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Topographic response to Neogene variations in slab geometry, climate and drainage reorganization in the Northern Andes of Colombia

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The tropical Northern Andes of Colombia are one the world's most biodiverse places, offering an ideal location for unraveling the linkages between the geodynamic forces that build topography and the evolution of the biota that inhabit it. In this study, we utilize a geomorphic analysis to characterize the topography of the Western and Central Cordilleras of the Northern Andes. We supplement our topographic analysis with erosion rate estimates based on gauged suspended sediment loads and river incision rates from volcanic sequences. In the northern segment of the Central Cordillera, an elevated low-relief surface (2,500m in elevation, ~40x110 km in size) with uniform lithology and surrounded by knickpoints, indicates a recent increase in rock and surface uplift rate. Whereas, the southern segment of the Central Cordillera shows substantially higher local relief and mostly well graded river profiles consistent with longer term uplift stability. These changes in the topography fit with the proposed location of a slab tear and flat slab subduction under the northern Central Cordillera, as well as with a major transition in the channel slope of the Cauca River. We identify several areas of major drainage reorganization, including captures and divide migrations that are supported by our erosion and incision rate estimates. We identify slab flattening as the most likely cause of strong and recent uplift in the Northern Andes leading to ~2 km of surface uplift since 8–4 Ma. Large scale drainage reorganization of major rivers is probably mainly driven by changes in upper plate deformation in relation to development of the flat slab subduction geometry; however, other factors such as climate and emplacement of volcanic rocks likely play secondary roles in this process. Several isolated biologic observations above the area of slab flattening suggest that surface uplift isolated former lowland species on the high elevation plateaus, and drainage reorganization may have driven diversification of aquatic species.