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Combined ^{142}Nd and ^{182}W systematics of Neoarchean rocks from the Yilgarn Craton, W-Australia

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The short-lived radiogenic ^{146}Sm-^{142}Nd and ^{182}Hf-^{182}W decay series can place important constraints on early Earth processes. While most modern rocks are largely homogeneous in their ^{142}Nd/^{144}Nd and ^{182}W/^{184}W isotope compositions, isotope anomalies of ^{142}Nd and ^{182}W were frequently observed in Archean rocks, revealing that the parent/daughter nuclides of these short-lived decay series must have been fractionated during their lifetime. Interpreting the origin of these anomalies hinges on a comprehensive characterization of the mantle reservoirs involved and the identification of possible biases, like metasomatic fluids and crustal contaminants.

Here, we present new high-precision ^{182}W/^{184}W and ^{142}Nd/^{144}Nd isotope data using previously published MC ICP-MS protocols [1,2] for Neoarchean samples from the Yilgarn Craton, W-Australia. For better characterization, we also investigated long-lived ε^{143}Nd-ε^{176}Hf isotope systematics, as well as trace element, and high-precision HFSE concentrations. Isochron approaches for 2.7 Ga old mafic to ultramafic samples from the Kalgoorlie Terrane reveal that ^{147}Sm-^{143}Nd and ^{176}Lu-^{176}Hf systematics remained pristine. A suite of 2.7 Ga old mafic samples from the Kambalda area shows small but resolvable μ^{142}Nd variations (+0.4±1.2 to -1.5±0.9) that correlate positively with ε^{143}Nd. When interpreted as differentiation model age, this correlation reveals a source differentiation no earlier than 4.12 Ga. We found resolvable μ^{182}W excesses of +4.5±1.6 and +5.3±3.6 in mafic-ultramafic rocks from the Kambalda and Kalgoorlie suites, respectively, that do not correlate with μ^{142}Nd values. In conjunction with previously reported ε^{100}Ru excesses observed in the same samples [3] we interpret the observed μ^{182}W excesses to reflect incomplete homogenization of late veneer in Kambalda mantle sources at 2.7 Ga, in line with similar observations from near-contemporaneous komatiites from Canada [4]. Our Yilgarn TTGs show uniform μ^{182}W excesses of +9.0±1.1, in line with previous data [5]. Paleoarchean ^{143}Nd-^{176}Hf model-ages reflect an ancient source for the TTGs and suggest the inheritance and long-term preservation of ^{182}W excesses from their precursor rocks.

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[3] Fischer-Gödde et al. (2021) Goldschmidt Abstract 4362
[4] Puchtel et al. (2018) GCA 228, 1-26
[5] Stubbs et al. (2020) Goldschmidt Abstract 2476