COMPOSITION OF METALLIC CORES IN THE EARLY SOLAR SYSTEM. Nancy L. Chabot[1], [1]Johns Hopkins University Applied Physics Laboratory, 11100 Johns Hopkins Rd, Laurel, MD, 20723, USA. Nancy.Chabot@jhuapl.edu

Introduction: Magmatic iron meteorites are believed to be samples of the central metallic cores of asteroid-sized bodies that formed in the early Solar System. With 11 magmatic groups identified in our meteorite collections, we have the opportunity to examine the diversity of early Solar System cores. In addition, recent work [1] has identified isotopic signatures in iron meteorites that suggest that they formed in two distinct reservoirs in the early Solar System: one with similarities to carbonaceous chondrites (CC type) and the other with similarities to other meteorites (NC type, noncarbonaceous). The two reservoirs have been proposed to be separated by Jupiter, thus representing inner and outer Solar System formation regions [1]. Here I investigate the different magmatic iron meteorite groups, to examine for compositional differences between CC and NC types, and to apply new trace element partitioning results [2] to determine the variability of the bulk composition of metallic cores in the early Solar System.

Magmatic Iron Meteorite Groups: The 11 magmatic iron groups are shown on ***Fig. 1***, colored by their classification as CC or NC type [1]. For the IIG group, the isotopic data do not exist to make such a classification, but previous work has suggested that the IIG and IIAB irons formed in the same core [3], which would predict a NC type for the IIG group. As seen on ***Fig. 1a***, there is not a clear distinction between the NC and CC types in regards to their abundance of volatile elements, as Ge exhibits orders of magnitude variation among iron groups because of its volatility, but this is not correlated with the NC or CC types.

In contrast, ***Fig. 1*** does show suggestive evidence of an oxidation distinction between the NC and CC types, as recorded by the Ni content of the groups. More reduced asteroidal bodies will support having more Fe in its reduced form, and hence more Fe in the metallic core, effectively lowering the core's Ni concentration [4]; more oxidized bodies will have more Fe as FeO, resulting in higher Ni concentrations in the core. Thus, NC iron meteorite parent bodies may have been more reduced relative to CC iron meteorite parent bodies. If the NC and CC groups sample inner and outer Solar System formation regions, respectively, then more oxidizing conditions during core formation are suggested in the outer Solar System relative to the inner Solar System.

Bulk Core Compositions: As seen on ***Fig. 1***, magmatic iron meteorites show well-defined fractional crystallization patterns in elemental concentrations. Thus, measurements of an individual magmatic iron meteorite do not represent the bulk composition of the asteroidal core. Modeling of the crystallization trend is needed to determine the bulk composition, and knowledge of each element's solid-metal/liquid-metal partitioning behavior is needed to calculate such models.

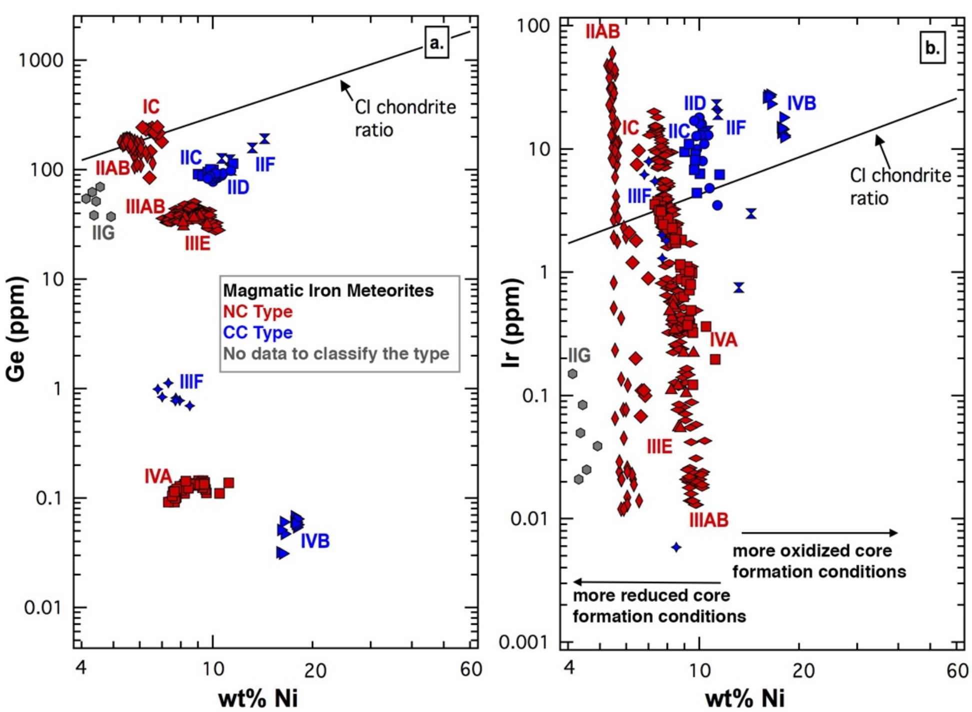

Figure 1. The 11 known magmatic iron meteorite groups, plotted as **a.** Ge and **b.** Ir vs Ni. Groups are colored based on their classification of NC or CC type [1]. The isotopic data needed to classify the IIG group do not currently exist, but a genetic relationship between the IIAB and IIG groups has been suggested [3]. Iron meteorite data from the compilation in [12].

Recent work has produced a new, extensive set of parameterizations for the solid-metal/liquid-metal partition coefficients of multiple siderophile elements as a function of the S, P, and C content of the metallic liquid [2]. Those new parameterizations were used in a simple fractional crystallization model following the approach of [5] to calculate the bulk core compositions for six magmatic iron meteorite groups to date. The results are shown in ***Fig. 2*** and detailed briefly below, along with the major reference for the source of the iron meteorite data for each group that was used in the modeling:

- **IIIAB** [6] – bulk Ni of 7.3 wt%; minor depletion of volatile elements; good agreement with previous study [7] except for Sb, which has more extensive partitioning data since the work of [7].
- **IID** [8] – bulk Ni of 11.7 wt%; minor enrichment of HSEs; minor depletion of volatiles; good agreement with previous study [8] except for Sb.
- **IVB** [9, 10] – bulk Ni of 17 wt%; minor enrichment of HSEs; strong depletion of volatiles; good agreement with previous study [9].
- **IVA** [7] – bulk Ni of ~8 wt%; uncertain initial S content, as discussed in [5], but bulk composition result is not greatly affected by two different S contents examined (4 and 9 wt% S), as shown in ***Fig. 2d.***; strong volatile depletion; good general agreement with previous study [7] except for Sb.
- **IIAB** [11] – bulk Ni of 5 wt%; slight enrichment of HSEs; largely chondritic element pattern; least volatile depleted of all the groups studied.
- **IIG** [3] – bulk Ni of 4.9 wt%; highly non-chondritic element pattern, consistent with the hypothesis of [3] that IIG irons represent only a part of a larger core that included the IIAB irons.

The combined results to date are shown in ***Fig. 2g***, which shows a range of volatility depletions for early Solar System cores but not a clear difference between the compositions of CC and NC groups. However, the calculated bulk Ni contents do support more oxidized core formation conditions for CC than NC parent bodies. Additional modeling is underway for the remaining five magmatic groups, to enable further comparisons.

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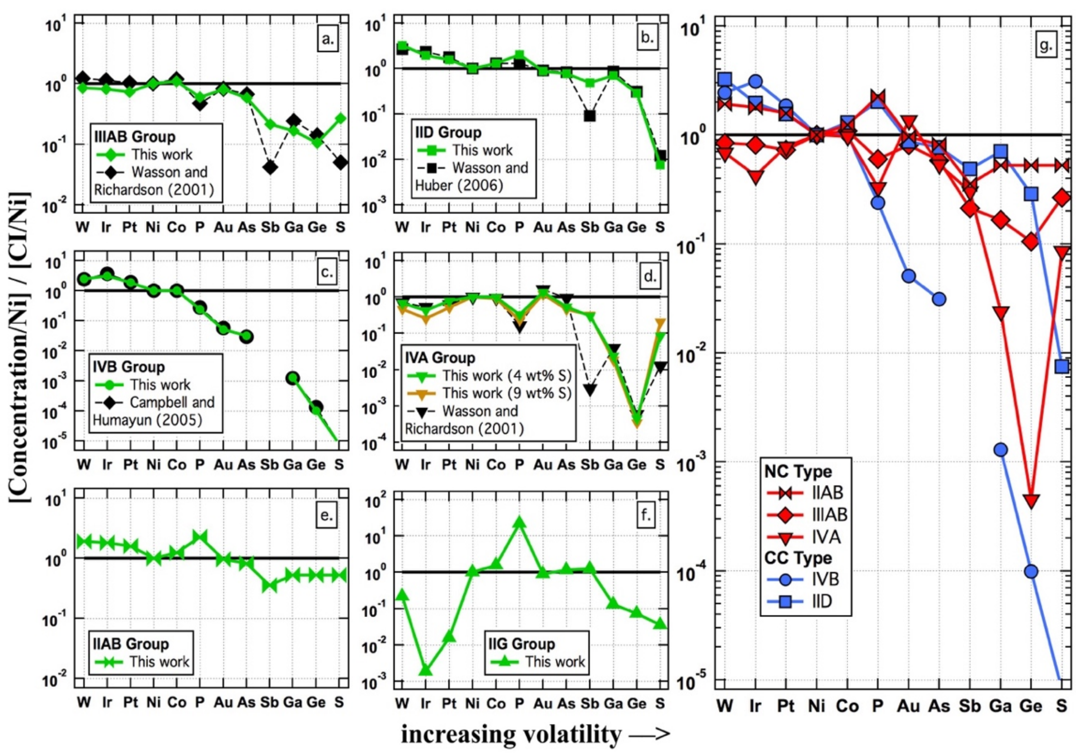

Figure 2. Bulk core composition results for six magmatic iron meteorite groups, with comparisons to previous studies: **a.** IIIAB, **b.** IID, **c.** IVB, **d.** IVA, **e.** IIAB, **f.** IIG. **g.** Combined results from this work, colored according to NC or CC.