Spatial patterns of mobile regolith thickness and meteoric 10Be in the Boulder Creek Critical Zone Observatory, Front Range, Colorado

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Authors	Shea, N*, Integrative Geosciences, University of Connecticut, Storrs, CT, USA Ouimet, W B, Integrative Geosciences, University of Connecticut, Storrs, CT, USA Dethier, D P, Geosciences, Williams College, Williamstown, MA, USA Bierman, P R, Geology, University of Vermont, Burlington, VT, USA Rood, D H, AMS Laboratory, East Kilbride, United Kingdom
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Abstract

The Boulder Creek Critical Zone Observatory (BcCZO) aims to understand the history, architecture and evolution of hillslopes found within the diverse topography and climate regimes of the Colorado Front Range. This information is crucial for testing and developing models of hillslope evolution, giving especial consideration to the production and downslope transport of mobile regolith on the hillslopes. Here, we present the results of a systematic study aiming to document spatial patterns of mobile regolith thickness and meteoric Beryllium-10 (10Be) concentrations in the Gordon Gulch basin of the BcCZO. Gordon Gulch lies within the unglaciated portion of the Colorado Front Range and is thought to be an artifact of long-term steady state evolution. The basin is characterized by mixed bedrock-soil mantled hillslopes, with intermittent bedrock outcrops (tors) on ~10% of slopes. It is currently unclear how the hillslopes of Gordon Gulch have evolved given the variable rock type and strength (i.e., fracture spacing), gradients (steep slopes in lower basin compared to gradual in the upper), and hillslope aspects (north versus south facing hillslopes, with varying tree types and soil moisture for frost cracking and heaving) that exist within the basin. Furthermore, climate data suggest that the current climate regime (relatively warm) is representative of only 20% of the last 65 ka. Mobile regolith thickness measurements provide a snapshot of hillslope evolution in the basin given these controls, and meteoric 10Be can used to constrain residence times and trace mobile regolith transport. We measure mobile regolith thickness as the depth to immobile weathered bedrock and/or saprolite. Preliminary analysis of over 200 soil pits reveals a high degree of variability in mobile regolith thickness. In general, the mobile regolith cover is thinner on the south facing slopes than the north facing and a general thickening of mobile regolith occurs on steeper slopes, especially along individual hillslope transects. Our meteoric 10Be analysis is an expansion of earlier work suggesting the typical inventory of meteoric 10Be on north facing hillslopes is greater than south facing

hillslopes, with little change moving downslope. In addition to studying hillslope evolution, we hope to incorporate our thickness measurements and meteoric 10Be timing constrains into a working understanding of Gordon Gulch's basin-wide sediment budget, as many toe-slopes, gully fills, alluvial fans and stream terraces attest to storage within the basin prior to evacuation and transport via the fluvial system.

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