Genetic heritage and chronology of ungrouped iron meteorites

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Nucleosynthetic Mo isotope anomalies revealed a fundamental dichotomy in the genetic heritage of meteorites, distinguishing between *non-carbonaceous* (NC) and *carbonaceous* (CC) materials [1]. In conjuction with age constraints, this dichotomy has led to major advances in our understanding of early Solar System dynamics [*e.g.*, 2]. These studies mainly relied on samples from the major meteorite groups, representing a total of ~15 undifferentiated and ~20 differentiated parent bodies. However, this number is small, when compared to the 283 meteorites currently listed as ungrouped, which–taking potential pairings into account–represent an additional ~150 parent bodies. Given the considerable potential of this untapped sample reservoir for better constraining early Solar System dynamics, we conducted a systematic study on ungrouped iron meteorites, with the ultimate goal to better constrain their genetic heritage and chronology.

All analyzed ungrouped irons exhibit well-resolved nucleosynthetic Mo isotope anomalies, which fall within the known range of anomalies from previously analyzed bulk meteorites. In a diagram of ε^{95}Mo vs. ε^{94}Mo, the ungrouped irons plot on one of the two distinct *s*-process mixing lines defined by NC and CC reservoirs [3]. Their pre-exposure ε^{182}W values indicate that metal-silicate separation occurred between ~0.5 and 4 Ma after formation of Ca,Al-rich inclusions (CAIs).

Collectively, the new data confirm the fundamental dichotomy between CC and NC materials for an additional ~20 different parent bodies. The ungrouped irons thus support the notion of an efficient separation of two genetically distinct source regions of planetesimals in the early Solar Nebula [3]. The most plausible mechanism for such an efficient separation over several millions of years is the early formation of Jupiter, which acted as a barrier against exchange of material between the NC (inside Jupiter's orbit) and CC reservoirs (outside Jupiter's orbit) [2,3].

[1] Warren P. H. (2011) *EPSL*, 311, 93-100. [2] Kruijer T. S. *et al.* (2017) *PNAS*, 114, 6712-6716. [3] Budde G. *et al.* (2016) *EPSL*, 454, 293-303.