



## **Insights into glacial erosion processes from digital elevation model analysis of glacial landscapes**

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Observations of glaciated topography from digital elevation models (DEMs) can provide significant insights into the glacial processes of importance in landscape evolution. However, in many cases further studies are required to confirm these inferences. In the Sierra Nevada, California, glacial erosion has been somewhat faster than fluvial erosion. In detail, there is a substantial difference in glacial landscapes between basins up to 20km long, and basins over 30km long. We infer that the initial size/slope of the drainage basin is the major cause. In terms of glacial dynamics, this could reflect: (i) the influence of contrasting subglacial hydrology (controlled by valley slope and width) on erosion by quarrying (the dominant erosion process in this range); and/or (ii) substantial differences in the hypsometry of the accumulation area (larger accumulation area allows larger, faster, longer-lived glaciers; steeper accumulation area inhibits glacier development). Here also headwall erosion by glaciers plays a major role in drainage basin reorganisation and relief inversion. In the Nanga Parbat region, glacial incision is able to keep pace with tectonic uplift, but again larger and smaller glaciers behave differently (presumably for similar reasons); the former maintain shallow slopes, while the latter steepen in response to uplift. Meanwhile, hillslope processes are or have been dramatically slower than glacial incision. This presumably reflects the extremely cold, dry conditions on these slopes. Coupled with high rock strength and a decrease in drainage density, this allows long, towering cirque headwalls and tall peaks. In the Bitterroot Range, Idaho/Montana, and the Sangre de Cristo Range, Colorado, prevailing westerly winds enhance snow accumulation on the leeward side of the range, causing pronounced asymmetry in glacial erosion. Headwall erosion has caused divide migration towards the west, and substantial moraines have accumulated on the east (leeward) side of the range.