

The fate of riverine alkalinity: a case study in the Upper Mekong and Salween River.

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Chemical weathering is an essential component of the carbon (C) cycle, transferring C between the atmosphere and the lithosphere by rock-CO₂ reactions. Silicate weathering by carbonic acid traps CO₂ by producing alkalinity available for marine carbonate burial, resulting in a potential driver of Cenozoic cooling. However, sulfuric acid produced by pyrite oxidation can weather sedimentary carbonate and result in a carbon dioxide (CO₂) source over geological time scales (>10⁶ years). This release might partially occur on continents, either through releasing CO₂ directly to the atmosphere, or through secondary carbonate precipitation, in both cases causing a "shortcut" of the C cycle. However, the relative roles of these processes, which are intimately linked to the fate of riverine alkalinity, are currently poorly quantified. Here, we use a suite of dissolved- and solid-phase data from the Upper Mekong and Salween rivers to evaluate how these different weathering processes affect alkalinity. Solute concentrations, combined with bedload sediment sequential leaching experiments, offer us first-order information to quantify the lithological composition and their contribution to the dissolved load. Dual C isotopes of DIC (stable isotopic composition δ¹³C and radiogenic carbon F¹⁴C) show the influence of alkalinity sources and CO₂ degassing, while S isotopes of dissolved sulfate from river waters and HCl leachates allow us to constrain the sources of sulfur and to evaluate the contribution of sulfuric acid to rock weathering in the Upper Mekong and Salween rivers. Altogether, this study improves our understanding of the fate of riverine alkalinity in mountainous settings, shedding light on the links between tectonics and the C cycle.