HAFNIUM-TUNGSTEN CHRONOMETRY OF WEAKLY IRRADIATED IRON METEORITES

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Introduction: Previous Hf-W studies revealed some iron meteorites to be as old as Ca,Al-rich inclusions, the oldest known objects formed in the solar system [1-3]. However, minor cosmic-ray induced W isotope variations [4,5] may at least in part be responsible for the old apparent ages of some iron meteorites [1-3;7-9]. Thus, determining reliable Hf-W ages for iron meteorites requires a quantification of cosmic-ray induced effects on W isotopes or preferably the identification of specimens that have been effectively shielded from any cosmic-ray induced nuclear reactions. Cosmic-ray produced noble gas abundances might provide a suitable monitor for the degree of cosmic-ray exposure and shielding conditions [6,7]. We here report data of a combined Hf-W and noble gas study that aims to better constrain the pristine Hf-W systematics and the differentiation ages of magmatic iron meteorites.

Methods: After careful cleaning and the separation of W using conventional anion exchange chromatography, W isotope compositions were measured using a Nu Plasma MC-ICPMS at ETH Zurich using previously published procedures [1]. The $^{182}W/^{184}W$ compositions of the iron meteorites are reported as ε-unit deviations relative to a terrestrial W standard that was analysed bracketing the sample analyses. Reported are mean values of multiple solution replicates (n=5-8) and their associated 95%-confidence limits. Cosmogenic noble gas ($^{3,4}He$, $^{21,22}Ne$ and ^{38}Ar) abundances of the same iron meteorite samples were determined at the University of Bern.

Results and Conclusions: Measured cosmogenic noble gas abundances are very low for iron meteorite standards and generally well correlated; ^{3}He concentrations range from 0 to 0.57, ^{21}Ne from 0 to 0.02, and ^{38}Ar from 0.002 to 0.08 [all in 10^{-8} cm^3STP/g]. Tungsten isotopic compositions were determined for the four samples having the lowest abundances of cosmogenic noble gases [Cape York (IIIA), Gibeon (IVA), Muonionalusta (IVA), Edmonton (IIA)]. These samples have $\varepsilon^{182}W$ values ranging from -3.3 to -3.2, indistinguishable from the CAI initial of -3.28±0.12 [8]. The lack of W isotopic compositions that are significantly less radiogenic than the initial W isotope composition of CAIs justifies our combined approach and suggests that any $\varepsilon^{182}W$ values lower than the CAI initial are caused by the interaction with cosmic rays. The W isotope results are compatible with iron meteorite parent bodies having differentiated within <1 Myr after CAI formation [1,8,9].

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