Stable silicon isotopes indicate chemical weathering and typhoon event impact in a small mountainous catchment

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Continental weathering plays an important role in earth surface processes by linking Earth's spheres. In surficial processes, light Si isotopes are preferentially incorporated into secondary minerals and biogenic silica, releasing a DSi pool that generally has an enriched isotope composition. This study investigates the silicon isotopic geochemistry during silicate weathering and its indication for extreme climatic events. We collected bulk sediment and clay samples from a granodiorite profile, suspended particulate matter and river water of Mulan River in Southeast China during normal seasons and Typhoon Meranti. All the samples were analyzed for elemental and mineral compositions and silicon isotopes.

The δ^{30}Si values in the bulk profile samples are overall homogeneous, varying between 0.81‰ and -0.23‰, suggesting the obvious dilution of quartz. The clay samples dominated by kaolinite has a δ^{30}Si of -1.40‰~-2.52‰, showing an obvious heavier trend toward the top of proflie, which is inconsistent with the general understanding of secondary minerals formation. We infer that during the early weathering stage, plagioclase dissolved gradually without remarkable isotopic fractionation. As further weathering, potassium feldspar started to dissolve as accompanied with the formation of illite; meanwhile, Si isotope fractionation is limited. When potassium feldspar was significantly dissolved, the secondary minerals gradually converted to kaolinite, which result in obvious Si isotopic fractionation. In the late stage of weathering, kaolinite and quartz are dissolved gradually with the release of light silicon, the weathering residues have heavier Si isotope. δ^{30}Si data of river samples collected during the Typhoon Meranti suggest the typhoon events enhanced the mineral weathering owing to the intense water-rock reactions caused by heavier runoff, and more light Si isotope was released into the river water. Moreover, high runoff limited the neoformation of secondary clay minerals, and the increasing clay contribution from upstream soil resulted in lighter Si isotopes of suspended particulate matter during typhoon period.