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Tibetan Plateau headward erosion accelerated by tributary glaciers

Abstract:

Low-relief landscapes of orogenic plateaus can form when rock uplift and lateral tectonic growth outpace the headward incision of rivers. While convergence rate and upstream aridity are commonly invoked to preserve plateau topography, recent studies have debated whether Quaternary glacial and hydrologic changes accelerated or impeded headward fluvial incision. Field observations and 10Be-exposure ages from the western Tibetan Plateau margin show that the Siachen Glacier repeatedly impounded the Shyok River, the largest Indus tributary, during the last two glacial periods. Despite extensive upstream aggradation, incision rates during ice-free periods appear high enough for upstream areas to adjust to base-level lowering in the glacially-overdeepened confluence. Conspicuous valley morphologies along the Shyok and Indus indicate that all confluences with major Karakoram tributaries are glacially overdeepened, implying a significant contribution of glaciers to headward erosion into the western Tibetan Plateau margin. In contrast, minor dissection of the plateau margin in the Tsango-Brahmaputra valley could be related to more limited glacial influence.