PETROLOGIC AND TEXTURAL DIVERSITY IN ONE OF THE LARGEST SAMPLES OF THE VESTAN REGOLITH.

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Introduction: With the upcoming arrival of Dawn, it will be beneficial to understand the scale of heterogeneity expected in the Vestan regolith. This will help in data interpretation from Dawn, and also in understanding regolith maturity. The best-suited samples for investigating regolith diversity are howardites [1]. Here, we examine the PCA02' paired howardite group, collectively among the largest samples from the Vestan megaregolith (~1m diameter, pre-atmospheric size) [2]. Along with reporting mineralogical diversity, we examine the scale of textural diversity using a new method where 8 x-ray maps are combined into a single image, allowing us to characterize distributions of specific subtypes of HEDs.

Methods: We have selected 6 PCA02' howardites for this study: PCA 02009(P9), PCA 02013(P13), PCA 02014(P14), PCA 02015(P15), PCA 02018(P18) and PCA 02019(P19). Mineral chemistries and the 8-element x-ray maps were acquired using EMP. X-ray maps were merged and classified using image-processing software [3].

Results and discussion: Pyroxene compositions range from Wo_1 En_{90} Fs_9 to Wo_8 En_{28} Fs_{64}, spanning the entire range of HEDs, including subtypes of eucrite and diogenite [4,5]. The majority of olivines fall within the diogenite range (Fo_{75-65}) [1]. However, groups of Fo_{80-90} and Fo_{44-60} olivine also occur. Plagioclase compositions are like those in basaltic and cumulate eucrites [1]. All samples contain metal, some of which is likely exogenic based on Co/Ni ratios [6].

X-ray maps reveal distinctive olivine-phyric (0.2-1mm) basaltic clasts, with fine-grained groundmass (~10μm) of Ol + Pyx + Plag. These are not typical eucrite basalts, as they contain olivine. Groundmass olivine is Fe-rich (~Fo_{50}). Olivine xenocrysts are ~Fo_{70} and ~Fo_{90}, both of which are zoned, the rims being in equilibrium with the groundmass (Fo_{50}). Several xenoliths of harzburgitic diogenite occur in these basaltic clasts. These clasts also contain ~80μm pieces of metal, some of which have exogenic Co/Ni [6].

We propose that these clasts are impact melts, not a new Vestan basalt. We hypothesize that they were generated from the melting of a polymict howardite, rich in a harzburgitic component, or the melting of a yet undiscovered Vestan norite (Opx + Ol + Plag). We favor the melting of a howardite rich in harzburgitic material given the xenocrysts and xenoliths observed in the melt clasts. The large metal grains in these melts suggest that the impactor was metal-rich (e.g. OC or Iron).

Modes among the samples vary considerably. Diogenite orthopyroxene (En_{90-66}) is the most dominant phase, ranging from 34-89%. Cumulate eucrite pyroxene (~En_{64-45}) ranges from 2-12%, and basaltic eucrite pyroxene (En_{44-30}) ranges from 3-22%. Olivine ranges from 1-10% and is correlated to the abundance of melt clasts. Melt clasts are ≤15%, though they comprise 33% of P15. All samples are exceptionally rich in metal, typically containing 1%, with P18 containing an impressive 20% metal.

The grain size of diogenitic material is primarily ≥300μm, whereas cumulate eucrite material is ~100μm and basaltic eucrite material is 80 - ≤3μm matrix material. This grain size distribution is important to Dawn VIR data interpretation, as spectral absorptions in the near infrared occur due to volumetric scattering, and fine-grained textures promote multiple scattering and would relatively increase reflectance [7]. From our textural observations, we anticipate the basaltic matrix material will disproportionately dominate the Dawn reflectance spectra of the regolith.

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