EXPERIMENTAL INSIGHTS INTO STANNERN-GROUP EUCRITE PETROGENESIS. S. D. Crossley1, R. G. Mayne2, N.G. Lunning3, T. J. McCoy3, R. D. Ash1, J. M. Sunshine1. 1Department of Geology, University of Maryland College Park, MD 20742 (sdcross@terpmail.umd.edu), 2Monnig Meteorite Collection, School of Geology, Energy, and the Environment, Texas Christian University, Fort Worth, TX 76109, 3Department of Mineral Sciences, Smithsonian Institution, Washington DC, 20560.

Introduction: Stannern-group eucrites are a geochemical subgroup of the HED meteorite clan, distinguished from main-group and Nuevo-Laredo-trend eucrites (hereafter referred to collectively as main-group, for clarity) by enrichment in incompatible lithophile elements (i.e., REEs and Ti) [1]. This enrichment does not appear to be derived solely from crystal fractionation processes in a magma ocean, as major element contents in Stannern-group eucrites are equivalent to those of the main-group, which is problematic for simple magma ocean models [2-4]. Partial melting models of the HED parent body suggest that Stannern-group eucrites crystallized from primary partial melts of regions within the HED parent body that were mineralogically distinct from the source regions of main-group eucrites [5]. However, partial melting alone fails to account for the homogenization of O-isotopes [6] and Fe/Mn [7] among most eucrites, assuming an initially heterogeneous parent body. The complications in facilitating Stannern-group eucrite formation through simple petrogenetic models highlight the importance of this subgroup in placing constraints on petrogenetic models for the HED parent body as a whole.

Background: The petrogenesis of Stannern-group eucrites have been modeled via crustal partial melt assimilation with a main-group eucritic magma [8]. The modeled results successfully replicated Stannern-group eucrite trace element contents, but not the major elements. Partial melting experiments were conducted with the main-group eucrite, HaH 262 [9], in order to determine REE-contributing phases during partial melting and the mechanisms of transport for those melts over 24 hours. Those experiments, however, did not attempt to assess the crustal partial melting model, and while some calculations can be made in order to determine the composition of a magma resulting from the mixture of HaH 262 partial melts and main-group magmas, several critical components needed for interpretation of magma mixing calculations (i.e., melt fraction produced, REE content of low-T melts) were not provided.

Our Experiments: Here, we discuss the results of our partial melting experiments on the unbrecciated, unequilibrated main-group eucrite, NWA 8562 [10]. These experiments were conducted in order to test the crustal partial melt assimilation model in [8] and expand the range of experimental temperatures from [9]. We have also modeled magma mixtures for HaH 262 melts from [9] and main-group eucritic magmas for comparison.

Methods: 5 partial melting experiments (Table 1) were carried out in a 1-atm Deltech gas-mixing furnace on chips of the eucrite NWA 8562. At the end the run, each chip was drop quenched in situ into water. fO2 was maintained by CO-CO2 mixing.

<table>
<thead>
<tr>
<th>T (°C)</th>
<th>Hours</th>
<th>Mass (mg)</th>
<th>F=</th>
</tr>
</thead>
<tbody>
<tr>
<td>1050</td>
<td>24</td>
<td>441</td>
<td>0.05</td>
</tr>
<tr>
<td>1075</td>
<td>48</td>
<td>290</td>
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<tr>
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<td>386</td>
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</tr>
<tr>
<td>1200</td>
<td>24</td>
<td>316</td>
<td>0.97</td>
</tr>
</tbody>
</table>

F is the partial melt fraction generated in each experiment. All experiments maintained log fO2 = IW-0.5.

Major element concentrations were determined via EMPA of mineral phases. Trace element concentrations of bulk unheated material, phases, and melt products were measured using LA-ICP-MS. Melt fractions were determined by point counting of BSE images of experimental charges.

In order to examine the petrogenesis of Stannern-group eucrites modeled in [8], we used simple binary mixing calculations after [8,11]. Our experimental melt (compositions and fractions) and bulk NWA 8562 were used to simulate main-group eucritic magma after contamination by partial melts of crustal material.

Results and Discussion: Experimental partial melt fractions produced major element enrichment trends (Figure 1) similar to previous experiments [9], notably with regard to P2O5 and TiO2. However, FeO is much more enriched in melts of NWA 8562 than in those of HaH 262 at equivalent temperatures.

REE enrichment in melt products was inversely proportional to temperature (Figure 2), as the majority of REEs are contained in mesostasis phases [9], but only began generating LREE enrichment patterns similar to modeled results at temperatures less than 1100°C (i.e., F < 0.18).

When included in binary mixing calculations, our results cannot generate Stannern-group eucrite compositions at melt fractions greater than F = 0.05 for magma mixture proportions of up to 15% crustal partial melt contaminant (Figure 3). At maximum La content of 3.77...
µg/g, where F=0.08, the calculated mixtures fall near Stannern-group compositions (minimum 4 µg/g). These mixtures, however, are too ferroan to generate eucritic compositions (FeOT/MgO=5.44). We have been unable to successfully measure the REE content of the 1050°C melt, due to the small size of melt pockets (<15 µm). However, by using P2O5 as proxy for La, following [10], the trace element content for the lowest-T experimental run can be estimated as nearly 10x enriched in La relative to bulk unheated material (a main group eucrite). Calculated magma mixtures incorporating the estimated compositions for this melt fraction (F=0.05) can produce Stannern-group trace element concentrations of 4.04-4.60 µg/g La if the proportion of the assimilating component in the magma mixture is at least 10% (Figure 3). However, the resulting magma composition is exceedingly ferroan (FeOT/MgO > 5) and falls outside of observed eucritic compositions. Calculated magma mixtures with estimated HaH 262 melt fractions [9] generate results that more closely resemble those modeled in [8], but are still too ferroan to generate Stannern-group eucrites (Figure 3).

**Implications:** Our melting results are inconsistent with those modeled in [8]. Due to the ferroan nature of our experimental melts, this renders the petrogenesis of Stannern-group eucrites unaccounted for with regard to simple magma ocean models, and may necessitate a reexamination of a magma ocean as the driving petrogenetic mechanism for the HED parent body. Additionally, we have shown that while trace element modeling can be useful in constraining the petrogenesis of eucrites, major element distribution must also be considered. Relevant experimental work is needed for assessment of petrogenetic modeling with regard to major, minor, and trace elements.

**References:**