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Topographic imprint on chemical weathering in deeply weathered soil-mantled landscapes (southern Brazil)

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The regolith mantle is defined as the thin layer of unconsolidated material overlaying bedrock that contributes to shape the Earth's surface. The development of the regolith mantle in a landscape is the result of in-situ weathering, atmospheric input and downhill transport of weathering products. Bedrock weathering - the physical and chemical transformations of rock to soil - contributes to the vertical development of the regolith layer through downward propagation of the weathering front. Lateral transport of soil particles, aggregates and solutes by diffusive and concentrated particle and solute fluxes result in lateral redistribution of weathering products over the hillslope.

In this study, we aim to expand the empirical basis on long-term soil evolution at the landscape scale through a detailed study of soil weathering in subtropical soils. Spatial variability in chemical mass fluxes and weathering intensity were studied along two toposequences with similar climate, lithology and vegetation but different slope morphology. This allowed us to isolate the topographic imprint on chemical weathering and soil development. The toposequences have convexo-concave slope morphology, and eight regolith profiles were analysed involving the flat upslope, steep midslope and flat toeslope part.

Our data show a clear topographic imprint on soil development. Along hillslope, the chemical weathering intensity of the regolith profiles increases with distance from the crest. In contrast to the upslope positions, the soils in the basal concavities develop on in-situ and transported regolith. While the chemical weathering extent on the slope convexities (the upslope profiles) is similar for the steep and gentle toposequence, there is a clear difference in the rate of increase of the chemical weathering extent with distance from the crest. The increase of chemical weathering extent along hillslope is highest for the steep toposequence, suggesting that topography enhances soil particle, aggregate and solute fluxes.