Hf-W chronology of the pallasite Brenham

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Pallasites are stony-iron meteorites consisting mainly of rounded olivine and metal. The formation process of the pallasite meteorites have been investigated from the petrological and chemical data, but it is still enigmatic. Two major hypotheses are considered: (i) fractional crystallization of olivine at core-mantle boundary on their parent bodies and (ii) metal-silicate mixing generated by a catastrophic impact. Determining the precise age of the pallasites and, more preferably, their constituent phases, are 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. Taking into account the effects of neutron capture and nucleosynthetic anomaly, the ε^{182}W value of the Brenham metal fraction is determined as -3.43 +0.23/-0.30. The tungsten isotopic value of Brenham metal corresponds to a model age of -0.22 +2.94/-3.34 Myr after the CAI formation. The result 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 ε^{182}W value 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 age would be attributed to the apparent elevated ε^{182}W values of the olivine fractions due to neutron capture. Such neutron capture effect on the ε^{182}W values can be potentially corrected by analyzing Hf stable isotopes in the fractions.

Keywords: stony-iron meteorite, Hf-W chronology, core-mantle differentiation

