Hf-W chronology of the Brenham pallasite

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Pallasites are stony-iron meteorites consisting mainly of huge olivine and FeNi metal coexist. The formation process of the pallasite meteorites has been investigated from the petrological and chemical data, but it is still enigmatic. There are two major hypotheses for the formation mechanism: (i) fractional crystallization of olivine at the core-mantle boundary on their parent bodies [1] and (ii) metal-silicate mixing generated by a catastrophic impact [2]. Determining the precise ages of the pallasites and, more preferably, their constituent phases, is key to constraining the formation process and the nature of the parent bodies.

In this study, Hf-W isotopic analyses have been performed on metal, olivine, and non-magnetic fractions of Brenham, a main group (MG) pallasite. The metal fraction yielded an $\varepsilon^{182}W$ value of -3.52 ± 0.26 relative to a standard solution NIST SRM 3163, which is within the range of previously reported $\varepsilon^{182}W$ values for MG pallasite metals [3]. Taking into account the possible effect of neutron capture as well as nucleosynthetic anomaly, the $\varepsilon^{182}W$ value of the Brenham metal fraction corresponds to a model age of -0.22 +2.94/-3.34 Myr after the CAI formation. This indicates that the differentiation on the MG pallasite parent body had occurred within the first 2.7 Myr of the solar system history. We further reveal that the olivine and non-magnetic fractions yielded substantially higher $\varepsilon^{182}W$ values and Hf/W ratios than the metal fraction. Extrapolating an internal isochron using the metal and olivine fraction data yields an age older than the CAIs. This unrealistically old isochron age would be attributed to the apparent increase of ^{182}W in the olivine fractions due to neutron capture. Such neutron capture effect on the $\varepsilon^{182}W$ values can be potentially corrected by analyzing Hf stable isotopes in the fractions, which is in progress.

[1] Boesenberg *et al.* (2012) *Geochim. Cosmochim. Acta*, **89**, 134-158. [2] Yang *et al.* (2010) *Geochim. Cosmochim. Acta*, **74**, 4471-4492. [3] Quitté *et al*. (2005) *Geochim. Cosmochim. Acta*, **69**, 1321-1332.