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Sediment transfer and denudation rates across the Central Andes in Bolivia

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The Eastern Andes of Bolivia are characterized by ongoing tectonic activity (focused in the Subandean Belt, SA) and the influence of Holocene to Pleistocene climate changes. Both affect geomorphic forms and process rates, sediment mobilization and redistribution. While the enduring debate whether either or both of these variables control or dominate landscape evolution is ongoing, we evaluated this for the Rio Grande catchment in Central Bolivia. We obtained 58 cosmogenic 10Be catchment wide denudation rates for catchments (102 to 104 km2) traversing the Eastern Cordillera (EC), and the Interandean Zone (IAZ) into the Subandes (SA) (integrations times of 400 to ∼30000 yrs). The (sub)catchment wide denudation rates within the Rio Grande catchments upstream of Abapó range from 7 mm/kyr to 1550 mm/yr, with a mean of 262 mm/kyr (median 85 mm/kyr), similar to worldwide compilations. The higher denudation rates are consistently observed in humid SA (mean rates 850 mm/kyr) in accordance with the active deformation front but also within the locus of a proposed Holocene climate change. The arid to semiarid EC and IAZ yielded rates of 88 and 60 mm/kyr, respectively.

Sediment budget analysis reveal that sediment mixing with respect to cosmogenic nuclide methods is not perfect. They also contrast earlier cosmogenic rates as well as sediment yield data from gauging stations. Specifically, high rates of the Subandes do not impact the further downstream located samples sites in an area-weighted mode. Currently, the upland low eroding signal is carried into the floodplain (outlet: 120 mm/kyr).

The study highlights that in mountainous catchments, prior to floodplain entry, cosmogenic derived catchment wide denudation rates can be biased when slow-eroding catchments meet fast-eroding catchments (IAZ into SA). This effect is subdued amongst slow eroding catchments (EC, IAZ). We suggest that the high SA-rates, that are coupled to episodic processes, are not fully connected at tributary junctions. Hence, care should be taken when sampling mountain fronts with a large diversity in denudation processes and rates in the upstream catchments.