Geophysical Research Abstracts
Vol. 19, EGU2017-11124, 2017
EGU General Assembly 2017

Denudational slope processes on weathered basalt in northern California: 130 ka history of soil development, periods of slope stability and colluviation, and climate change

Eric McDonald (1), Bruce Harrison (2), John Baldwin (3), William Page (4), and Dylan Rood (5)

(1) Desert Research Insistute, Earth and Ecosystem Science, Reno, United States (emcdonal@dri.edu), (2) Dept of Earth & Environmental Science, New Mexico Tech, NM, United States (james.harrison@nmt.edu), (3) Lettis Consultants International, Inc, Walnut Creek, CA, United States(WDP7@pge.com), (4) Geosciences Department, Pacific Gas & Electric Company, San Fransisco, CA, United States (WDP7@pge.com), (5) Department of Earth Science and Engineering, Imperial College London, Royal School of Mines d.rood@imperial.ac.uk)

The geomorphic history of hillslope evolution is controlled by multiple types of denudational processes. Detailed analysis of hillslope soil-stratigraphy provides a means to identify the timing of periods of slope stability and non-stability, evidence of the types of denudational processes, and possible links to climatic drivers. Moreover, the degree of soil formation and the presence of buried or truncated soils provide evidence of the relative age of alternating periods of colluviation and stability. We use evaluation of soil stratigraphy, for a small forested hillslope (<500 m of slope length) located in the Cascades of northern California, to elucidate both the timing and processes controlling $\sim$ 130 ka of hillslope evolution. The soils and slope colluvium are derived from highly weathered basalt. Stratigraphic interpretation is reinforced with soil profile development index (PDI) derived age estimates, tephrochronology, luminescence ages on colluvium, and He3 nuclide exposure dates. Soils formed along hilltop ridges are well developed and reflect deep (>2-3 m) in-situ weathering of the basalt bedrock. PDI age estimates and He3 exposure dates indicate that these hilltop soils had been in place for $\sim$100-130 ka, implying a long period of relative surface stability. At about 40-30 ka, soil stratigraphy indicates the onset of 3 distinct cycles of denudation of the hilltop and slopes. Evidence for changes in stability and onset of soil erosion is the presence of several buried soils formed in colluvium downslope of the hilltop. These buried soils have formed in sediment derived from erosion of the hilltop soils (i.e. soil parent material of previously weathered soil matrix and basalt cobbles). The oldest buried soil indicates that slope stability was re-established between $\sim$32-23 ka, with stability and soil formation lasting to about 10 ka. Soil-stratigraphy indicates that two additional intervals of downslope transport of sediment between $\sim$6-10 ka, and 2-5 ka. Soil properties indicate that the primary method of downslope transport is largely due to tree throw and faunal burrowing. Onset of slope instability at $\sim$40-30 ka appears to be related to changes in vegetation with establishment of a pine dominated forest (increase in tree throw) and/or onset of local faulting. By comparison, slope stability from 30-10 ka appears to be a related to the formation of a shrub dominated steppe and a decrease in tree throw. The two periods of slope erosion after $\sim$10 ka appear related to regional periods of pronounced channel incision. Results indicate that soil stratigraphy can provide a key record of slope evolution and related paleoenvironmental changes.