7%	4.7%±0.5%
Shergottites	4	3.43	3.10±0.04		5.9%±0.3%	7.7%±4.0%
Chassigny	1	3.32				7.50%
Nahkla	3	3.29	3.15±0.07	5.70%	5.60%	4.20%
Ureilites	7	3.5	3.05±0.22	6.00%	12.1%±6.7%	8.90%
CI	14	2.26±0.08	2.11	8.7%±9.1%		11.30%
CM	33	2.71±0.11	2.12±0.26	9.3%±6.9%		23.0%±7.5%
CR	7	3.23±0.28	3.1	6.4%±3.8%		
CO	22	3.48±0.27	2.95±0.11	8.5%±4.6%		19.8%±4.1%
CV	51	3.48±0.09	2.95±0.26	9.7%±9.2%		13.8%±9.1%
CH	1	3.44				
CK	4	3.47±0.02				
Aubrites	10	3.12	3.12±0.15	9.7%±7.6%	6.2%±4.4%	0.00%
EH	8	3.67±0.07	3.72±0.02		10.5%±2.6%	-1.2%±2.5%
EL	15	3.58±0.05	3.55±0.1		9.3%±3.9%	2.70%
H	265	3.64±0.12	3.40±0.18	6.0%±4.5%	10.6%±4.8%	6.4%±4.2%
L	277	3.51±0.11	3.35±0.16	5.8%±4.7%	6.9%±.6%	4.5%±4.6%
LL	149	3.48±0.08	3.21±0.22	9.3%±8.5%	10.0%±6.3%	7.9%±4.2%
Pallasites	10	4.49±0.53	4.76±0.10	2.4%±5.3%		0.0%±5.2%
Mesosiderites	8	4.40±0.36	4.25±0.02	5.0%±6.9%		3.0%±8.1%
Steinbach	2	4.56±0.01	4.18±0.10			8.20%

Table 1: Meteorite Porosity Data