

Pd-Ag evidence for rapid cooling of the IIIAB iron meteorite parent body

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We applied the short-lived ^{107}Pd - ^{107}Ag system ($t_{1/2} = 6.5$ Ma) [1] to a suite of early- to late-crystallized IIIAB iron meteorites to constrain the cooling history of their parent body. Because exposure of the iron meteoroids to galactic cosmic rays can modify the Ag isotopic composition [2], we used Pt isotopes as an independent neutron-dose proxy and developed a model linking this to the effects on $^{107}\text{Ag}/^{109}\text{Ag}$. The IIIAB irons investigated for this study are Boxhole, Cape York (Agpalilik), Grant and Henbury. After dissolution, three different aliquots were taken for the determination of Pd and Ag concentrations and Pt isotope compositions. Ion exchange procedures were adopted and slightly modified from [3] [4]. All measurements were performed on the Thermo Scientific[®] Neptune *Plus* MC-ICPMS in Münster.

With the exception of Cape York, all samples exhibit well-resolved Pt isotope anomalies, indicating significant neutron capture effects. After correction for these effects, Pd-Ag isochrons are obtained for all investigated irons. The initial $^{107}\text{Pd}/^{108}\text{Pd}$ inferred from the isochrons are indistinguishable from each other and correspond to Pd-Ag ages between ~ 3 and ~ 5 Ma relative to an inferred solar system initial of $(3.1 \pm 0.5) \times 10^{-5}$ [5] [6].

The Pd-Ag ages thus obtained indicate cooling of the IIIAB metal core below the Pd-Ag closure temperature at ~ 4 Ma after CAI formation. Assuming the core was surrounded by an insulating mantle, such rapid cooling would indicate a small parent body with a radius of ~ 10 km. However, large variations in metallographic cooling rates [7] appear inconsistent with this scenario. They were interpreted to indicate removal of the mantle in a hit-and-run collision [7], which would have exposed the IIIAB metal core to space, facilitating a rapid and simultaneously heterogeneous cooling of a much larger metal core. If the cooling history of the IIIAB irons reflects mantle removal by such a collision, then the Pd-Ag ages date this event at ~ 4 Ma after CAI formation.

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