EFFECTS OF VARYING PROPORTIONS OF GLASS ON REFLECTANCE SPECTRA OF HED POLYMICT BRECCIAS.

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Introduction: Some meteorites contain significant amounts of glass, which, in most cases, probably results from impact processes on parent bodies [e.g., 1, 2]. Yamato 82202 is an example of one of the unequilibrated eucrites that contains significant proportions of impact glass distributed as veins throughout the meteorite [3]. In other cases, fragments of glass are distributed throughout polymict breccias. For example, the polymict eucrite EET 87509 contains rare angular fragments of devitrified glass [4]. Proportions of glass in most of these meteorites and in lithic clasts within these meteorites may vary locally from small amounts (less than one percent) to much larger amounts (subequal proportions of glass and mineral material). For example, some fragments within the South African polymict eucrite Macibini contain approximately 50% glass [5]. The presence of these variable proportions of meteorite glass confirm the increased recognition that impact processes played an important role in the histories of asteroidal bodies. This study attempts to quantify the effects of a glass component on reflectance spectra by analyzing in the laboratory mixtures of varying proportions of a well-characterized HED polymict breccia and glass derived by melting a bulk sample of that breccia.

Sampling and Analytical Techniques: To this end, we requested from the Meteorite Working Group (MWG) and were allocated a sample of the howardite EET87503, a meteorite that is relatively well-characterized [6] with relatively little alteration (alteration classification A) [7]. Two bulk matrix samples without large visible clasts (EET 87503,172 and EET 87503,174) totaling 3.26 g were extracted from the interior of the meteorite at Johnson Space Center (JSC). These samples were combined, crushed to a relatively uniform, fine grain size, and homogenized by mixing. Several aliquots of approximately 100 mg were separated and melted in the furnaces at JSC at high temperatures (1300-1400°C) and low oxygen fugacity (~IW-1) for 24 hours before being quenched. The resulting green glass was crushed to a similar grain size and mixed in varying proportions with remaining crushed meteorite material. These mixtures were analyzed with both a Maya (using QTH light) and an Analytical Spectral Devices FieldSpec Pro HR spectrometer over the wavelength range from 0.35µm to 2.5µm. Analyzed mixtures ranged from 200mg to 400mg in size. Analyzed mixtures included 100% meteorite, 85% meteorite+15% glass, 70% meteorite+30% glass, 55% meteorite+45% glass, 50% meteorite+50% glass, 45% meteorite+55% glass, 30% meteorite+70% glass, 15% meteorite+85% glass, and 100% glass. Spectra were then corrected and normalized so that all spectra have a normalized reflectance of 1.0 at 1.5 µm wavelength. The resulting spectra are displayed in Fig. 1. Band parameters were extracted from the spectra using the Matlab-based code. A detailed description of the various band parameters evaluated is contained in [8]. Both the meteorite sample and the glass sample also were analyzed by XRD. This indicated that the glass sample was, as expected, composed of amorphous material and the meteorite sample mostly contained the appropriate pyroxenes and feldspars.

Discussion: A few observations seem relevant. First, the analysis of 100% glass is characterized by a major absorption band at ~1.1µm (Band I) and another minor band at ~1.83µm (Band II). A major shoulder is present at 0.6 µm and a minor shoulder at ~1.6µm. In contrast, the spectrum of the 100% meteorite sample is dominated by absorption bands related to pyroxene at ~0.94µm (Band I) and ~1.96µm (Band II). Mixtures of glass and meteorite show a progressive change in the positions of Band I and Band II with increasing proportions of glass.

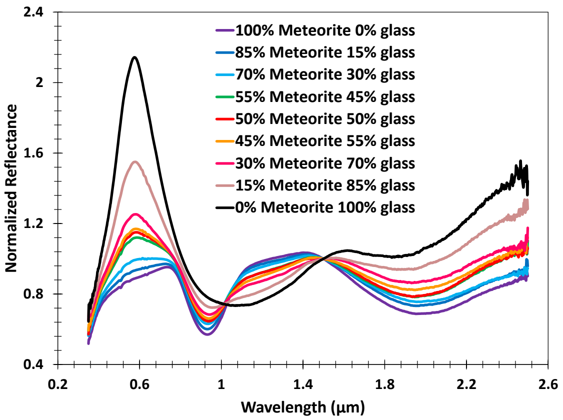

Fig. 1 Normalized spectra of mixtures of varying proportions of meteorite and melted glass for a bulk matrix sample of EET 87503

The visible slopes of the spectra (the slopes between 0.55µm and 0.65µm) decrease continuously with increasing glass abundances (Fig. 2). Even more striking, the Band Area Ratio (BAR; the ratio of the Band I area to Band II area) decreases significantly with increasing glass abundances (Fig. 3). This suggests that this parameter may be useful in the future in determining the spacial distribution of glass in areas that have well-characterized polymict mixtures of HED materials. Band I continuum slope decreases slightly, but continuously, with increasing glass abundances (Fig. 4). Band II depth (Fig. 5) decreases continuously with increasing abundance of glass.

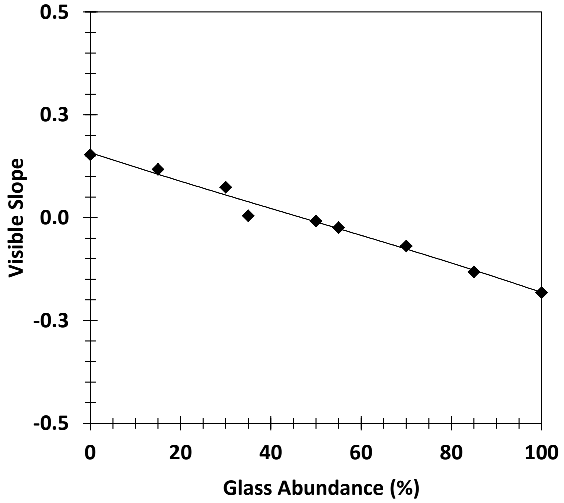

Fig. 2. Visible slope vs. glass abundance. Visible slope is the slope of the spectrum between 0.55µm and 0.65µm.

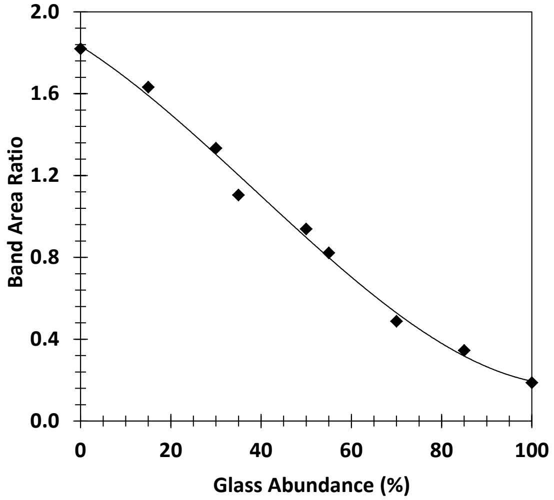

Fig. 3. Band Area Ratio vs. glass abundance. Band Area Ratio is the ratio of Band I area to Band II area.

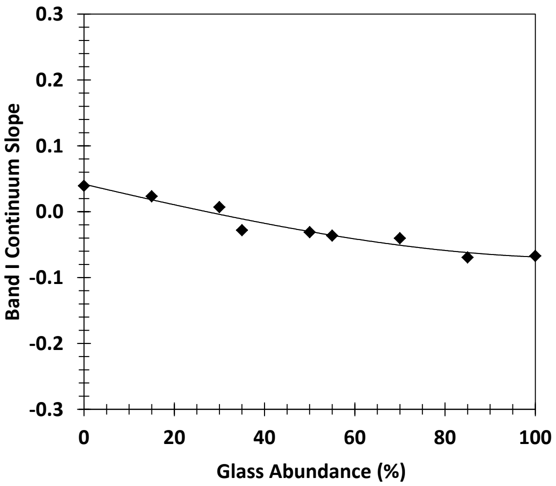

Fig. 4. Band I continuum slope vs. glass abundance.

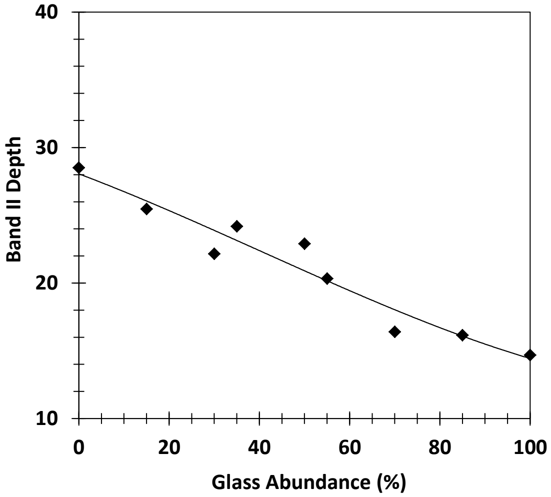

Fig. 5. Band II depth vs. glass abundance.

References: [1] Barrat J. A. et al. (2008) 71st MetSoc abstract #5165. [2] Singerling S. A. et al. (2013) *MAPS, 48,* 715-729. [3] Buchanan P. C. et al. (2005) *GCA, 69,* 1883–1898. [4] Buchanan P. C. (1995) *Ph.D. dissertation,* Univ. of Houston. [5] Burbine T. H. et al. (2001) *MAPS, 36,* 761-781. [6] Buchanan P. C. and Mittlefehldt D. W. (2003) *Antarctic Meteorite Ressearch, 16,* 128-151. [7] *The Meteoritical Bulletin Database*, The Meteoritical Society. [8] Le Corre et al. (2014) 45th LPSC abstract, this volume.