Goldschmidt 2025 Abstract
https://doi.org/10.7185/gold2025.31276

Timing of the global decrease in the $^{182}W/^{184}W$ of the accessible silicate Earth

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The ^{182}Hf-^{182}W decay system ($t_{1/2}$=8.9 Ma) is a powerful tool for tracking the history of convection in the Earth's mantle. Many Archean samples show $^{182}W/^{184}W$ compositions that are ~10ppm more radiogenic than modern continental crust and the upper mantle. This implies that substantial unradiogenic material has been stirred into the upper mantle some time since the Archean. To account for this observation, several hypotheses have been proposed, e.g. addition of late veneer materials [1], early silicate differentiation [2], or core-mantle interaction [3].

The timing and rate of change of $^{182}W/^{184}W$ from elevated to modern values can provide clues on the process involved but both currently remain uncertain. Previous studies suggest that radiogenic $^{182}W/^{184}W$ ratios persisted in the upper mantle until at least 2.4 Ga [4,5], while a 2 Ga granite from Guernsey provides a tentative first marker of modern crustal values [1]. However, the sample coverage from the period between ~2.4 and ~1 Ga is sparse, making the exact timing and style of the change in $^{182}W/^{184}W$ ratios difficult to constrain.

To address this problem, we present high-precision $^{182}W/^{184}W$ data from crustal and mantle-derived rocks of 4 different Proterozoic orogens: Birimian Orogen (West Africa; 2.20–2.09 Ga), Halls Creek Orogen (northern Australia; 1.85 Ga), Svecofennian Orogen (southern Sweden; 1.88–1.80 Ga), and Sveconorwegian Orogen (southern Sweden; 1.73–1.22 Ga). Unradiogenic ^{182}W signatures are identified in all four orogens, indicating that a global stepwise transition to the modern mantle-like ^{182}W compositions was complete by ~2.1 Ga.

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