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# Tungsten and molybdenum isotopic evidence for an impact origin of pallasites

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The origin of pallasites—stony-iron meteorites mainly composed of olivine and Fe-Ni metal—is debated and proposed formation scenarios broadly range from models that explain pallasite formation by internal processes in the mantle of a differentiated planetesimal to those that involve impact–induced mixing of core and mantle materials [1-4]. Here, the origin of pallasites is examined by studying the nebular source regions of their precursor material using Mo isotopes and their history of metal-silicate segregation using Hf-W chronometry. We report new Mo and W isotopic data for a large suite of pallasite metal samples, alongside Pt isotope data to quantify superimposed cosmic ray exposure effects. Most main-group pallasites exhibit uniform pre-exposure $^{182}$W and Mo isotopic compositions that bear an excellent similarity to those of IIIAB iron meteorites. Four main-group pallasites and the IIIAB iron Thunda have more radiogenic pre-exposure $^{182}$W compositions, but display the same Mo isotopic composition as other main-group pallasites and IIIAB irons. This strong chronological and genetic link strongly suggests that main-group pallasite metal originated in the IIIAB parent body core. This, combined with prior Pd-Ag chronometric evidence for an early collisional disruption of the IIIAB parent body [5], implies that main-group pallasites formed by impact–induced mixing of metal and silicates rather than by an internal process on the IIIAB parent body. This mixing led to elevated $^{182}$W compositions in some pallasites, which are best accounted for by partial re-equilibration of IIIAB metal with radiogenic $^{182}$W from the colliding body. Collectively, our results support models that explain main-group pallasite formation by injection of pallasite metal into the mantle of another differentiated body, implying that pallasite silicates did not primarily derive from the IIIAB mantle, but instead from that of the colliding body.

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