NEW INSIGHTS INTO THE GENETICS, AGE, AND CHEMICAL COMPOSITION OF THE GROUP IIIE IRON METEORITE PARENT BODY. E.M. Chiappe, R.D. Ash, R.J. Walker, Department of Geology, University of Maryland, College Park, Maryland, 20742, USA (echiappe@umd.edu)

Introduction: The IIIE magmatic iron meteorites comprise a magmatic iron group currently comprised of sixteen members. We have acquired and analyzed ten of these. The IIIE iron meteorites have been previously characterized as having moderate depletions in the volatile siderophile elements (e.g., Ga and Ge) and are structurally classified as coarse octahedrites [1]. The IIIE irons are chemically similar to the larger IIIAB group, but are distinguished by their coarser kamacite bandwidths, as well as by the presence of the C-rich minerals graphite and haxonite ($[Fe, Ni]_{23}C_6$). Recent studies of genetic isotopes (e.g., Mo, Ru, ^{183}W) have revealed nucleosynthetic characteristics consistent with the IIIE group belonging to the non-carbonaceous (NC) type of planetary materials [2-3]. The limited chemical and isotopic analyses of the IIIE irons means that little is known of the IIIE parent body core, and as such, further investigation of the chemical compositions of the group IIIE irons was warranted.

Samples: We obtained pieces of Coopertown (USNM 1003), Kokstad (USNM 488), Paloduro (USNM 6877), Rhine Villa (USNM 272), Staunton (USNM 2204), Tanokami Mountain (USNM 1456), and Willow Creek (USNM 900) from the Smithsonian Institution. Burlington (ASU #978) and Colonia Obrera (ASU #1032) were obtained from Arizona State University. Aletai was commercially obtained from KD Meteorites, Kansas. The latter is currently classified as an anomalous IIIE due to inconsistencies in Au and Ir concentrations relative to the rest of the group [4].

Methods: Chemical and isotopic analyses were carried out at the University of Maryland. Bulk siderophile element concentrations were obtained via laser ablation inductively coupled mass spectrometry (LA-ICP-MS) using a *New Wave UP213* ultraviolet laser coupled to a *Thermo Finnigan Element 2* ICP-MS. High precision highly siderophile element concentrations (HSE; Re, Os, Ir, Ru, Pt, Pd) and ^{187}Re-^{187}Os isotopic data were obtained on bulk samples via isotope dilution [5]. Osmium concentrations and isotopic ratios were determined using a *Thermo Fisher Triton* thermal ionization mass spectrometer (TIMS). The remaining HSE concentrations were determined using a *Thermo Neptune Plus* multi-collector ICP-MS. Molybdenum and W isotopic data were collected via TIMS. Ruthenium isotopic data were collected via MC-ICP-MS. Cosmic ray exposure (CRE) correction was accomplished through utilization of the μ^{196}Pt dosimeter.

Results: Highly siderophile element concentrations of the IIIE irons, normalized to the CI-chondrite Orgueil [6], are shown in **Fig. 1**. The generally nested HSE patterns are broadly consistent with fractional crystallization. The HSE pattern for Aletai, however, is not consistent with the trend established by the rest of the group. The HSE concentrations of the IIIE irons also exhibit similarities to moderately fractionated irons belonging to the IIIAB group. Cosmic ray exposure-corrected μ^{94}Mo and μ^{95}Mo values for the IIIE irons and Aletai are shown in **Fig. 2**. These data are consistent with previously reported Mo isotopic data for the IIIE irons [2]. The CRE-corrected Mo, Ru, and ^{183}W isotopic data for Aletai are not resolved from the group IIIE averages. Further, isotopic data for both Aletai and the IIIE irons are not resolved from previously reported group averages for the IIIAB irons.

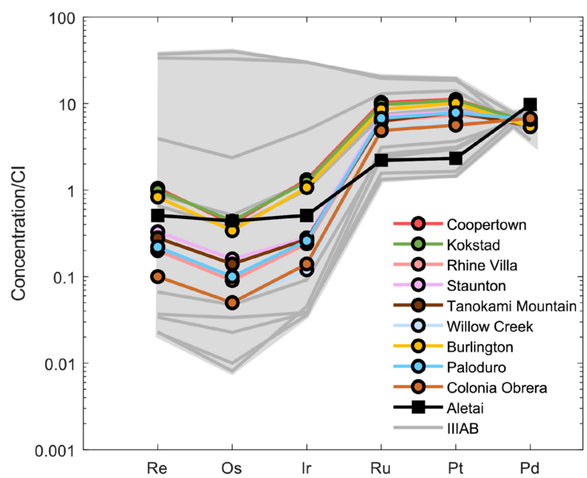

Figure 1. Bulk CI-chondrite normalized HSE abundances for nine IIIE irons and the anomalous IIIE Aletai. Note that the pattern obtained for Aletai differs from that of the other IIIE irons. Highly siderophile abundances for the IIIAB irons are represented by the gray lines and light gray field [7].

Discussion: The IIIE irons exhibit depletions in the strongly compatible elements Re, Os, and Ir, relative to Ru, Pt, and Pd, suggesting moderate fractionation of these samples. The HSE pattern for the anomalous iron Aletai differs substantially from the other IIIE irons. Aletai exhibits similar depletions in Re and

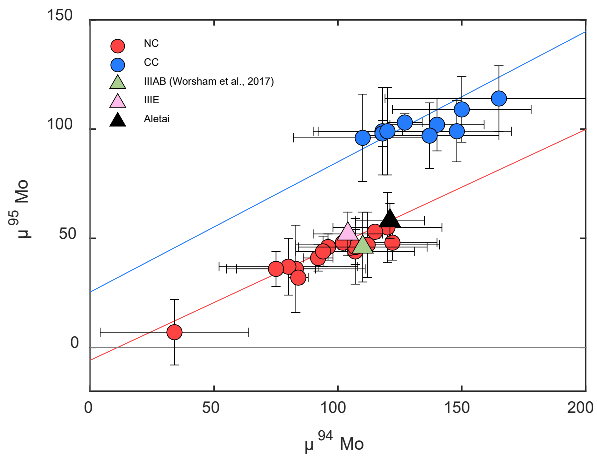

Figure 2. Compilation of μ^{94}Mo vs. μ^{95}Mo data for iron meteorites [2, 8-11]. Blue symbols represent CC-type iron meteorites. Red symbols represent NC-type iron meteorites. Red and blue lines represent NC and CC lines reported by [12] and [13], respectively.

Ir, but stronger depletions in Ru and Pt, relative to the other irons. Aletai also exhibits a higher Re/Os compared to the other IIIE irons. The composition of Aletai is thus inconsistent with it sampling the same crystal-liquid fractionation sequence as the *bona fide* IIIE irons, and should not be considered a IIIE iron meteorite.

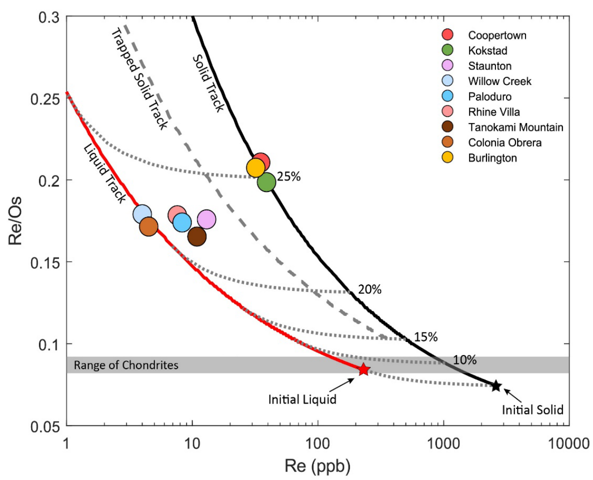

Figure 3. Best-fit fractional crystallization model for Re (ppb) vs. Re/Os systematics for the IIIE iron meteorites and Aletai. Small dotted gray lines represent solid metal-liquid metal curves for the labeled increments of fractional crystallization.

The evolution of the remaining nine irons by fractional crystallization was further examined through detailed modeling of HSE behavior. Initial S, P, C, and HSE concentrations were varied until a model crystallization sequence was produced that matched the HSE abundances of the IIIE irons. The Re-Os systematics for the best fit model are shown in **Figure 3**. The crystallization of all nine IIIE irons can be accounted for through crystal-liquid fractionation of a parent melt with initial S, P, and C concentrations of 12 wt.%, 0.8 wt.%, and 0.15 wt.%, respectively. The modeled parent melt composition is ~4 times more enriched in HSE than a NC chondrite-like parent body. This corresponds to a core that comprises ~22% of the mass of the total parent body.

Cosmic ray exposure-corrected nucleosynthetic Mo, Ru, and W isotopic compositions of the IIIE irons and Aletai indicate an origin from the same isotopic domain within the solar nebula.

Tungsten-182 isotopic data for the IIIE irons and Aletai yield similar model metal-silicate segregation ages of 1.6 ± 0.8 Myr and 1.2 ± 0.8 Myr, respectively, after calcium aluminum-rich inclusion (CAI) formation.

Conclusions: The bulk chemical characteristics of Aletai are inconsistent with the iron sampling the same crystallization sequence as the other IIIE irons analyzed here. The remaining nine irons can otherwise be related to one another through a common fractional crystallization process. The chemical, genetic, and chronological characteristics observed across the IIIE irons, IIIAB irons, and Aletai are permissive of them sampling the same parent body. Differences in chemistry, texture, and mineralogy of Aletai can be explained as a result of crystallization from a different metallic melt on either the same parent body, or another parent body with genetically identical characteristics. The possible relationship between IIIAB and IIIE groups requires further consideration.

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