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Chemical and Isotopic Compositions of the IIG Iron Meteorites

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The IIG iron meteorite group is comprised of six members and is characterized by high P concentrations relative to the other iron meteorite groups. It has been proposed that this unique characteristic is the product of liquid immiscibility, which occurs when a metallic melt becomes increasingly enriched in light elements, such as S and P, eventually separating into two isolated immiscible liquids, one S-rich and one P-rich. It has been suggested that the IIG irons sample one such P-rich melt and that their S-rich counterpart is represented by the IIAB iron meteorites [1]. Chemical and isotopic data have been obtained for the six irons currently classified as members of the IIG group. Five of these irons exhibit broadly similar siderophile element patterns, consistent with a common parent body origin. Chemical data for the meteorite Auburn, however, indicates that it likely does not sample the same crystallization sequence as the other irons and should be reclassified as an ungrouped iron meteorite until an association to a group, if possible, can be made. Formation of the remaining five irons can otherwise be accounted for through crystal-liquid fractionation of a parent melt with an initial S concentration of 3 wt.% and a relatively high initial P concentration of 11 wt.%. The initial highly siderophile element (HSE) concentrations of the modeled parent melt are significantly depleted relative to those previously modeled for other magmatic iron meteorite groups [2]. The high P, low HSE crystallization model proposed here is consistent with the IIG irons forming via liquid immiscibility of an evolved melt. Molybdenum isotopic data indicate that the IIG irons belong to the non-carbonaceous (NC) suite of meteorites and overlap the Mo isotopic composition previously reported for the IIAB irons [3], further supporting a common parent body origin for the two groups.

[1] Wasson et al. (2009), GCA 73. [2] Hilton et al. (2022) GCA 318. [3] Spitzer et al. (2020), ApJL 898.