Martian core formation:
Implications from the Hf–W system

Matthew C. Brennan[1]*, Rebecca A. Fischer[1],
Francis Nimmo[2], and David P. O'Brien[3]

[1]Harvard University, Dept. of Earth and Planetary Sciences
[2]University of California Santa Cruz, Dept. of Earth and
    Planetary Sciences
[3]Planetary Science Institute
*Correspondence: mcbrennan@g.harvard.edu

The extinct hafnium–tungsten (Hf–W) radioisotopic system, which is sensitive to the timing and conditions of core formation, is a common geochemical proxy for determining the differentiation timescales of terrestrial bodies. Previous work has shown that Mars accreted and differentiated rapidly, perhaps within 1–3 Myr of solar system formation [1–2]. Many such studies rely on highly simplified core formation models, usually with a single metal segregation event at a fixed time. Accretion and core formation, however, are highly stochastic processes, so *N*-body simulations have also been used to explore the implications of Hf–W geochemistry for the dynamics of Martian formation [3–4].

In this study, we will couple additional sets of such simulations [5–6] with a more realistic model of Martian core formation [7] to self-consistently track the full bulk chemistry and Hf–W evolution of Mars, similar to our recent work for the Earth [8]. One significant advantage of this method is that we are able to include the evolution of D_W (the metal/silicate partition coefficient of W) as Mars accretes. The siderophile tendency of W decreases at high pressures, oxygen fugacities, and sulphur contents [9], all of which were present during Martian core formation, possibly altering the evolution of $\varepsilon^{182}W$.

Preliminary findings using homogenous accretion are consistent with previous suggestions that the geochemically-determined Martian Hf/W ratio and $\varepsilon^{182}W$ arise because Martian core formation occurred early and with a relatively lower D_W compared to Earth [2]. The exact timescale implied by these parameters depends on the details such as the provenance of impactors and their degree of equilibration.

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