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The role of lightning strikes in sediment generation in low-latitude mountains

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Lightning strikes are common along the Drakensberg escarpment of east-central southern Africa in particular where they are driven by rapidly-rising and moist air masses. Although lightning climatology is not fully known and is subject to high spatial and temporal variability, the geomorphological impacts of cloud-to-ground lightning strikes have been described from several bedrock mountain surfaces worldwide. This evidence includes the presence of angular and shattered bedrock fragments, conjugate fractures that penetrate into bedrock, and heat-fused mineral grains in loose surface sediments and soils (fulgurites). Despite this wide-ranging evidence, the role of lightning strikes in sediment generation on mountains has not been previously examined. Through field mapping in the Drakensberg (3200-3400 m asl) of eastern Lesotho, southern Africa, we show that lightning strike sites have a distinctive spatial clustering along scarp edges, and their geomorphological expression can be readily distinguished from more commonly observed mountain weathering processes and products. Based on measurements of strike impact distribution, size and relative age, and with reference to the South African Weather Service database of radar-collected lightning strike rates and locations, we are able to calculate the rate of sediment generation by lightning strikes. This is the first such estimate of lightning strikes as an agent of mountain sediment generation. Calculated rates of sediment yield over the last decades compares very favourably to other natural rates of sediment generation in mountains summit regions (including frost shattering), and is likely the most significant control on slope sediment yield into mountain valleys (after human activity) throughout the Holocene, in the high Drakensberg and other low-latitude mountain blocks.