How pebbles destroy mountains: the role of sediment in river incision into bedrock

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Rivers cut vertically and laterally into bedrock, creating valleys and canyons. River incision into bedrock is the fundamental erosional process that links climate and tectonics to topography and sets the pace for landscape evolution. River sediments play an essential role in controlling the efficiency of bedrock erosion, by providing abrasive tools to the flow but also by forming transient deposits that bury and thus insulate bedrock channel beds from the erosive forces of the flow. The saltation-abrasion bedrock incision model captures the physics of bedrock wear by bedload impacts, and can be used to explore the sensitivity of river profiles and topographic relief to changes in rates of tectonic and climatic forcing. This theoretical model, which has been calibrated with laboratory experiments, predicts that the grain size and supply rate of coarse sediment are the dominant controls on bedrock river channel slope, with rock strength only of secondary importance. Field studies in the Henry Mountains of Utah, and other landscapes, confirm several key predictions of the model, including potential for growth of fluvial hanging valleys at tributary junctions. A key outstanding question that emerges is: what controls the size distribution of sediments supplied by hillslopes to channels in tectonically active terrain? Coupling the saltation-abrasion incision model with models for the influence of climate on sediment production and orographic precipitation leads to new predictions of possible positive feedbacks that could drive mountain growth as a result long-term climate change.

Biography: **Dr. Leonard Sklar** is a geologist and civil engineer, currently Assistant Professor in the Department of Geosciences at San Francisco State University. He earned a MS in Civil Engineering and PhD in Geology and Geophysics from U.C. Berkeley and has worked as a consulting engineer in Northern California. Dr. Sklar's research interests include experimental, field and theoretical studies of river incision into bedrock, and the role of debris flows in cutting headwater channels in tectonically active terrain. He is also studying river channel incision on Saturn's frozen moon Titan, and the rheological properties of ice and silicate rock that control material resistance to abrasion. Dr. Sklar also works on questions related to restoration of rivers downstream of dams, including dam removal, coarse sediment management, and river channel design. He is currently co-leading an interdisciplinary group studying the feedbacks between biotic and fluvial-geomorphic processes in Fossil Creek, a spring-fed travertine stream in Arizona, following decommissioning of a large diversion dam. Dr. Sklar also serves as faculty manager of the experimental geomorphology laboratory at U.C. Berkeley's Richmond Field Station, in collaboration with William Dietrich, Professor in the Department of Earth and Planetary Science.