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FLUVIAL KNICKPOINTS AND TRANSIENT EROSION ON BASSE-TERRE, GUADELOUPE, WITH IMPLICATIONS FOR ESTIMATES OF CHEMICAL WEATHERING

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The mountainous island of Basse-Terre in the Guadeloupe archipelago of the Lesser Antilles is well suited for investigating factors influencing chemical weathering of the critical zone. For example, MAP varies from 200 to >6500 mm/yr along an east-west gradient and is associated with a 6-fold difference in total weathering rates (TWR) in large watersheds. In the well-studied Bras David watershed, weathering rates constrained at the clast, soil profile and watershed scales range from ~0.3 m/Myr to ~30m/Myr to ~300 m/Myr, respectively, consistent with anticipated variations in weathering rates as a function of roughness. Here, we focus on the role of transient erosion in the spatial distribution of weathering. Across the island, slope-break knickpoints in rivers separate gentler upstream reaches from steeper downstream reaches and cluster in chi-elevation space (6-8 m chi, 350-450 m elevation), suggesting they are the result of transient erosion. Regions upstream of these knickpoints define a contiguous ~80 km^2 region of relatively low slope that we interpret as a relict landscape with slower physical erosion rates than downstream of knickpoints. We hypothesize that this low-slope region, accounting for ~10% of the surface area of the island, is mantled by a thick, chemically inert regolith pile where hydrologic flow paths are too shallow to intersect the reactive bedrock. Detailed water sampling along the entire 700 m length of the Quiock River, a tributary of the Bras David River, indicates low pH values (<5.6) and slow TWR (~30 $t/km^2/yr$) in the portions of the stream flowing over the relict landscape, where saprolite exceeds 10 m in thickness. This contrasts with higher pH (>6) and faster TWR (~130 $t/km^2/yr$) downstream of the knickpoint, where the stream flows across bedrock. Regionally, watershed-scale TWR measured below knickpoints similarly increase downstream as the proportion of runoff from the relict landscape decreases. TWR above knickpoints are similar to deposition rates of windblown dust, implying solutes are not derived from reactive bedrock. Consequently, surface area-normalized watershed-scale estimates of chemical weathering likely underestimate the magnitudes of chemical weathering in the reactive portions of the critical zone where flow paths intersect fresh bedrock.