EVIDENCE FROM OXYGEN ISOTOPES AND METAL CHEMISTRY FOR A COMMON PARENT BODY FOR H CHONDRITES AND IIE IRON METEORITES. Rachel S. Kirby[1], Penelope L. King[1] and Marc D. Norman[1] [1]Research School of Earth Sciences, The Australian National University, Acton ACT 2601, Australia

Introduction: The IIE iron meteorites and H chondrites have been linked by some authors [e.g. 1, 2], whereas others suggest that IIE irons are derived from an ordinary chondrite (OC) parent body that is further reduced and enriched in metallic iron compared to the H chondrite parent body [e.g. 3, 4]. Mo and Ru isotopic compositions for IIE irons overlap with OC values, which is interpreted to indicate formation of the IIE irons through impact melting of an OC parent body [5, 6]. IIE iron meteorites have a $\delta^{74/70}Ge_{metal}$ range that encompasses all OC values including H chondrites [7 and ref. within]. Here we present geochemical evidence that IIE irons formed on the H chondrite parent body under high-temperature, low-pressure, low-oxygen fugacity conditions.

Petrogenetic context: Peak temperatures vary amongst the IIE iron meteorite group; Miles cooled rapidly from >1160°C [8], whereas Netschaëvo reached temperatures of 920 - 1080°C [9]. Pressure during crystallization was <0.7 GPa [8]. IIE irons formed under highly reducing conditions (IW -1.43 to -2.09) [8].

Metal composition: Siderophile elements will mostly remain in the metal portion of meteorites during planetary processes such as differentiation and density separation, impact melting etc. Therefore, to examine relationships between meteorite groups we only compared analyses the metal portions and not bulk analyses. When the concentrations of Ni, Ga, Ge, Ir, Co, and Au in the metal portion of OCs are plotted on the iron meteorite classification diagram, the H chondrites overlap in composition with the IIE irons and Mont Dieu (ungrouped iron), whereas the other OCs form distinct clusters (Fig. 1). The Ge vs Ni and Ir vs Ni contents show a complete overlap of IIE irons and H chondrite metal, with Co vs Au showing close agreement. These elements are classified as moderately siderophile to highly siderophile elements [11], thus melting a H chondrite source under high-T, low-P, low-fO_2 conditions is expected to preserve the concentrations of these elements in the metal (IIE).

As a moderately siderophile element with a $(Ga_{BSE}/Ga_{CI})/(Fe_{BSE}/Fe_{CI})>1$ (where X_{BSE} = Bulk Silicate Earth abundance and X_{CI} = CI chondrite abundance) [11], Ga is found in both the metal and silicate of H chondrites [12]. However under high-T, low-P, low-fO_2 conditions the silicate:metal partition

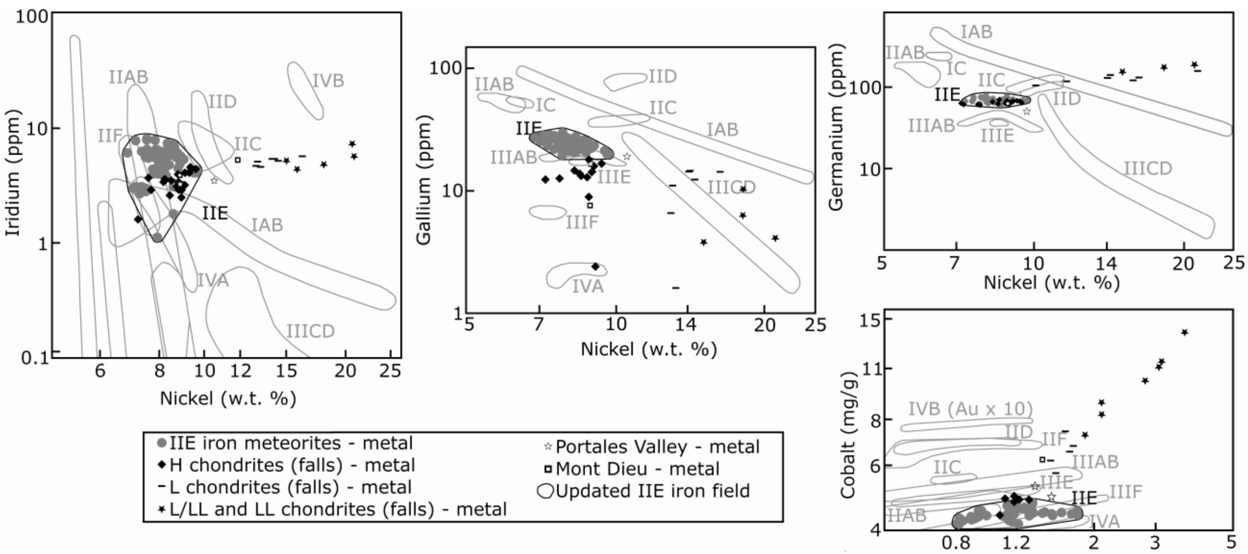

Figure 1: *Updated IIE fields incorporating all available data points on Ga vs. Ni, Ge vs. Ni and Ir vs. Ni graphs for iron meteorite classification adapated from [14] and Co vs. Au adapted from [15], with the metal portion of ordinary chondrite falls [7, 12, 16, 17] IIE iron meteorites [14, 18 - 25], the Portales Valley H6 chondrite [7, 24], and the Mont Dieu iron (ungrouped) meteorite [9, 24]. H chondrite compositions have a clear overlap with IIE iron meteorites and Mont Dieu, whereas their composition does not overlap with L or LL chondrites.*

coefficient is <1 [e.g. 13]. Thus the Ga hosted in H chondrite silicates will partition preferentially into the metallic melt, resulting in increased Ga concentrations in IIE irons relative to H chondrites. This is most consistent with H chondrites (not L or LL) as the source for Ga in IIE irons.

Oxygen isotopes: Oxygen isotopes are useful geochemical indicators to ascertain genetic relationships because each meteorite group has a distinct $\Delta^{17}O$ composition (Fig. 2). A two-sample t-test was performed to compare the $\Delta^{17}O$ for the H chondrites and IIE irons available in the literature [2, 7, 26-31]. For each ordinary chondrite meteorite group there is not a statistically significant difference between the falls and finds which rules out any issues with terrestrial contamination. For the rarer IIE irons there are insufficient falls to evaluate the role of terrestrial contamination. There is not a significant difference in $\Delta^{17}O$ between H chondrites (M=0.69, SD=0.11) and IIE irons (M=0.64, SD=0.12); $t(40) = 1.97$, p=0.056 (Fig. 2) (M = mean, SD = standard deviation, t(degrees of freedom) = t statistic, p = p value). There is a significant difference between H chondrites and L chondrites (M=1.05, SD=0.13), $t(113)=-17.69$, $p<.001$, and L chondrites and LL chondrites (M=1.19, SD=0.15), $t(79)=-4.89$, $p<.001$. In sum, the IIE irons and H chondrites cannot be differentiated on the basis of $\Delta^{17}O$ whereas the OC groups (H, L and LL) form statistically distinct isotopic groups.

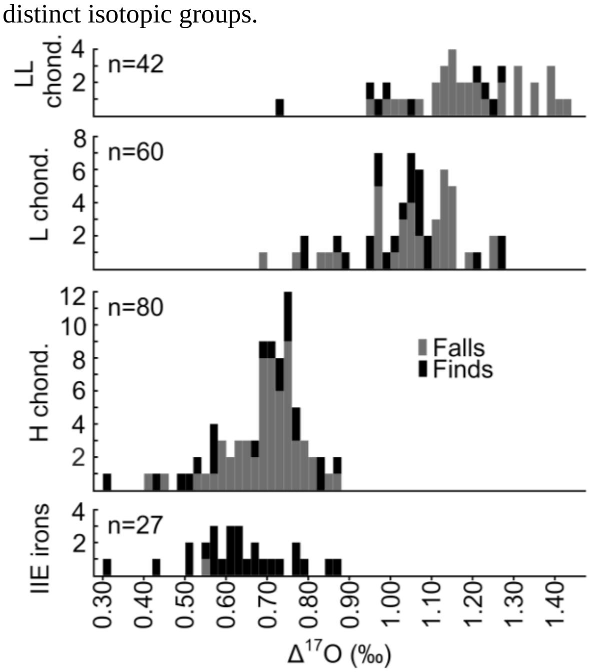

Figure 2: *Histogram of $\Delta^{17}O$ composition of LL, L and H chondrites and IIE iron meteorites (falls and finds). Each bar represents a 0.02‰ range. Data from [2, 15, 24-29].*

Conclusions: Based on the composition of the metal portion of meteorites there is significant overlap between the H chondrites and IIE irons in moderately-highly siderophile elements (Ir, Ni, Ge, Co and Au). Gallium vs nickel relationships in the IIE irons is consistent with melting of a H condrite precursor and not L or LL chondrites. There is a statistically valid correlation between $\Delta^{17}O$ for the H chondrites and IIE irons, but not the L or LL chondrites. The overlap between IIE irons and OC in other isotopes, e.g. Mo, Ru and Ge should be further assessed in future work. We propose that the IIE irons formed on the H chondrite parent body and our other work [5, 7] indicates that this occurred under high T (>1160°C), low P (<0.7 GPa) and low fO_2 (IW -1.43 to -2.09) in an impact event.

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