Goldschmidt 2026 Abstract
https://doi.org/10.46427/gold2026.38299

Iron isotope fractionation between IIAB and IIG irons: a record of liquid immiscibility?

KABIR S. DIWANSINGH, CORLISS KIN I SIO AND NEIL R BENNETT

University of Toronto

IIAB and IIG irons are thought to represent conjugate liquids from the same parental core, based on trace element systematics [1] and nucleosynthetic isotope anomalies [2]. We evaluate the possibility of this relationship using stable Fe isotope measurements. Our previous study shows that heavy Fe isotopes concentrate in the P-rich liquid (i.e., IIG) relative to the S-rich liquid (i.e., IIAB). At a molar P/S ratio of 0.5, the P-rich liquid is measured to be 0.07 ± 0.06 ‰ in Δ^{56}Fe heavier than the S-rich liquid [3]. We analyzed eight IIAB irons and all six IIG irons to test whether the same direction of fractionation can be resolved between these groups.

To achieve representative sampling, we used a dental drill bit to remove materials from large surface areas (several cm^2) of each iron meteorite. Due to the high abundance of chromite observed in Auburn (IIG), the milled powders were all dissolved in Parr bombs. Samples were purified for Fe and analyzed using a Neoma MC-ICPMS system at the University of Toronto. The IIG irons are slightly heavier but identical within uncertainty relative to the IIAB irons ($\Delta^{56}Fe_{IIG\text{-}IIAB}$ = 0.02 ± 0.02 ‰). The true IIG-IIAB fractionation, however, is expected to be higher given that the IIAB liquid is estimated to have ~17 wt.% S – an order of magnitude higher than that present in the meteorites [4]. Correction for this missing S would increase the IIG-IIAB Fe isotope fractionation. This direction of Fe isotope fractionation is consistent with that predicted from our immiscibility experiment. Our results therefore support IIAB and IIG irons originating from conjugate liquids in the same parental core.

[1] Wasson and Choe (2009) GCA, 73(16), 4879-4890.
[2] Anand et al. (2024) GCA, 382, 118-127.
[3] Bennett et al. (2026) Am. Min. 111(1), 118-127.
[4] Chabot (2004) GCA, 68(17), 3607-3618.