PRELIMINARY BULK AND GRAIN DENSITY MEASUREMENTS OF MARTIAN, HED AND OTHER ACHONDRITES. P.J.A. McCausland[1] and R.L. Flemming[1], [1]Department of Earth Sciences, University of Western Ontario, London, ON, Canada (pmccausl@uwo.ca; rflemmin@uwo.ca).

Meteorite density and porosity measurements can provide fundamental information pertaining to their mechanical behaviour and can give clues to the origin and history of the meteorites and their parent bodies. Recent compilations of meteorite density and porosity data have highlighted the need for more measurements of these fundamental bulk properties for all classes of meteorites [1,2].

Here we report preliminary density and porosity data for several achondrites, most of which are previously unstudied finds from North West Africa (Table 1). Repeatable bulk and/or grain density measurements of ten meteorites were made via the Archimedean method for bulk density using 40 µm beads as the fluid [3] and a Quantachrome Multipycnometer using helium for measurements of grain density. Porosity is calculated for those meteorite fragments which have both bulk and grain density measurements.

Martian basalts: The basaltic shergottites Zagami and NWA 3171 are reported in Table 1. The 23.5 g Zagami fragment has a bulk density of 3.08 g/cm^3 and a grain density of 3.31 g/cm^3 which agree with literature values measured previously on separate fragments [1]. The calculated porosity of 6.8% for this Zagami fragment supports the ~6% model porosity calculated for the shergottites from their constituent mineralogy [1]. NWA 3171 gives a grain density of 3.34 g/cm^3, similar to Zagami and other shergottites.

HEDs: Four eucrite and two howardite fragments were measured. The eucrites have bulk densities that are substantially less than their measured grain densities, resulting in estimated porosities of between 4.4% and 17.4%. NWA 999, a 37 g fragment, has an unusually low bulk density of 2.64 g/cm^3 and is visibly brecciated, perhaps accounting for its 17.4% porosity. The howardite Kapoeta provided a grain density of 3.76 g/cm^3, well in excess of the literature value of 3.26 g/cm^3 [1]. Our 1.2 g Kapoeta fragment measurement has a large formal error due to its small volume, however. NWA 1929 is a 140 g howardite fragment that yields a bulk density of 2.91 g/cm^3, in good agreement with and refining the literature value for howardite based on five fragments of 18.4 g total mass [1].

Ureilite and Winonaite: We measured the ureilite NWA 853 (46.2 g) and the winonaite NWA 1463 (11.8 g). The measured NWA 853 grain density of 3.43 g/cm^3 is similar to that reported for ureilites [1], but the bulk density is much greater at 3.73 g/cm^3, leading to an impossible porosity of -8.9%! Other ureilites have porosities on the order of 6% to 12% [1]. The fragment NWA 853 is a cut slab which exhibits visible mm-scale cracks, leading us to conclude that either some internal porosity is unaccounted for (making our grain density an underestimate), or that the slab behaved differently than other, typically more rounded meteorite fragments during our bulk density measurements. Further work is underway to test these options. The winonaite NWA 1463 is, to our knowledge, the first primitive achondrite to have a reported density. Its high grain density of 3.82 g/cm^3 likely reflects the prevalence of sulphides and metal in the meteorite.

Meteorite	Mass (g)	Grain density	Bulk density	Porosity %
Basaltic shergottites				
Zagami	23.51	3.31	3.08	6.8%
NWA 3171	2.49	3.36	--	--
Eucrites				
Agoult	32.26	3.22	2.95	8.4%
NWA 999	36.98	3.20	2.64	17.4%
NWA 1918	96.98	--	3.07	--
NWA 1923	101.97	3.11	2.97	4.6%
Howardites				
Kapoeta	1.21	3.75	--	--
NWA 1929	140.00	--	2.90	--
Ureilite; Winonaite				
NWA 853	46.24	3.42	3.73	-8.9%
NWA 1463	11.82	3.82	--	--

Table 1: Preliminary grain and bulk density measurements of some achondrites.

Acknowledgements: We thank D. Gregory for kindly providing these meteorites for this and other research. RLF acknowledges support from the University of Western Ontario (ADF) and the Province of Ontario (PREA).

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