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Revising the Lunar W Budget

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To understand the ^{182}W excess of the Moon and its implications for a late-veneer requires revisiting the Hf/W of the Moon. We performed high-precision HFSE and U-Th measurements on 29 lunar samples, and combined this with experimental elemental and isotopic partitioning data. These samples demonstrate lunar mantle-wide heterogeneities in element ratios such as U/W, which are traditionally assumed to be invariant. Our data enable us to constrain the bulk Hf/W value of the Moon's silicate portion by modelling of element distributions during lunar silicate differentiation. That this Hf/W value exceeds the terrestrial value suggests that the radiogenic ^{182}W excess in the Moon must result from its formation within 40 to 64 million years after solar system formation, rather than from disproportional late accretions to the Earth and Moon. Our findings question the uniform significance of a late accretion component for siderophile elements on Earth, as well as demand revisiting plausible but overly simplistic models for mantle dynamics within the infant Earth.

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