Coupled Sm-Nd, Lu-Hf, ^{142}Nd and ^{182}W study of Mt. Ada Basalt, East Pilbara Terrane, Western Australia

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The study of short- and long-lived radiogenic isotope systems in mantle-derived rocks is a powerful tool for investigating the evolution of the Earth's mantle. Here, we present Lu-Hf, Sm-Nd, ^{142}Nd and ^{182}W results for rock samples of the Doolena Gap greenstone belt (East Pilbara Terrane, Western Australia). The samples are metavolcanic rocks with tholeiitic-like affinities and affected by low greenschist facies metamorphism. Whole-rock Lu-Hf and Sm-Nd isochrons yield, respectively, 3485 ± 48 Ma and 3469 ± 28 Ma, consistent with U-Pb zircon ages of 3449 and 3470 of a felsic schist found within the Mount Ada Basalt [1]. These similar ages suggest both Lu-Hf and Sm-Nd isotope systems have remained closed since the crystallization of the rocks. Initial Nd and Hf isotope compositions of εNd= +0.7 ± 1.3 and εHf= +2.3 ± 0.5 suggest the mantle source of these rocks evolved with chondritic to slightly suprachondritic Sm/Nd and Lu/Hf ratio. High-precision Nd isotope results of eight samples resulted in μ^{142}Nd values between -3.3 ± 3.8 and +6.2 ± 3.7, indistinguishable from the JNdi-1 Nd standard measured with a ± 3.6 ppm precision. Results obtained here add an important constraint on Earth's mantle homogenization by ~ 3.5 Ga. Two samples measured for high-precision W isotope compositions yielded positive ^{182}W anomalies of +15.3 ± 4.6 and +13.1 ± 4.1. The cause of the ^{182}W anomalies is still debated, and hypotheses include early (< 50 Ma) silicate or metal-silicate differentiation, mantle source isolation from late accreted meteoritic components, or W isotope modification of the mantle due to core-mantle interactions throughout Earth's history. Our results imply that the short-lived ^{146}Sm-^{142}Nd and ^{182}Hf-^{182}W system are decoupled in the source of the Pilbara rocks, possibly ruling out early-silicate differentiation.

[1] Thorpe et al. (1992) *Precambrian Res.* 56, 169-189.