THE EFFECTS OF GRAIN SIZE, <10 µm – 4.75 mm, ON THE REFLECTANCE SPECTRUM OF PLANETARY ANALOGS FROM 0.35-2.5 µm. M. A. Craig[1,2], E. A. Cloutis[1], V. Reddy[3], D. T. Bailey[1] and M. J. Gaffey[2], [1]Department of Geography, University of Winnipeg, 515 Portage Ave., Winnipeg, MB, Canada R3B 2E9, [2]Department of Space Studies, University of North Dakota, 4149 University Ave., Grand Forks, ND, 58202, USA, [3]Department of ESSP, University of North Dakota, Grand Forks, ND, USA; michael.craig2@und.edu.

Introduction: In addition to work already completed for this study we have added the following samples and grain size splits to those already publicized in [1]: a single basalt and a single pyroxene in 29 different grain size splits. As basalt and pyroxene are known to be present on many bodies in the inner solar system [2, 3], our hope is that this study will aid in not only identifying the materials we are seeing in collected spectra but also aid in discerning the nature of the surface under investigation, i.e. mixed or uniform regolith, or fine/course grained solid surfaces.

Experimental Procedure: The basalt and pyroxene samples were gently crushed by hand with an alumina mortar and pestle to produce a total of 37 different grain size splits. The smallest of the grain size splits, <10, 10-15, 15-20, 20-25 and 25-38µm were crushed dry then wet sieved with isopropyl alcohol. Splits shown below at 38-45, 45-63, 63-75, 75-90, 90-125, 125-150, 150-180, 180-212, 212-250, 250-300, 300-355, 355-425, 425-500, 500-600, 600-700, 700-850, 850-1000µm, 1-1.4, 1.4-1.7, 1.7-2, 2-2.36, 2.36-2.8, 2.8-3.35 and 3.35-4.75mm were dry sieved, as were those that are not shown: <20, <25 and 25-38µm for the basalt, SA-51, and the pyroxene, PYX023. The 5 split series shown in [1], were also dry sieved and have now had spectra remeasured at i=30º, e=0º.

Absolute reflectance spectra were collected with an Analytical Spectral Devices (ASD) FieldSpec Pro HR field portable spectrophotometer. Sample spectra were collected at i=30º, e=0º using a goniometer built in-house at the University of Winnipeg Planetary Spectrometer Facility (PSF) and illumination was provided by a 50 watt Quartz-Tungsten Halogen light source. The field-of-view (FOV) imaged by the spectrometer was ~5mm.

The spectral resolution of the ASD instrument is fixed at 2-7nm and the spectra as shown are extrapolated to 1nm resolution internally by the instrument. Spectra were measured relative to Spectralon® and corrected for the irregularities in Spectralon's® reflectance in the 2-2.5 µm region. Each individual spectrum is an average of 1000 spectra to increase the signal-to-noise ratio and each spectrum shown is a further average of two or more 1000 spectra sets to ameliorate some of the factors which complicate the qualitative assessment of spectra when working with large grain sizes. For the spectra shown below, the <10–150µm spectra are an average of two spectra where the sample cup was turned 90º following the first collection, from 150–1000µm the spectra are an average of 3 measurements, with sample cups turned 90º, from 1–4.75mm sample cups were moved about randomly and an average of 5 spectra are shown.

All samples were loaded into aluminum sample cups with well depths of 3, 5 or 9mm and well diameters of 10, 15 or 20mm. In all instances samples were loaded into the largest sample well the available sample volume could fill. Sample was loaded into each cup, lightly tamped and "cut" level with the top surface of the cup to produce a flat matte surface.

Spectral measurements were consistent such that overall reflectance is a useful metric within each sample set. Of note, the spectra were corrected in post-processing for breaks that often occur as a result of the three detectors used by the ASD instrument and the FOV is given as approximate as the fibre-optic bundle that feeds the three detectors has a random distribution of fibres at the pick-up end.

Results: The results are presented in Figures 1 thru 4 below. The PYX023 absolute reflectance spectra (Figures 1 and 2) are normalized at 1.3µm with the "whole rock," in this instance comprised of large crystals of essentially the same size as the 3.35-4.75mm grain size, normalized to 1 and each subsequent smaller grain size offset one order higher, ending with the smallest <10µm split offset to 30 at 1.3µm. Figures 3 and 4 are of the basalt sample normalized at 1.8µm following the same procedure used for the pyroxene with the "cut rock" being a fine-grained saw cut surface.

References: [1] Craig M. A. et al. (2007) *LPS XXXVII*, Abstract #1356. [2] Harloff J. and Arnold G. (2001) *PSS., 49*, 191-211. [3] Fuji N. et. al. (1986) *LPS XVII*, Abstract #245.

Additional Information: M. A. Craig would like to thank everyone on the PSF team for all their help and support. For any further information please contact the author or if you are curious about any PSF spectra see the PSF website at http://psf.uwinnipeg.ca

Acknowledgments: This study and the attendant spectrometer facility were enabled by grants from the Canadian Space Agency, NSERC, the Canada Foundation for Innovation, the Manitoba Research and Innovation Fund, and the University of Winnipeg.

Figure 1: Fine Pyroxene Samples

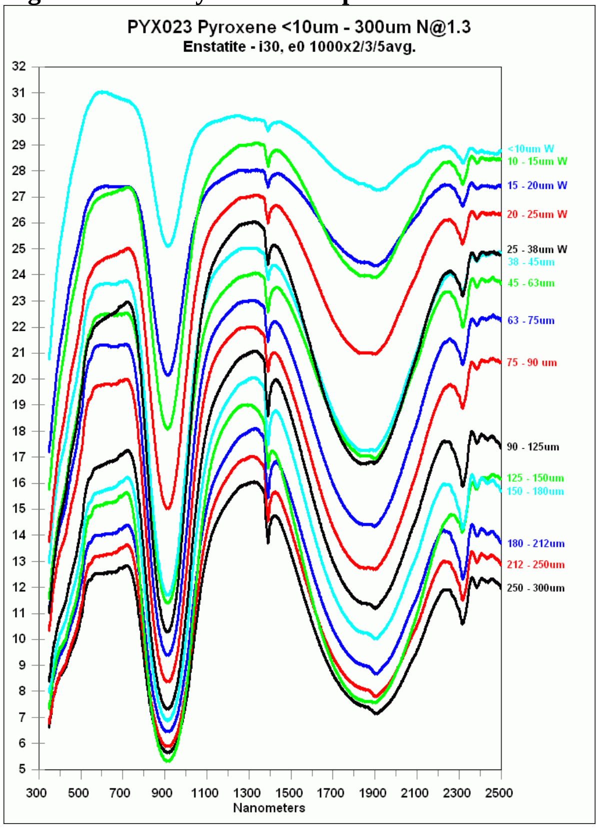

Figure 2: Course Pyroxene Samples

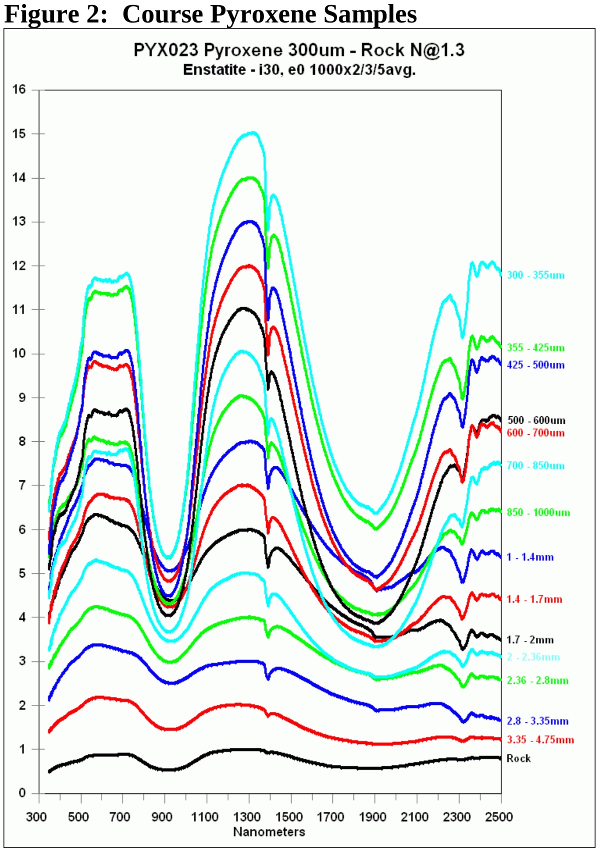

Figure 3: Fine Basalt Samples

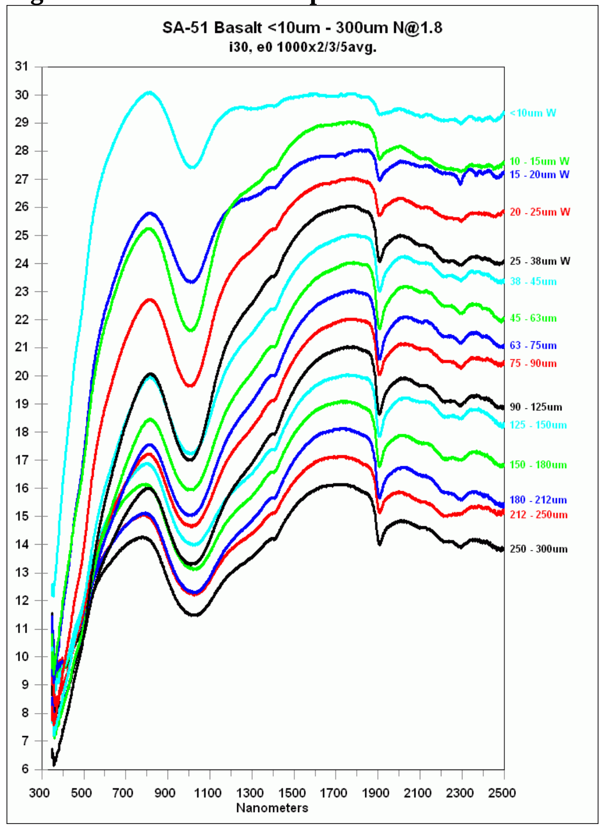

Figure 4: Course Basalt Samples