The impact of landsliding on chemical weathering in an active mountain belt

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The stochastic nature of erosion in tectonically active mountain belts can give rise to accumulation of large amounts of sediment within steep bedrock topography. Such deposits are found primarily in landslide lobes, colluvial hollow fills, alluvial terraces and active floodplains. The sediment is typically poorly weathered, with a high specific surface area and permits rapid percolation of water. These factors combine to create an environment supportive of rapid weathering. We have investigated examples of these deposits to better constrain the solute budget, in particular the balance between weathering driven by abiotic and biotic factors.

We have focussed on the 370 km^2 Chenyoulan catchment, Central-West Taiwan, set in steep mountains underlain by marine sedimentary and meta-sedimentary rocks. We sampled the main river, small tributaries, springs fed by deep groundwater, and seepage from landslides and terraces. Concentrations of major cations and anions together with the isotopic composition of water and dissolved inorganic carbon ($\delta^{18}O_{H2O}$ and $\delta^{13}C_{DIC}$, respectively) have been quantified.

In this contribution, we focus on weathering within recent landslide deposits. High solute concentrations in water collected from spring-lines below large landslide deposits demonstrate their role as a ‘weathering reactor’. $\delta^{13}C_{DIC}$ correlates with the proportion of sulphate in the anions suggesting that sulphuric acid, derived by rapid oxidation of pyrite in the recently fractured deposits and their source regions, is the primary weathering agent in this setting. Organic sourced carbonic acid plays a significantly smaller role. Streams draining landslide-prone areas exhibit major element ratios that closely match the spring water from the landslides, suggesting that these are a dominant source of solutes within the catchment. Notably, silicate weathering is elevated compared to dissolution of carbonate in the pyrite-rich substrate, which is common in many mountain belts. This suggests that atmospheric CO_2 consumption by silicate weathering, modulated by soil organic matter oxidation, may have a smaller influence on the global carbon budget than currently thought.