

An inorganic carbon budget for three of the largest rivers in SE Asia, the Irrawaddy, Mekong and Salween Rivers

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To determine the impact of mineral weathering on long and short-term climate it is essential to partition

- The cations derived from carbonate and silicate mineral sources,
- The source of acidity between sulfuric acid and carbonic acid,
- The effect of cation exchange on the supply and removal of cations from the dissolved load.

Most studies of chemical weathering have partitioned carbonate and silicate weathering, the textbook view being that silicate weathering consumes atmospheric CO₂ whereas carbonate weathering is CO₂ neutral on long time-scales. Some studies have accounted for the weathering of carbonates with sulfuric acid, which can release CO₂ to the atmosphere [1]. Very few studies have accounted for the cation exchange process which may bias estimates of silicate weathering through the supply of sodium from the exchange pool. Even fewer studies have attempted to combine all three factors above for continental scale basins. In the present study we present a large new data set that partitions the source of sulfate between that derived from pyrite and evaporites using coupled oxygen and sulfur isotopes on the sulfate ion in the dissolved load which allows carbonate weathering via sulfuric acid weathering to be quantified. We also presented sequential extraction data of the exchange pool of suspended particulate matter for many of the sub-basins of the Irrawaddy, Salween and Mekong Rivers allowing the cation exchange effect to be quantified. These observations are brought together, combined with discharge in a mixing model to estimate the true carbon fluxes associated with silicate and carbonate weathering at a continental scale over different time-scales. We quantify how these fluxes change over the hydrological extremes of the monsoonal climate.

[1] Torres et al. 2016, EPSL 450, 381-391

[2] Tipper. et al, 2020, PNAS, 118 (1) e2016430118