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From mass-wasting to slope stabilization - putting constrains on the transition in slope erosion mode: A case study in the Judea Hills, Israel

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The geomorphic response of a drainage system to the termination of tectonic uplift includes the stabilization of base level followed by a transition in the mode of hillslope erosion from mass wasting to diffusive processes. We test this transition in the Soreq drainage, Judea Hills, Israel. This study area is characterized by Upper Cretaceous marine carbonate rocks and sub-humid Mediterranean climate, and the drainage hillslopes are typically mantled by thick calcrete crusts. Calcretized remnants of landslide debris and alluvial deposits are evident along the presently stable hillslopes. These remnants indicate that a transition from landslides to dissolution-controlled hillslope erosion had occurred, most likely due to the stabilization of the present base-level which probably followed a significant decrease in tectonic uplift during late Cenozoic. Four deposits were dated using thermally transferred OSL of aeolian quartz grains incorporated in the calcrete which cement the ancient deposits. Three deposits are associated with the present streambed and constrain the hillslope stabilization period; one deposit is associated with a $\sim$100 m higher base-level and puts constrains on the rate of stream incision prior to the stabilization of the current streambed.

We conclude that incision of $\sim$100 m occurred between 1056$\pm$262 ka to 688$\pm$86 ka due to $\sim$0.3° westward tilt of the region; such incision invoked high frequency of landslide activity in the drainage. The ages of a younger landslide remnant, alluvial terrace, and alluvial fan, all situated only a few meters above the present level of the active streambed, range between 688$\pm$86 ka and 244$\pm$25 ka and indicate that since 688$\pm$86 the Soreq base level had stabilized and that landslide activity decreased significantly by the middle Pleistocene.

This study demonstrates that colluvial deposits may be used as markers for stream incision and base level stabilization, much like alluvial deposits that are commonly used for this purpose. Based on the colluvial deposit archive, the geomorphic response of hillslopes can be translated to phases of tectonic uplift and quiescence; thus enabling future studies in regions that do not contain alluvial deposits and therefore were left unstudied.