TUNGSTEN ISOTOPES AND THE TIME-SCALES OF PLANETARY ACCRETION. A. N. Halliday[1], G. Quitté[1] and D-C. Lee[2], [1] ETH Zürich, Dept. of Earth Sciences, 8092 Zürich, Switzerland (halliday@erdw.ethz.ch), [2] Academica Sinica, Institute of Earth Sciences, Taipei 115, Taiwan.

Hafnium-tungsten chronometry is critically dependent on knowledge of the initial W isotopic composition of the bulk solar system (or $\varepsilon^{182}W_{BSSI}$). The difference between this and the present day W isotopic composition precisely redefined with new data [1] for carbonaceous chondrites at $\varepsilon^{182}W = -1.9\pm0.1$ relative to the silicate Earth, provides the most reliable current constraints on the initial Hf isotopic composition of the solar system or $(^{182}Hf/^{180}Hf)_{BSSI}$. The least radiogenic W isotopic compositions have been found in iron meteorites [2,3] and provide evidence that the $(^{182}Hf/^{180}Hf)_{BSSI}$ is $\geq (2.1\pm0.7)\times10^{-4}$. Recently these data have been called into question [4] in support of the proposition that the $(^{182}Hf/^{180}Hf)_{BSSI}$ is closer to 1.0×10^{-4} [1,5]. We have re-determined the W isotopic compositions of several iron meteorites using N-TIMS and MC-ICPMS and find a spread in values, consistent with parent body accretion over millions of years and extending to $\varepsilon^{182}W \sim -4.0$ for Tlacotopec and Arispe. There are no resolvable nucleosynthetic or cosmogenic effects; the results hold independent of the normalization scheme deployed. The implied $(^{182}Hf/^{180}Hf)_{BSSI}$ is $\geq (1.4\pm0.2)\times10^{-4}$. This estimate is easier to reconcile with W isotope data for the Earth [1,5,6], Moon [7], Mars [8] and Vesta [9].

It is a common misconception that the W isotope composition of the silicate Earth defines an age of terrestrial core formation. This is only likely to be true for rapidly formed objects and even then the duration is unconstrained. In objects like Earth the protracted time-scales of accretion limit W isotopic effects [10,11]. The same holds for U-Pb [10]. With $\varepsilon^{182}W_{BSSI} = -4.0$ the mean life of accretion assuming exponentially decreasing rates is 13 Myrs. The W isotopic data for the Earth and Moon are consistent with an age for the Giant Impact of ~ 40 to 45 Myrs. Though longer than recently proposed [1,5] these time-scales are shorter than obtained from Pb isotope modeling. The values obtained from most recent estimates of the Pb isotopic composition of the silicate Earth are >15 Myrs for the mean life and > 45 Myrs for the Giant Impact. This apparent discrepancy might reflect the relative rates of refractory W versus volatile Pb isotopic equilibration during accretion. The spread in published W isotope data for martian meteorites also is more readily explained if the $(^{182}Hf/^{180}Hf)_{BSSI}$ is $\geq (1.4\pm0.2)\times10^{-4}$ given the low Hf/W of the martian mantle. The time-scales for accretion and differentiation still have to be rapid ($<10^7$ years). The W isotope data for eucrites indicate that the time-scales for the accretion and differentiation of Vesta are $\sim10^7$ years, consistent with other isotopic data.

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