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Neutron capture effects on Pt isotopes and the Hf-W chronometry of iron meteorites

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The Hf-W chronometry of magmatic iron meteorites indicates that small planetary bodies segregated their cores very early in the history of the solar system, but neutron capture induced W isotope shifts in iron meteorites [1,2] currently complicate an accurate and precise determination of the core formation time scales [e.g., 3]. Only if cosmic-ray effects are accounted for using an independent correction monitor, can the timing of core formation in the parent bodies of magmatic iron meteorites be accurately constrained to within less than $\sim$ 1 Myr [3,4]. Being more sensitive to neutron capture reactions in the (epi)thermal energy range than W, isotopes of Pt might be a powerful monitor for cosmic-ray effects on W isotopes in iron meteorites. The present study, therefore, concentrates on combined high-precision Pt and W isotope analyses of group IID, IVA and IVB iron meteorites. Selected meteorite samples were dissolved in HNO_3:HCl and aliquots were taken for Pt and W isotope analyses. The purification of Pt involved solvent extraction of Os from reverse aqua regia into CCl4 [5] and ion exchange chromatography [6]. Platinum isotopes were measured using a ThermoScientific Neptune Plus® MC-ICPMS at the University of Münster. The Pt isotope anomalies observed for all studied iron meteorite samples are interpreted to result from neutron capture reactions that occurred during cosmic-ray exposure of the iron meteoroids. The correlated Pt and W-182 isotope anomalies found for these samples were used to obtain W isotope compositions for the IID, IVA and IVB iron meteorite groups that are unaffected by neutron capture. The resulting pre-irradiation, radiogenic W-182 isotope anomalies are identical for these iron meteorite groups, indicating that the associated parent bodies segregated their cores concurrently. The Hf-W results for iron meteorites presented here, combined with a recently revised initial W isotope composition of CAI [7], suggest that core formation in these planetesimals occurred around 2 Myr after CAI formation.

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