Increased storminess during MIS3 altered the late Quaternary basin-scale weathering, erosion, and deposition in Nahal Yael, hyperarid Negev, Israel

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Abstract

A conceptual model for geomorphic response to Pleistocene to Holocene climate change (Bull and Schick, 1979, Quat. Res. 11: 153-171) was probably based on earlier observations in the southwestern US, but first applied to the hyperarid (<30 mm yr-1) Nahal Yael watershed, southern Negev desert. This influential model includes a chain of events following a climate change from semiarid late Pleistocene to hyperarid Holocene: reduced vegetation cover, increased yield of sediments from slopes, and accelerated aggradation of terraces and export of sediment from the basin to deposit an alluvial fan. The model is now >30 years old and during this time chronologic, paleoenvironmental and hydrogeomorphic research have all advanced but the discussions are still within the framework put forward then. The model is revaluated here by using data acquired in Nahal Yael over the 30 years since the original model was proposed. Recent studies indicate late Pleistocene climate was hyperarid and the transition from semiarid to hyperarid climates did not occur. The revised chronology reveals a 35-20 ka episode (probably already beginning at ~50 ka with lower rates) of accelerated weathering and sediment production and distinct talus accretion on slopes. Coeval with accretion on slopes, sediments were also transported and aggraded in fluvial terraces and alluvial fans, without noticeable lag time or a chain of discernable events. This intensified sediment production and delivery phase is unrelated to the Pleistocene-

Holocene transition. The depositional landforms were rapidly incised during 20-18 ka; since this approximately LGM incision, sediment yield is from the storage in these depositional landforms and is not produced from bedrock in significant quantities. We propose that in such hyperarid environment, the main operators are individual extreme storms, and in this case specifically an episode of frequent storms and floods is the driver of change regardless the mean climatic conditions. It created a pulse of intense weathering due to numerous cycles of wetting and drying on slopes and sediment transport to fluvial terraces and alluvial fans; its impact continues all the way to the present. We suggest that even if aspects of the original conceptual model of Bull and Schick (1979) are correct, it has been applied too frequently, too generally, across very diverse arid climates and settings, and for too long in lieu of collecting new data at a full basin scale and testing the model.

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