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Stable W isotope fractionation during granite weathering: evidence from weathering profiles of granite in South China

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Chemical weathering exhibits critical control on behavior of the elements with great environmental and economic importance. However, investing the behavior of elements in regolith is complicated by selective disintegration of the rock−forming minerals and the subsequent elemental uptake by secondary precipitates such as Fe/Mn hydroxides and phyllosilicate clays. Elements and their isotopes that are widely involved in these processes may provide key constrains on the weathering mobility of all elements in general. In this study, we show that the stable tungsten isotopes can help to constrain the weathering mobility of elements and their subsequent uptakes by Fe/Mn hydroxides and phyllosilicate clays taking advantage of the significant stable isotopic fractionation of tungsten during weathering processes. An investigation on a granitic regolith in subtropical south China shows that saprolite tends to enrich lighter ^{184}W isotope relative to bedrock, with degree of enrichment depending on the relative amount of W in the clay−sized fraction modulated by the overall weathering intensity. Reductive leaching of the clay−sized fractions of the regolith indicates that Fe/Mn oxyhydroxides are responsible for the light ^{184}W isotope enrichment with a $\delta^{186/184}W$ value in equilibrium with that of local stream water. Our results show the great potential of stable tungsten isotopes in tracing the cycling of the elements in the critical zone.