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Hf and W fractionation between liquid metal and liquid silicate and resultant core-mantle interaction signature on the ^{182}W isotope of the Ethiopian basalts

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^{182}Hf decays to ^{182}W with a relatively short half-life of 8.9 m.y., and the parent nuclide of ^{182}Hf is extinct in the early history of the Earth. Low $^{182}W/^{184}W$ relative to the average value of modern mantle have been found in certain modern ocean island basalts such as the ones from Hawaii, Samoa, Azores and Galapagos (i.e,, Mundl et al., 2017; Rizo et al., 2019; Mundl-Petermeier et al., 2020). The most plausible process among the proposed models so far for such ^{182}W variations is the one including the fractionation of Hf-W in core separation from the mantle due to the affinity of W to metal while ^{182}Hf remains in silicate mantle. This process leads to a low ^{182}W of the metallic core, which may have contributed to the source of the ocean island basalt.

We report the evidence of the Hf-W fractionation under the lowermost mantle condition in core segregation in the early Earth. First-principles free energy calculations reveal that W is strongly partitioned into the liquid metal phase, while Hf remains in the molten silicate even at the core-mantle boundary *P-T* condition. Such Hf-W fractionation imparts a low ^{182}W property to the core.

We also present slightly negative ^{182}W anomalies relative to the average present-day mantle for the Ethiopian basalts, which is closely related to the Afar mantle plume, and give non-resolvable ^{182}W isotope for the Aden Bay MORB. The basalt samples were analyzed following the modified procedure from Takamasa et al. (2020). The low ^{182}W isotope values indicated the Afar mantle plume generating the Ethiopian basalts were originated from the lowermost mantle and likely contained the core component with low ^{182}W isotope values, which was likely to be diffused from the core (Yoshino et al., 2019).