COMPARATIVE MOLYBDENUM-TUNGSTEN-OSMIUM ISOTOPE EVIDENCE FOR THE DIVERSE GENETICS AND CHRONOLOGY OF IAB COMPLEX IRON METEORITES. E.A. Worsham[1], K.R. Bermingham[1], and R.J. Walker[1], [1]Dept. of Geology, University of Maryland, College Park, MD 20742 USA (eworsha1@umd.edu).

Introduction: The IAB complex is a silicate-bearing iron meteorite group consisting of a chemical main group (MG) and several subgroups (e.g., sLL, sHL) [1]. Trace elements show that these subgroups did not originate from a single parental melt, and therefore, may not represent a single parent body. Proposed origins of the IAB complex include crystallization of a S-rich core in a partially differentiated body [2], equilibrium crystallization and crystal segregation in impact-generated melt pools in a chondritic body [1], and core formation in a partially differentiated body, followed by an impact(s) which disrupted the body and generated near-surface melt pools [3-5]. Any of these scenarios may have occurred on multiple parent bodies to generate the IAB complex.

To better understand how the constituent IAB subgroups may be related, we have undertaken a study to examine the chronology and genetic relations of the IAB complex subgroups using Mo, W, and Os isotopic compositions of MG, sLL, sLM, sHL, and sHH irons. Osmium isotopes are used to monitor and correct for cosmic ray exposure (CRE). Molybdenum isotopes are used as genetic tracers because most planetary bodies show distinct Mo isotopic compositions due to nucleosynthetic heterogeneities. Therefore, it is possible to reject genetic linkages among meteoritic material if isotopic differences can be resolved [6, 7]. The ^{182}Hf-^{182}W chronometer ($t_{½}$ = 8.9 Myr) is used to determine the relative timing of metal-silicate segregation of the individual subgroups [e.g., 5]. By combining Mo as a genetic tracer and ^{182}W as a chronometer, the question of whether the MG and subgroups originated contemporaneously on a single parent body can be answered. If it can be shown that the IAB complex represents multiple metal-silicate differentiation events, and/or multiple parent bodies, then it might ultimately be concluded that the processes that created the chemically and texturally similar subgroups were temporally and/or spatially widespread.

Experimental Methods: The digestion and chromatography methods for Mo analyses were adapted from [8]. Osmium and W isotope compositions were determined for adjacent pieces of metal from each iron meteorite, such that the pieces had similar shielding conditions. The digestion and chromatographic methods for Os and W are described in [9, 10]. Some Mo analyses were collected from the same digestions as the W analyses.

Isotope compositions of Os and W were determined using a *Thermo-Fisher Triton* TIMS. The external reproducibility (2σ) of the repeated analysis of terrestrial standards is ~ ± 4.5 ppm for ^{182}W and ± 5 and 7 ppm for $^{189, 190}$Os, respectively. Molybdenum isotope compositions were determined using a *Thermo-Fisher Triton Plus* TIMS. The external reproducibility (2σ) of Mo standards for ^{97}Mo, for which the best precision is obtained, is ± 5 ppm. The Mo, W, and Os isotopic compositions are reported in μ notation (parts in 10^6 deviations from terrestrial standards). The data are normalized to ^{98}Mo/^{96}Mo, ^{186}W/^{184}W, and ^{192}Os/^{188}Os.

Results: Osmium isotopic compositions are typically within uncertainty of terrestrial values, but some samples show deviations which are attributed to CRE [9]. Deport and Bischtube show large Os isotopic anomalies (μ^{189}Os = -107±5 and -28±7) which define correlations with μ^{182}W and, to a lesser extent, μ^{97}Mo [11]. Pre-CRE exposure μ^{182}W and μ^{97}Mo can be calculated as the y-intercept of these correlations. Corrected μ^{182}W are reported for Landes and Sombrerete and corrected μ^{97}Mo is reported for Deport.

Most IAB complex iron meteorites have Mo isotopic compositions that are within uncertainty of the terrestrial Mo isotopic composition (Fig. 1a). The MG, sLL, and sLM samples, on average, have indistinguishable Mo isotopic compositions (μ^{97}Mo= -0.5 ± 5, -0.9 ± 5, and 2.5 ± 5), which are in agreement with [6, 7], but are ~3x more precise. Sombrerete (sHL) and ALHA80104 (sHH) are not within uncertainty of each other, terrestrial Mo, or the other IAB subgroups (μ^{97}Mo= 55 ± 5 and 26 ± 5).

The W isotope compositions (Fig. 1b) of the MG and sLL are characterized by μ^{182}W values of -306±6 and -297±7, which overlap within uncertainties. The isotopic compositions of Canyon Diablo and Toluca are in good agreement with [5], whereas the μ^{182}W of Campo del Cielo is slightly lower than that reported by [5]. Sombrerete (sHL) has a CRE-corrected μ^{182}W of -308±5 that is within uncertainty of the MG. ALHA80104 and Persimmon Creek have lower and higher μ^{182}W values than the MG, respectively.

Discussion: The MG and sLL subgroups have Mo and W isotopic compositions that are indistinguishable from one another, and Mo isotopic compositions that are within uncertainty of terrestrial standards and the sLM subgroup. The sLM sample Persimmon Creek, however, has a W isotopic composition that corresponds to a younger metal-silicate segregation age than that of the MG. This observation suggests that this sample, and perhaps the entire sLM subgroup, either formed on the same parent body as the MG, but at a different time, or on a distinct parent body in a similar nebular environment. If Persimmon Creek formed on the same parent body, it suggests that the IAB MG parent body had a protracted history, and it supports the idea that at least some of these subgroups formed *via* impact rather than radiogenic heating.

The Mo isotope evidence is permissible of the MG, sLL, and sLM subgroups having their origins on the same parent body. However, Sombrerete (sHL) and ALHA80104 (sHH), having well resolved differences in μ^{97}Mo, likely originated on different parent bodies from the other subgroups. If Sombrerete and ALHA80104 are representative of their subgroups, then at least two IAB subgroups are genetically unrelated to the IAB-MG. Consistent with this, Sombrerete also has a lower Δ^{17}O than most IAB complex irons [1], and ALHA80104 has an older Hf-W metal segregation model age (Fig. 1b). Because nebular heterogeneity is the likely source of the Mo isotopic anomalies, these subgroups likely originated on separate parent bodies in isotopically distinct nebular environments.

Collectively, our new data argue that the IAB complex does not represent a single metal-silicate segregation event, or a single parent body. Chemical and textural similarities within the complex, therefore, suggest that the processes that created these meteorites were widespread in time and space. It has been repeatedly speculated that the formation of silicate-bearing meteorites is dependent on some form of collisional process [1, 3-5]. The ubiquity of this type of process is not surprising, but the chemical similarity of the meteorites formed by such a process is noteworthy.

Finally, IAB subgroups are some of the few meteorite groups with a Mo isotopic composition that is indistinguishable from that of the Earth, even at the fine scale revealed here. Even enstatite chondrites, which have been promoted as representative precursor materials to Earth, have a resolvably higher μ^{97}Mo (Fig. 1a). This suggests that much of the IAB complex represents Earth's closest genetic relation.

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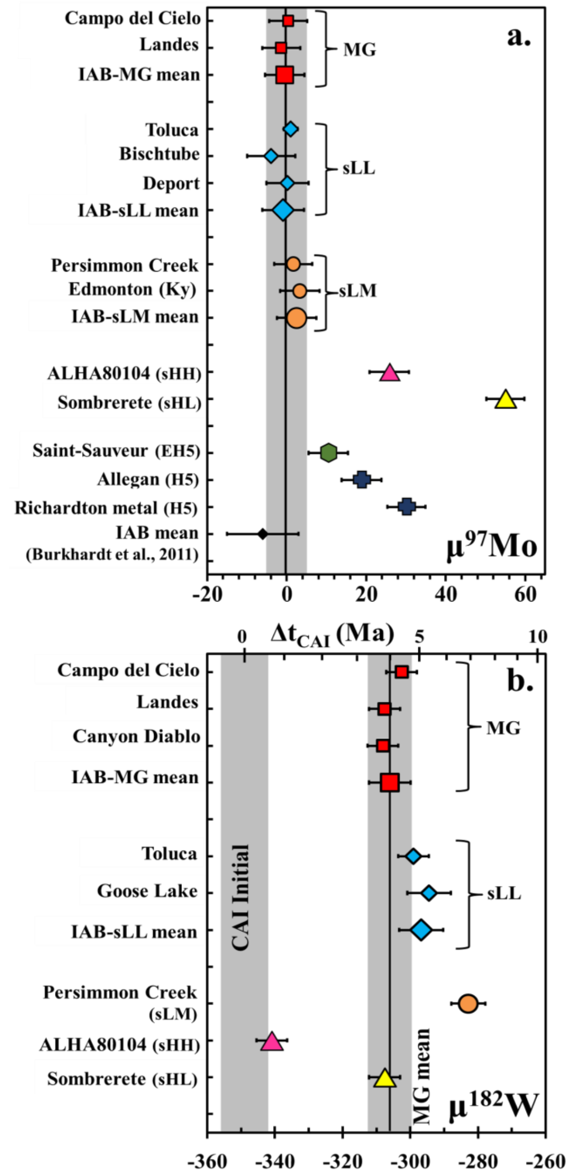

Fig. 1. μ^{97}Mo (a) and μ^{182}W (b) for IAB complex iron meteorites, with enstatite and ordinary chondrites for reference in (a). a) The grey bar indicates the external reproducibility (2σ) of repeated analyses of terrestrial standards. b) The grey bars are the MG mean and the Ca-Al rich inclusion (CAI) initial. The upper x-axis is the time of metal-silicate segregation after the formation of CAIs, calculated using the $^{182}W_{CAI}$ of [12]. Uncertainties of each data point in (a) and (b) are the 2σ external reproducibility of standards. Data are corrected for CRE where possible.