

Evaluating bedrock influences on chemical weathering via a comparative study between tropical rivers in Hong Kong and Marianas Islands

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Silicate weathering is a fundamental process that removes CO₂ from the atmosphere. This, coupled with other processes in the carbon cycle, regulates climate over multimillion-year timescales through a strong negative feedback mechanism. The dissolved load of rivers is a useful way of studying weathering processes as they carry the weathered products from the Earth's crust to the ocean. East and Southeast Asia theoretically features some of the highest weathering rates around the world due to the hot and humid tropical climate and the continuous supply of fresh silicate material via active tectonics; however, rivers in these areas remain understudied. Here, we present new data generated from 13 rivers sampled across Hong Kong and the Mariana Islands that help to better understand how regional tectonics and bedrock composition influence weathering processes. Given that Hong Kong and the Mariana Islands are situated in different tectonic regimes and most rivers studied consist of watersheds sourcing single lithologies ranging from sedimentary (sandstones) to igneous (rhyolites and andesites), these data allow us to evaluate first-order impacts on weathering fluxes in tropical river systems. Our new data included major (cation and anion) and trace element concentrations, clay mineralogy and dissolved d⁷Li isotopic signatures from these rivers.

Our data indicate limited variability in the sum of major cation concentrations (Na⁺ + K⁺ + Mg²⁺ + Ca²⁺) between rhyolitic and sandstone-draining rivers in Hong Kong (both average ~10,000 ppb); however, differences can be seen in the relative abundances of the major cations. Sodium and potassium are relatively enriched in the rhyolitic-draining rivers, while calcium is more enriched in the sandstone-draining rivers. Magnesium is relatively similar in both. Moreover, the sum of major cations is higher in andesitic-draining rivers (~20,000 ppb) in the Mariana Islands when compared to those from rivers of comparable size in Hong Kong. Nontronite is also present only in the Mariana Islands and not in Hong Kong. These variations can be attributed to the higher weatherability and mafic nature of the bedrock within the Mariana Islands. New d⁷Li data will further inform us on bedrock influences on weathering intensity.