STANNERN-TREND EUCRITE PETROGENESIS: AN ASSESSMENT OF PARTIAL MELT CONTAMINATION MODELS VIA EXPERIMENTAL PETROLOGY

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Introduction: Stannern-trend eucrites are problematic in simple petrogenetic models for HEDs, as they cannot be explained as either products of fractional crystallization in a magma ocean, or as partial melts of a chondritic precursor [1]. Currently, the most widely accepted petrogenetic model asserts that they may represent the products formed when Main-Group-Nuevo-Laredo-trend eucritic magmas were contaminated by melts released during fusion of eucritic crust [1]. Melting experiments were conducted with eucrites at near-solidus temperatures in order to determine carrier phases and transport mechanisms for incompatible elements [2]. These experiments at near-solidus temperatures did not yield enough melt product in some samples for analysis [2]. However, we expand upon previous experimental conditions (i.e. increasing temperature) to yield a greater percentage partial melt, which can be analyzed and used to test the currently accepted model of Stannern-trend eucrite petrogenesis. Specifically, a composition enriched in incompatible elements (i.e. Ti and LREEs), but otherwise similar in bulk composition to main-group eucrites, should be possible to reproduce from the assimilation of a partial melt product with a main-group eucritic composition. To most accurately replicate vestan petrologic processes, the starting material would need to meet a set of petrologic and geochemical criteria in order to reflect the petrogenetic processes involved in the formation of Stannern-trend eucrites.

Starting Material: The starting material for experimentation must be an unbrecciated, unequilibrated main-group eucrite that is preferably fine-grained and rich in mesostases. In June 2015, the Monnig Meteorite Collection at TCU acquired the main mass (510 g) of NWA 8562, an unbrecciated, unequilibrated main-group eucrite [3,4]. The $\Delta^{17}O$ value of the sample plots close to and within error of the HED fractionation line of [5] and indicates that NWA 8562 is an isotopically normal member of the HED suite [4].

Petrographic characterization. Two thin sections of the meteorite were examined to characterize the suitability of NWA 8562 for petrologic experimentation. NWA 8562 is composed of approximately 60% pyroxene and 35% plagioclase, with accessory silica, ilmenite, and troilite [3]. Most plagioclase range from <10µm to ~80 µm. Pyroxenes retain igneous zonation and range from pigeonite to ferro-augite [3]. The size of pyroxenes range from <10µm to ~100 µm. The presence of metastable ferro-augite and Fe-rich mineral endmembers places NWA 8562 within the Type 1 eucrite classification [6]. Some shock mosaicism is present in pyroxene.

Experimental & Analytical Methods: Following experimental techniques established in [2], we prepared four samples (~0.3-0.4 g each) of NWA 8562, and placed each sample in an alumina crucible inside a 1 atm gas mixing furnace. The four experiments were run at 1050, 1100, 1150, and 1200°C for 24 hours at $\log f\text{O2} = \text{IW-0.5}$. At the end of the run time, the samples were drop-quenched in water. Major element geochemistry has been gathered via electron microprobe for both starting material and experimental products. Trace elements have been measured for bulk composition via ICP-MS, and their distribution in both unheated and heated samples was measured using LA-ICP-MS.

Preliminary Results: Experiments yielded approximate melt fractions of <5, 20, 50, and >95%, respectively. Melting occurs most extensively in mesostatsis-rich regions between plagioclase and pyroxene. Fe-rich pyroxenes are also major contributors in low-percent melts. Major element geochemical analysis of the low melt-fraction products (<5%) shows a strong enrichment in TiO_2, P_2O_5, K_2O, and SO_3, relative to bulk composition, and depletion in Cr_2O_3, Al_2O_3, MgO, and NiO.

Discussion: Simple mixing equations, such as those used in [1], applied to TiO_2 and Mg# can yield products within the Stannern-trend compositional range. TiO_2 is sourced from ilmenite, chromite, and ülvospinels. P_2O_5 is largely derived from mesostasis, possibly metasomatic, fayalite in these experiments. Contribution of phases introduced through metasomatic processes will be considered with regard to [1]. We will also quantitatively assess the application of this data and trace element concentrations within the constraits of [1] in order to ascertain its validity.

References: [1] Barrat J.A. et al. (2007) *GCA*, 71, 4108-4124. [2] Yamaguchi A. et al. (2013) *Earth and Planet. Sci. Letters*, 368, 101-109. [3] Agee C. (2014) *Met. Bull., 103*. [4] Crossley S.D. et al. (2016) *LPSC XLVII*, #2821. [5]] Greenwood R. C. et al. (2014) *EPSL,* 390, 165-174. [6] Takeda H. and Graham A.L. (1991) *Meteoritics,* 26, 129-134.