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Chemical weathering and physical erosion rates along a vegetation and climate gradient, Chilean Coastal Cordillera (26° – 38°S)

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Chemical weathering and physical erosion are important processes shaping topography, producing soils, and providing nutrients for life. The rates of these processes are influenced not only by tectonics, but also by climate and biota. The Chilean Coastal Cordillera from 26° to 38°S is a natural laboratory to investigate chemical weathering and physical erosion rates over different climatic settings. From North to South, climate changes from arid (Pan de Azúcar), semi-arid (Santa Gracia), Mediterranean (La Campana) to temperate humid (Nahuelbuta). Here we present chemical weathering and physical erosion rates based on published and new in situ-produced cosmogenic nuclides and immobile elements published from soil pedon depth profiles in the four study areas.

Calculated chemical weathering rates range from zero in Pan de Azúcar to an high value of 211 t/(km^2 yr) in La Campana. Chemical weathering rates are comparable in Santa Gracia and Nahuelbuta (~20 t/(km^2 yr). Physical erosion rates are low in Pan de Azúcar (~11 t/(km^2 yr)) and increase towards the South (~ 40 t/(km^2 yr)). Combined chemical weathering and physical erosion rates indicate that denudation rates are lowest in Pan de Azúcar and highest in La Campana. The contribution of chemical weathering to total denudation rates is increasing and then decreasing with increasing mean annual precipitation from North to South. The observation that the calculated chemical weathering rates in the southernmost location with the highest mean annual precipitation and the highest chemical index of alteration are not the highest of all four study areas is evaluated and discussed. We investigate possible influence of precipitation and vegetation on chemical weathering and physical erosion rates.