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Germanium isotopes reveal distinct processes of MVE depletion among planetesimals

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MVE depletion is a key characteristic of planetary materials, but its origin is unclear. To investigate the relative importance of nebular vs. planetary volatile depletion processes, we studied the mass-dependent isotopic composition of the MVE Ge in chondrites and iron meteorites. Chondrites exhibit Ge isotope fractionations, which correlate with matrix mass fraction and Ge depletion, indicating mixing between volatile-rich, isotopically heavy matrix and volatile-poor, isotopically light chondrules. Despite much larger Ge depletions, iron meteorites exhibit a similar range of Ge isotope fractionations as chondrites, indicating that the MVE depletions among irons cannot simply result from degassing of CI-like starting materials. Instead, these systematics likely reflect two stages of MVE depletion. The first stage took place in the solar nebula and, like for the chondrites, involved mixing of volatile-rich and volatile-poor precursor components. The second stage occurred on the iron parent bodies and involved degassing from molten iron cores, after collisional disruption of the parent bodies. Thus, both primordial nebular and secondary planetary volatile loss shaped the MVE budgets of differentiated planetesimals.

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