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Erosion and Sediment Transport Across Steep Topographic and Climatic Gradients: Examples from the Central Andes

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Moisture impinging on high topographic barriers result in effective orographic barriers. For example, the interaction of the South American Monsoon System with the eastern central Andes result in an efficient orographic barrier. The steep topographic gradient, sparse vegetation cover and the highly seasonal and spatially focused rainfall result in an spatially-varying erosional regime stretching from low to high rates. The spatiotemporal correlation between various topographic, tectonic, environmental, climatic, and exhumational phenomena in this region has resulted in the formulation of models of possible long-term erosional and tectonic feedback processes that drive the lateral expansion and vertical growth of mountain belts. However, despite an increase in thermochronologic, cosmogenic radionuclide, and sedimentological datasets that help explain the underlying mechanisms, the true nature of these relationships is still unclear and controversies particularly exist concerning the importance of the different forcing factors that drive sediment transport on different time scales.
Here, we synthesize and assess these controversies with observations from studies conducted perpendicular to strike of the orogen, and combine them with new basin-wide erosion-rate data from the Central Andean Plateau and remote-sensing derived erosion measurements. At first order and at the wet mountain front, erosion rates based on cosmogenic nuclide inventories from river sands suggest a correlation with rainfall rates and spatial structure of vegetation cover. Further leeward in the high-elevation and internally-drained part of the central Andean Plateau, we observe that aelion transport can exceed fluvial transport rates.