Controls on the slope and relief of headwater channels in steep landscapes: Field constraints from the San Gabriel and San Jacinto Mountains, CA

Details

Meeting	2017 Fall Meeting
Section	Earth and Planetary Surface Processes
Session	Sediment Dynamics Across Landscapes: Steep and Low-Relief Terrains IV Posters
Identifier	EP33B-1939
Authors	Neely, A*, Department of Geosciences, Pennsylvania State University Main Campus, University Park, PA, United States DiBiase, R A, Department of Geosciences, Pennsylvania State University Main Campus, University Park, PA, United States Corbett, L B, University of Vermont, Burlington, VT, United States Bierman, P R, University of Vermont, Burlington, VT, United States
Index Terms	Geomorphology: general [1824] Geomorphology: fluvial [1825] Geomorphology: hillslope [1826] Sediment transport [1862]

Abstract

Headwater colluvial channels thought to be carved mainly by debris flows form a key but understudied link between hillslope and fluvial domains. Surface processes in headwater channels influence 1) drainage density responses to changes in climate or tectonics; 2) the grainsize distribution and flux of sediment delivered to downstream channels; and 3) the size, extent, and recurrence of hazardous debris flows. Here, we use field observations, cosmogenic nuclides, and high-resolution topography and imagery data to study headwater channels in rocky landscapes of the Northern San Jacinto Mountains and Eastern San Gabriel Mountains in southern California. Both study sites have similar runoff regimes and lithology, but bedrock cliffs in the San Gabriel Mountains are highly fractured compared to massive bedrock exposed in the San Jacinto Mountains. Sparser fracture spacing in the Northern San Jacinto Mountains leads to steeper cliffs, coarser sediment, steeper fluvial channels, and a reduction of catchment erosion rates from ~0.6-2.2 mm/yr in the Eastern San Gabriel Mountains to ~0.1-0.3 mm/yr in the Northern San Jacinto Mountains. Colluvial channels show similar gradients (~35) in both landscapes, but are 2-3 times longer in the Northern San Jacinto Mountains, increasing headwater channel relief in this mountain range. In both landscapes, field observations indicate that most colluvial channels are mantled with sediment, but the steepest headwater channels are bedrock-dominated, consistent with a critical slope for colluvial channels that appears to be independent of grain size. We hypothesize that the lengthened colluvial network in the San Jacinto Mountains could be a consequence of coarser sediment cover that requires a larger drainage area to mobilize by fluvial transport, but we also explore the potential controls of hillslope rock

mass strength and sediment supply. Our findings highlight how changes in rock properties affect drainage density and the partitioning of relief between hillslope, fluvial, and colluvial domains.

Cite as: Author(s) (2017), Title, Abstract EP33B-1939 presented at 2017 Fall Meeting, AGU, New Orleans, Louisiana, 11-15 Dec.
