REFLECTANCE SPECTRA OF IRON METEORITE POWDERS. E. A. Cloutis[1], D. T. Bailey[2], M. A. Craig[1], and P. S. Hardersen[2]. [1]Department of Geography, University of Winnipeg, 515 Portage Ave., Winnipeg, MB, Canada R3B 2E9; e.cloutis@uwinnipeg.ca. [2] Department of Space Studies, University of North Dakota, Box 9008, Grand Forks, ND 58202, USA; hardersen@space.edu.

Introduction: Iron metorites and their parent bodies provide important insights into the pervasivenesss of igneous processes in the asteroid belt. Understanding the spectral reflectance properties of iron meteorites is important for identifying possible parent bodies. We have measured the reflectance spectra of both slabs and powders of a hexahedrite, octahedrite, and ataxite, for a variety of grain sizes and surface roughnesses.

The bulk of previous studies of iron meteorite spectral reflectance properties have examined slabs with various surface finishes; spectral slopes of slab surfaces have ranged from overall blue to strongly red-sloped [e.g., 1-2]. However, polarimetric data suggest that M-asteroids, the most plausible iron meteorite parent body class [3], appear to have powdered surfaces with average grain sizes on the order of a few tens of microns [4]. Therefore we decided to investigate the spectral properties of iron meteorite powders and compare them to slabs roughened with various sizes of abrasive paper.

Experimental Procedure: Cut slabs of a hexahedrite (North Chile; MET03), a coarse octahedrite (Odessa; MET01), and an ataxite (Hoba; MET02) were used in this study. Powders of these samples were prepared by hand grinding the samples with coarse (60 and 80 grit) garnet sandpaper. The resulting powders were purified by using a hand magnet and by visual inspection and dry sieved to obtain the following size ranges: <45, 45-90, and 90-250 µm; insufficient 90-250 µm powder was produced for North Chile to permit spectral measurements. The remaining portions of the slabs were roughened with progressively coarser garnet paper: 400, 220, 120, and 60 grit. Spectra were acquired immediately after each roughening treatment.

Reflectance spectra (0.35-2.5 µm) were measured with the HOSERLab [5] ASD HR spectrophotometer at i=30°, and e=0° relative to Spectralon and corrected to absolute reflectance. The resolution of the instrument varies from 2 to 7 nm and is resampled by the instrument at 1 nm spacing. Narrow spectral features in the 0.62-0.68 µm region are artifacts due to the instrument's order sorting filter. Powders were measured within 2 weeks of their production and slab spectra were measured within 5 minutes of each roughening. The MET01 sample was also measured at different viewing geometries.

Results (1) Ni content variations: Figure 1 shows the spectra of the <45 µm fractions of the three meteorites. The three samples all exhibit red-sloped spectra with very little difference in overall slope and absolute reflectance. They appear to exhibit a slope change near 0.6 µm, which may be the result of incipient oxidation. These spectra are similar to those of pure Fe, Ni, and FeNi alloys [6].

Results (2) Grain size variations. Figure 2 shows the reflectance spectra of the three different powdered size fractions of Odessa (MET01). The <45 and 45-90 µm spectra are nearly identical, while the 90-250 µm fraction spectrum has substantially lower reflectance; the MET02 and MET03 samples show greater differences between the <45 and 45-90 µm size fractions. When normalized, the spectral differences are reduced and the coarsest fraction is only slightly less red-sloped than the finer fraction spectra.

Results (3) Slabs versus powders. Figure 3 shows the reflectance spectra of Odessa (MET01) roughened with the progressively coarser sandpapers. It can be seen that the change in overall reflectance is not systematic, the brightest sample was prepared with the second roughest sandpaper (220 grit) and the darkest spectrum is exhibited by the 60 grit-treated surface. The same lack of systematic change in overall reflectance was exhibited by the other two iron meteorites. The slab spectra are also somewhat less red-sloped than any of the powdered samples and this is most evident shortward of ~0.6 µm.

Results (4) Viewing geometry variations. The <45 µm Odessa powder was measured at a variety of viewing geometries; here we present the results for i=0° and e=30, 45, 60, or 75° (Figure 4). The spectra show a gradual decrease in overall reflectance with increasing phase angle. However, when normalized (Figure 5), the spectra are quite similar. The slightly different behavior of the 0/75° spectrum may be due to a small contribution from the Al sample holder.

Discussion: One feature which characterizes all of the samples, regardless of composition, grain size, slab surface treatment, or viewing geometry, is the overall red slope of the spectra. This seems to be a ubiquitous feature of all but highly polished metal slabs and suggests that the spectra of iron meteorite parent body surfaces (which will undoubtedly not possess mirror finishes) will exhibit red-sloped spectra with no diagnostic absorption features.

Ni content does not seem to have a strong effect on overall spectral slope. Therefore it seems unlikely that Ni-rich vs Ni-poor parent bodies can be distinguished using the 0.35-2.5µm region. Constraining grain size cannot rely on differences in spectra slope and may require absolute reflectance. However, overall reflectance variation with grain size is not systematic.

Differences between the slab and powder spectra suggests that slabs may not be a suitable spectral analogue for asteroid surfaces, where a powdered regolith is expected on the basis of both polarimetry [3] and brittle-ductile studies of iron meteorites at temperatures appropriate to the main asteroid belt [7].

The present results suggest that viewing geometry has little effect on overall spectral slope of iron meteorite powders, although overall reflectance does decrease with increasing viewing geometry.

Conclusions. Iron meteorite powders are characterized by featureless red-sloped spectra over the 0.35-2.5 µm interval. This suggests that their parent bodies can be recognized on this basis. The range of overall spectral slope is quite narrow and seems to be relatively insensitive to metal composition, grain size variations, and viewing geometry. Absolute reflectance is required to constrain some of these properties. Possible spectral confusion with E-chondrites, which can also exhibit featureless red-sloped spectra [2], will be the subject of a future investigation.

References: [1] Britt D. T. and Pieters C. M. (1988) *Proc. 18th LPSC*, 503-512. [2] Gaffey M. J. (1976) *JGR*, *81*, 905-920. [3] Hardersen P. S. et al. (2005) *Icarus*, *175*, 141-158. [4] Dollfus A. et al. (1979) *Icarus*, *37*, 124-132. [5] Cloutis E. A. et al. (2006) *LPSC*, *37*, Abstract #2121. [6] Cloutis E. A. et al. (1990) *JGR*, *95*, 281-293. [7] Marcus H.L. and Hackett Jr. L. H. (1974) *Meteoritics*, *9*, 371-376.

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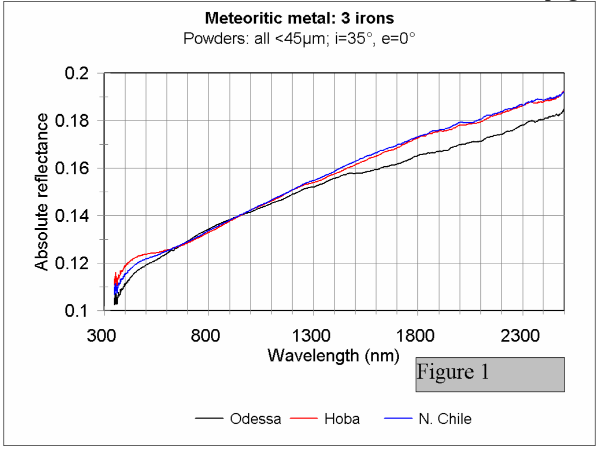

Figure 1

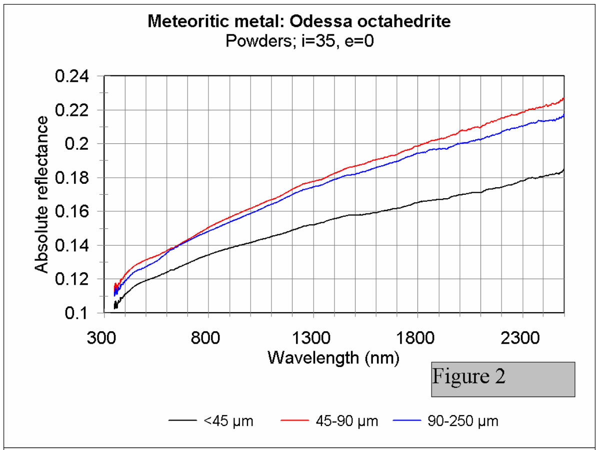

Figure 2

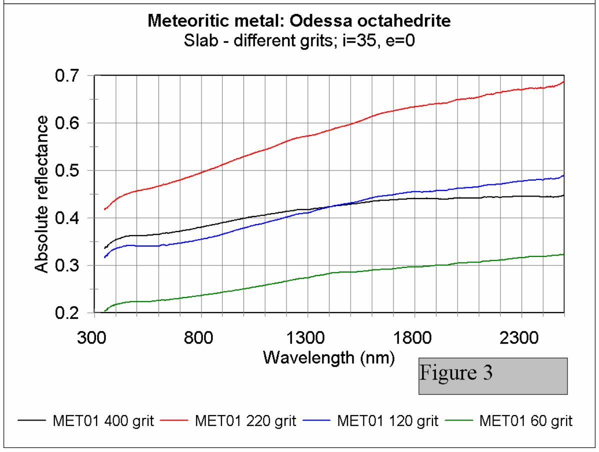

Figure 3

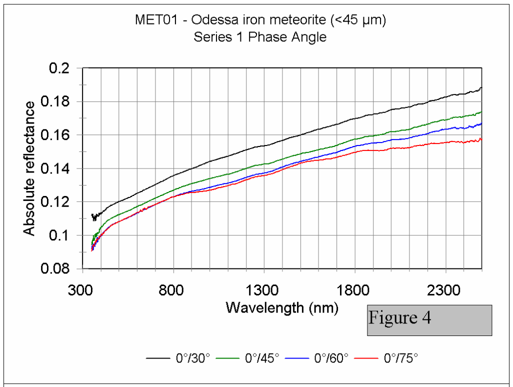

Figure 4

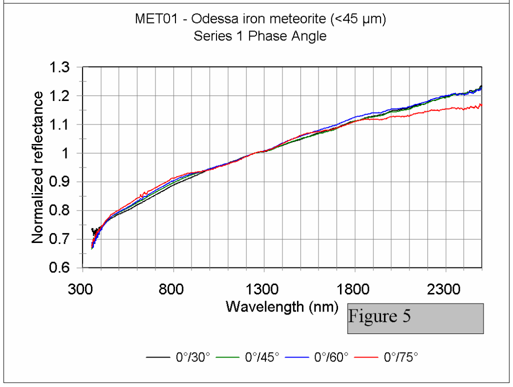

Figure 5