Homogenization of Eucritic Oxides and Implications for the Magmatic History of 4 Vesta. C. J. Anderkin [1, 2]
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Introduction: The analysis of mineral distribution within samples of eucrites and howardites is invaluable in obtaining a cogent understanding of Vestan crustal components [1], as well as in providing insight as to how the geological history of Vesta guided the formation of mineralogical characteristics within crustal samples [2]. This petrologic study of 8 samples within the HED suite (with a focus on eucrites and howardites), was conducted to assess the extent to which igneous minerals within howardite breccias displayed chemical similarity to eucritic minerals.

Methods: Here, pyroxene phases within eucrites and howardites were geochemically assessed to determine mol% of Ferrosilite (Fs) and Wollastonite (Wo) in pyroxenes, and plagioclase phases were assessed to determine the mol% of Anorthite (An) in the plagioclase feldspar series. Comparative features and chemical compositions were then employed to characterize the samples. The observed textural and petrologic properties of said phases were characterized by ZEISS scanning electron microscope (SEM) back-scattered electron (BSE) imaging. A beam current of 100 µA was employed, as well as a 15 kV probe potential and a spot size of 4 µm. Mean weight and atomic percentages, as well as compositional components and chemical mappings of pyroxene and anorthitic feldspar were characterized through use of the EDAX energy-dispersive x-ray spectroscope (EDS). Five separate observations were made for each type of mineral in each sample (Fig. 1). Elemental percentages of oxygen, fluorine, sodium, magnesium, aluminum, silicon, phosphorus, chlorine, potassium, calcium, chromium, manganese, and iron were captured. The sample set spans 80 assessed phases in 8 samples, across 7 different specimen classifications.

Results: While the initial aim of these research efforts was to determine similarities between howarditic clasts and eucritic basalts, it was observed that nearly all tested samples displayed a rather unexpected degree of near total homogeneity, not only amongst the mineral grains within individual samples, but also between samples of different classifications. This was especially apparent in the mineralogical similarities between brecciated and un-brecciated samples. Homogeneity presented itself most prominently as consistent values for ferrosilite, wollastonite, and anorthite oxide molar percentages. Of these, wollastonite values exhibited the greatest degree of variance. It is postulated that the observed values can be accounted for under the theory of a global magma ocean [3], by which the relative homogenization of crustal material would transpire with relative ease [4].

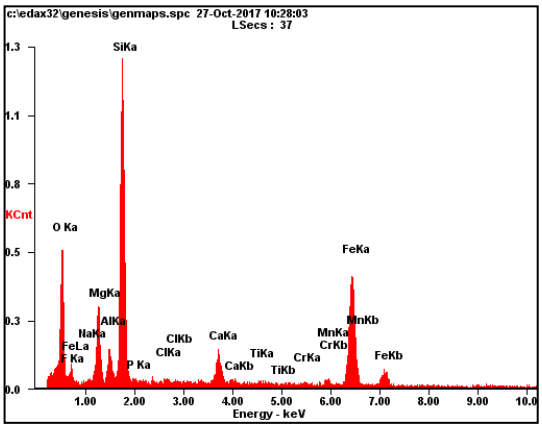

Fig. 1: Resultant spectrum of an SEM BSE spot analysis on a phase of low-Ca pyroxene. This is a typical readout consistent with the homogeneity of the dataset.

Conclusions: It was here noted that this homogenization of eucritic and howarditic mineral chemistry could realistically be attributed to the presence of a magma ocean, and by proxy, could be used to infer the existence of total or partial melting events on or within 4 Vesta [4]. The observation of the trend of generally high anorthite percentages in plagioclase is suggestive of a Ca-enriched, Na-depleted average feldspathic mineralogy, while the observation of the trend of generally high ferrosilite percentages in pyroxene is suggestive of a Fe-enriched, Mg-depleted average pyroxenoid mineralogy. Further material analysis is in progress.

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