A new decay constant for $^{184}$Os and evidence for p-process heterogeneity of $^{180}$W in iron meteorites

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Introduction: Variations in $^{180}$W occur in iron meteorites from a wide range of magmatic groups; however, their origin is debated. Excess $^{180}$W has been ascribed to p-process heterogeneity in the nebula [1], radioactive decay of $^{184}$Os [2], and spallogenic production from exposure to galactic cosmic rays (GCR) [3]. Five IIAB irons were chosen from different positions in the crystallization sequence [4] to determine the magnitude of the relative contributions to $^{180}$W excesses from the various proposed sources.

Methods: Tungsten isotopes were measured by MC-ICPMS at ETH Zürich [5]. Noble gases were measured at the University of Bern [6]; cosmogenic radionuclide analyses were carried out at the DREAMS facility in Dresden [7]. Trace element concentrations were determined at the University of Maryland [8]. The model for GCR effects on W isotopes [3,9] was improved to include spallation effects from Pt and Ir.

Results and Discussion: CRE ages, based on $^{36}$Cl-$^{36}$Ar, were used with trace element concentrations (Os, Re, Ir, Pt, W), measured $\varepsilon^{180}$W and $\varepsilon^{182}$W values, and our new GCR model to correct $\varepsilon^{180}$W values for effects from neutron capture and spallation reactions. The corrected values correlate with Os/W ratios and define a decay constant for $^{184}$Os of $(2.22 \pm 1.10) \times 10^{-14} \text{ a}^{-1}$, a value smaller than previously suggested [2,3]. The isochron intercept ($\varepsilon^{180}$W$_i = 0.64 \pm 0.35$) differs significantly from the terrestrial value and provides the first cogent evidence for p-process variability in W isotopes in the early solar system.