CHEMICAL AND ISOTOPIC COMPOSITIONS OF THE IIG IRON METEORITES.

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Introduction: The IIG iron meteorite group currently consists of six members (Auburn, Bellsbank, Guanaco, La Primitiva, Tombigbee River, and Twannberg) characterized by low Ni and Ir (4-5 wt. % Ni, <0.15 ppm Ir; **Fig. 1**), and high P (~2 wt. %) concentrations, compared to other iron meteorite groups [1]. Scott et al. [2] noted the compositional similarity between Auburn (USNM 957) and Tombigbee River, and posited that they may be the same meteorite. The IIG iron meteorites have chemical compositions that plot near the extension of some chemical trends defined by group IIAB iron meteorites, which led [1] to argue for IIG iron meteorite formation in the IIAB core through liquid immiscibility. Genetically diagnostic isotope data are lacking for the IIG irons inhibiting a "genetic" test of the IIAB and IIG relationship. Due to the implications such a relationship has on the current understanding of the formation of magmatic iron meteorites, this group is worthy of additional study.

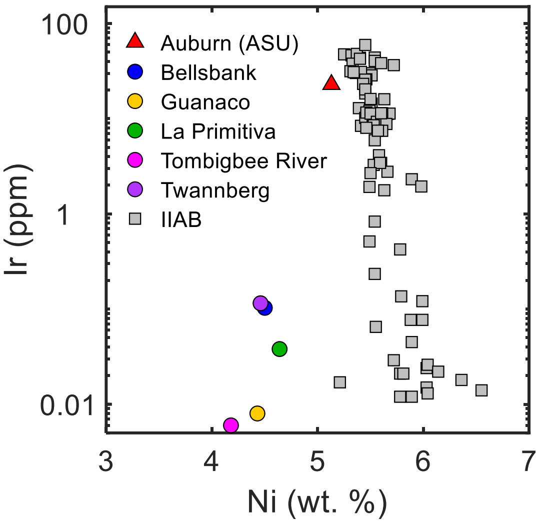

Figure 1. Ni (wt. %) vs. Ir (ppm) concentrations of the IIG iron meteorites compared to the IIAB iron meteorites [1,3]. Nickel concentrations for all meteorites except Auburn are from the literature. Iridium concentrations of the IIG irons were obtained here by isotope dilution. Note that the Ir concentration of Auburn is much higher than reported by [2].

Methods: Pieces of Bellsbank (USNM 2162), Guanaco (USNM 7198), and La Primitiva (USNM 741) were obtained from the Smithsonian National Museum of Natural History. Pieces of Tombigbee River (ME 504 #11) and Twannberg (ME 3153 #2) were obtained from the Field Museum, and a piece of Auburn (#443) was obtained from the Carleton B. Moore Meteorite Collection at Arizona State University. Between 0.11-0.34 grams of each meteorite were analyzed for bulk concentrations of Re, Os, Ir, Ru, Pt, and Pd (highly siderophile elements; HSE) by isotope dilution [4] and analyzed for siderophile element concentrations by ablating ten tracks (1.5-2 mm each) across each meteorite piece using laser ablation (LA) ICP-MS at the University of Maryland.

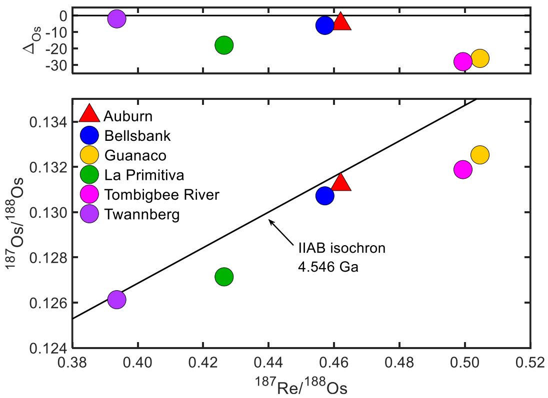

Figure 2. Plot of ^{187}Re/^{188}Os vs. ^{187}Os/^{188}Os for the IIG irons with the IIAB isochron [5]. Δ_{Os} is the deviation of the ^{187}Os/^{188}Os ratio from the IIAB isochron in parts per 10,000.

Results: The results of ^{187}Re-^{187}Os measurements of the IIG iron meteorites are shown in **Fig. 2**, compared to the IIAB iron meteorite isochron [5]. Auburn, Bellsbank, and Twannberg plot on or near the IIAB isochron, whereas Guanaco, La Primitiva, and Tombigbee River plot considerably to the right of the isochron, suggesting open-system behavior. Highly siderophile element concentrations of the IIG iron meteorites, normalized to the CI-chondrite Orgueil [6], are shown in **Fig. 3** with the range of IIAB HSE concentrations shown in grey [7]. Concentrations of siderophile elements obtained by LA-ICPMS from the IIG irons and one IIAB iron are shown in **Fig. 4**, normalized to CI-chondrites.

Discussion: Bellsbank and Twannberg are characterized by Re-Os isotopic systematics expected for irons formed in the early solar system. This likely reflects closed system chemical behavior. These meteorites are, therefore, the best candidates for assessing the Mo isotopic composition of in order to assess a possible genetic link to the IIAB iron meteorites. The piece of Auburn analyzed in this study is chemically different from the piece studied by [2]. The piece of Auburn meteorite from the ASU collection has siderophile element concentrations that are similar to the chemically less evolved IIAB members, suggesting that it may be a IIAB iron. The small piece we examined had slightly lower Ni and slightly higher Ga and Ge (68 ppm, 275 ppm) concentrations compared to averaged published data for IIAB irons (58 ppm, 169 ppm), consistent with this tentative interpretation. Determination of the Mo isotopic composition of Auburn as well as Bellsbank and Twannberg is in process.

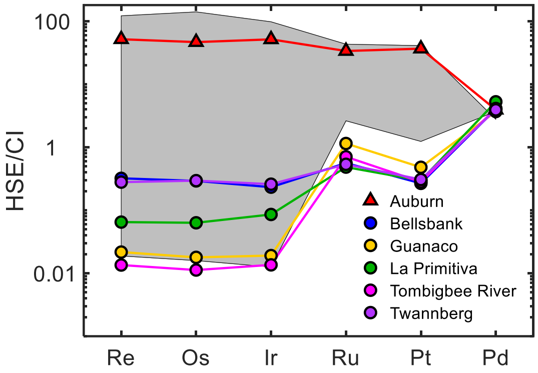

Figure 3. CI-normalized HSE abundances of the IIG iron meteorites shown with a range of IIAB HSE abundances (grey) [7].

Guanaco, La Primitiva, and Tombigbee River fall off the IIAB isochron, which likely indicates open-system behavior for these meteorites. These meteorites are also characterized by the lowest concentrations of Re and Os, and, therefore, were likely the last IIG irons to crystallize.

The IIG iron meteorites share some chemical similarities and have some key differences with IIAB HSE compositions. The IIG irons overlap with the range of Re, Os, and Ir concentrations observed among depleted IIAB irons, however, they have lower Ru and Pt concentrations (**Fig. 3**). If the IIG iron meteorites are found to be genetically identical to the IIAB iron meteorites, crystallization models involving liquid immiscibility will be assessed to determine whether the samples could form in the IIAB core.

Conclusions: Auburn (ASU) is chemically distinct from the IIG iron meteorites, indicating that it should not be considered a IIG iron. It is chemically similar to some IIAB irons and may be a member of that group instead. The IIG iron meteorites are characterized by HSE patterns that differ from the IIAB irons, noticeably for Ru and Pt concentrations, which may be a result of immiscibility within the IIAB core, or may indicate that the IIG iron meteorites sample a different parent body from the IIAB iron meteorites. Molybdenum isotopic measurements of the IIG irons are underway to assess a potential genetic link to the IIAB irons.

References: [1] Wasson and Choe (2009) *Geochim. Cosmochim. Acta* **73**, 4879-4890. [2] Scott *et al.* (1973) *Geochim. Cosmochim. Acta* **37**, 1957-1983. [3] Wasson *et al.* (2007) *Geochim. Cosmochim. Acta* **71**, 760-781. [4] Walker *et al.* (2008) *Geochim. Cosmochim. Acta* **72**, 2198-2216. [5] Cook *et al.* (2004) *Geochim. Cosmochim. Acta* **68**, 1413-1431. [6] Horan *et al.* (2003) *Chem. Geol.* **196**, 5-20. [7] Dietderich and Walker (2012) *LPSC XLIII*, Abstract #1195.

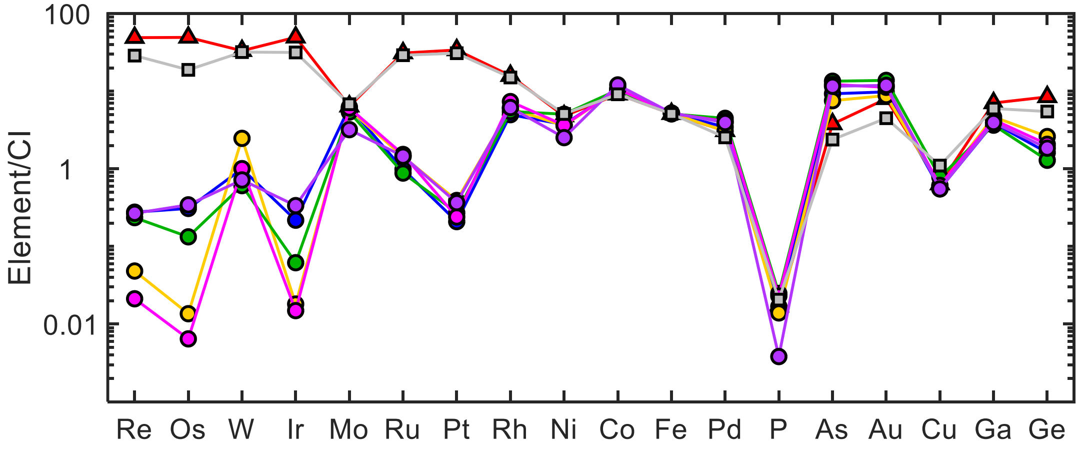

Figure 4. CI-chondrite normalized siderophile element concentration patterns for the IIG iron meteorites with Coahuila (IIAB iron; grey square) shown for reference. The symbols are the same as previous. The chemical composition of Auburn (ASU) is broadly similar to Coahuila.