Compositional diversity of the vestan regolith derived from howardite compositions and Dawn VIR spectra

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Howardite, eucrite and diogenite meteorites likely come from asteroid 4 Vesta [1]. Howardites - physical mixtures of eucrites and diogenites - are of two subtypes: regolithic howardites were gardened in the true regolith; fragmental howardites are simple polymict breccias [2]. The Dawn spacecraft imaged the howarditic surface of Vesta with the visible and infrared mapping spectrometer (VIR) resulting in qualitative maps of the distributions of distinct diogenite-rich and eucrite-rich terranes [3, 4]. We are developing a robust basis for quantitative mapping of the distribution of lithologic types using spectra acquired on splits of well-characterized howardites [5, 6]. Spectra were measured on sample powders sieved to <75 μm in the laboratories of the Istituto di Astrofisica e Planetologia Spaziali and Brown University. Data reduction was done using the methods developed to process Dawn VIR spectra [4]. The band parameters for the ~1 and ~2 μm pyroxene absorption features (hereafter BI and BII) can be directly compared to Dawn VIR results.

Regolithic howardites have shallower BI and BII absorptions compared to fragmental howardites with similar compositions. However, there are statistically significant correlations between Al or Ca contents and BI or BII center wavelengths regardless of howardite subtype. Diogenites are poor in Al and Ca while eucrites are rich in these elements. The laboratory spectra can thus be directly correlated with the percentage of eucrite material contained in the howardites. We are using these correlations to quantitatively map Al and Ca distributions, and thus the percentage of eucritic material, in the current regolith of Vesta.

[1] McSween *et al* (2013) *Meteoritics Planet. Sci.* **48**, 2090-2104 [2] Warren *et al* (2009) *Geochim. Cosmochim. Acta* **73**, 5918-5943 [3] De Sanctis *et al* (2012) *Science* **336**, 697-700 [4] Ammannito *et al* (2013) *Meteoritics Planet. Sci.* **48**, 2185-2198 [5] Mittlefehldt *et al* (2013) *Meteoritics Planet. Sci.* **48**, 2105-2134 [6] Cartwright *et al* (2013) *Geochim. Cosmochim. Acta* **105**, 395-421