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From perched high elevation surfaces to sediment entering the foreland: the dynamics of erosion, deformation and landscape evolution in the Argentine Precordillera

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The geomorphic processes that control temporal and spatial patterns of erosion, sediment storage and evacuation in an active mountain range (source) have a direct impact on how the signal of tectonics and climate, are recorded in the adjacent sedimentary basins (sinks). Stream power based numerical models of landscape evolution predict strong time lags between rock uplift and waves of erosion in the foreland, but this is difficult to test without proper resolution between source and sink signals. Confirmation of model results is typically gleaned through observations that are either snapshots of processes in modern systems, or inversion of the stratigraphic record to decipher what occurred in the uplands. While cosmogenic nuclide derived, catchment wide erosion rates in the modern rivers provide a snapshot of processes happening in the last thousands of years, thermochronometers average over the \geq millions of years it takes a rock to ascend from the closure isotherm to the Earth's surface, making it difficult, if not impossible to capture a minimally time averaged signal of the geomorphic system in the stratigraphic record. Paleoerosion rates from the residual cosmogenic nuclide concentration of buried sediments offer a means to bridge the gap in resolution.

This study combines numerical modeling and cosmogenic nuclide paleoerosion rates in the Argentine Precordillera to build a rich picture of how this foreland basin system, from the hinterland through the foreland basin evolves in time and space. Our modeling shows that the dynamics of wedge-top basin formation behind a rising, and then subsequently inactive range have profound and systematic effects on the geomorphic signals both upstream and downstream of the wedge-top basin. Downstream, it is clear that there are strong, million year time lags in the uplift-triggered erosive pulse and spatial controls on where the sediment delivered to the foreland is sourced. Upstream, aggradation in the wedge top leads to the development of a wave of low erosion into the hinterland that results in the creation of perched surfaces coeval to erosive pulses downstream. In the Argentine Precordillera at 30°S an 8 Ma record of paleoerosion rates from the wedge top and foreland basin deposits along with detrital zircons provenance in the foreland largely verifies the predictions of the numerical modeling. Similarly, upstream of the wedge-top

basin, there are concordant knickpoints and large, broad planation surfaces perched some 1500 m above the floor of wedge top as predicted by the low erosion wave pulse. Our combination of numerical modeling and paleoerosion rates capture the dynamic evolution of mountain range at million to thousand year timescales.

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