Goldschmidt 2025 Abstract
https://doi.org/10.7185/gold2025.28620

In Search for the Origin of Tungsten in Global Komatiite-Basalt Record: Implications for the early Earth's History

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Variations in $^{182}W/^{184}W$ ratios among cosmochemical and geochemical materials are the result of the radioactive decay of ^{182}Hf ($t_{½} \approx 8.9$ Ma), coupled with fractionation of Hf/W, during the first ~50 Ma of Solar System history. Three broad types of models have been proposed in the literature to explain the $^{182}W/^{184}W$ variations in the terrestrial mantle, including: (1) early magma ocean processes, (2) core-mantle interactions, and (3) grainy late accretion. These models, which have far-reaching implications for our understanding of early Earth history, are based upon the assumption that ^{182}W compositions of mantle-derived rocks reflect those of their mantle sources. But, is this always the case, and how can one tell?

We have established that W in the studied global mafic-ultramafic terrestrial rock record is of an: (1) endogenous origin, whereby it originated within the komatiite-basalt system and is genetically related to it, (2) exogenous origin, whereby it was introduced into the system from genetically unrelated sources, and (3) unknown origin, whereby its source is unknown. In order to distinguish between these different origins of W, we collected and processed comprehensive information for each komatiite-basalt system, such as geological setting, including spatial and temporal relationships between different rock types and the degree of alteration, trace element geochemistry of whole rocks and primary and secondary minerals (e.g., W/Th, Nb/Nb*), and short- and long-lived radiogenic isotope systematics (e.g., $^{142,143}Nd$, ^{176}Hf, $^{186,187}Os$, and ^{182}W) of these rocks.

Based on the data collected and processed, we highlighted the systems for which an endogenous origin of W is inferred; these are the best candidates for deciphering the early Earth history. Some of the systems for which an exogenous origin of W is inferred can still be successfully used to model the early Earth evolution after the exogenous contribution of W has been estimated and corrected for. Finally, we conclude that caution needs to be exercised when dealing with the komatiite-basalt systems in which the source of W is unknown. Such systems, however, may still be re-interpreted to be grouped according to one of the above two categories as research continues and more information becomes available.