Goldschmidt 2025 Abstract
https://doi.org/10.7185/gold2025.31624

Li isotopes in Thailand rivers record highly variable weathering congruency in tropical upland settings

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Lithium isotopes (δ^7Li) in river waters have been widely used to track silicate weathering processes and their role in the global carbon cycle. Tropical Southeast Asia exhibits some of the highest observed silicate weathering rates globally, yet river Li data from this region remains sparse. Here we present new dissolved river water Li isotope (δ^7Li_{diss}) measurements from Thailand, including the Chao Phraya river basin and upstream tributaries of the Mekong and Salween rivers. We observe highly variable δ^7Li_{diss} in isolated upstream catchments (+5.15 to +41.82‰), mixing downstream to more intermediate values (~25‰) typical of the global average. We determine that >90% of river water Li derives from silicate weathering, primarily from siliciclastic sedimentary and granitic lithologies, while ~5% derives from atmospheric inputs, primarily continental rather than marine. Samples collectively fall along a Rayleigh distillation curve commonly observed in floodplain settings, but the extent of Rayleigh fractionation does not increase with stream distance. Instead, the most fractionated and isotopically heaviest samples (δ^7Li_{diss} > 35‰) come from upslope catchments, requiring extensive Li uptake by clays over short distances. Likewise, the least fractionated samples (δ^7Li_{diss} < 15‰) come from upslope catchments with similar hydrologic characteristics to those with heavy Li, indicating that clay formation is likely controlled by differences in bedrock lithology. Our results demonstrate the potential for highly variable weathering congruency in kinetically-limited upland settings. While these effects are moderated at the basin scale, high variability across isolated coastal drainages could add significant uncertainty to estimates of the total weathering flux reaching the oceans.