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

H. Rizo¹, D. Murphy², J. O’Neil³, A.I.S. Kemp⁴, J.D. Vervoort⁵

¹Dept. of Earth Sciences, Carleton University, Ottawa, ON, Canada; hanika.rizo@carleton.ca
²Queensland University of Technology, Brisbane, QLD, Australia; david.murphy@qut.edu.au
³Dept. of Earth and Environmental Sciences, University of Ottawa, Ottawa, ON, Canada; jonathan.oneil@uottawa.ca
⁴School of Earth Sciences, University of Western Australia, Crawley, Australia; tony.kemp@uwa.edu.au
⁵School of the Environment, Washington State University, Pullman, USA; vervoort@wsu.edu

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 $\varepsilon_{\text{Nd}} = +0.7 \pm 1.3$ and $\varepsilon_{\text{Hf}} = +2.3 \pm 0.5$ 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 $\mu^{144}$Nd values between -3.3 ± 3.8 and +6.2 ± 3.7, indistinguishable from the JNd1-1 Nd standard measured with $a \pm 3.6$ 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 $^{150}$Sm-$^{142}$Nd and $^{182}$Hf-$^{182}$W system are decoupled in the source of the Pilbara rocks, possibly ruling out early-silicate differentiation.