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Behavior of stable tungsten isotopes on the Earth's surface

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Stable tungsten isotope compositions ($\delta^{186/184}W$) show great potential for reconstructing paleo-redox conditions and environmental changes, as well as for tracing cycling of materials associated with solid Earth dynamics. However, the $\delta^{186/184}W$ of Earth's major W reservoirs are not fully characterized. It is also unclear how the Earth surface processes redistribute W between different reservoirs, which is a prerequisite for widespread application of $\delta^{186/184}W$ as a paleoclimatic proxy.

In this work, we conduct a systematic investigation on $\delta^{186/184}W$ compositions of a wide range of geological materials, specifically aiming to explore the behavior of stable W isotopes during Earth's surface processes, and to constrain modern marine W budget. The $\delta^{186/184}W$ of granite samples shows that the upper continental crust (UCC) has a heterogenous W isotopic composition, ranging from 0.08 to 0.16‰. We provide a useful estimation for the average $\delta^{186/184}W$ composition of UCC documented by the eolian loess with an average $\delta^{186/184}W$ value of 0.01±0.01‰ (mean±2 standard error) *(1)*, which is lower than the mantle value (0.09 ± 0.02‰) *(2)*. River water samples taken from major Asian rivers show consistently higher $\delta^{186/184}W$ value of 0.17-0.71‰ than bedrock. Furthermore, a detailed research on a granitic catchment in Southeast China shows that light W isotopes are preferentially adsorbed to Fe-Mn oxyhydroxides in weathering processes.

This work comprehensively constrain the W cycle on the Earth's surface, which is of fundamental significance in understanding the global elemental and isotopic W budget.

[1] Yang et al. (2022) *GCA* **in press**, (doi:10.1016/j.gca.2022.01.006)

[2] Kurzweil et al. (2019) *GCA* **251**, 176-191