

Post-fire „Hillslope Debris Flows”: evidence of a distinct erosion process

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Debris flows occurring soon after fire have been associated with a somewhat mysterious erosion process upslope of their initiation zone that some authors have called ‘miniature debris flows on hillslopes’, and that leave behind levee-lined rills. Despite the unusual proposition of debris flow on planar hillslopes, the process has not received much attention. The objective of this study was to present evidence of this process from field observations, to analyse its initiation, movement and form through runoff experiments and video, explore the role of fire severity and runoff rate, and to propose a conceptual model of the process. Hillslope debris flows (HDF) consist of a lobe of gravel- to cobble-sized material 0.2 – 1 m wide that is pushed by runoff damming up behind it. During initiation, runoff moved individual particles that accumulated a small distance downslope until the accumulation of grains failed and formed the granular lobe of the HDF. They occur at relatively steep slope gradients (0.4 – 0.8), on a variety of geologies, and after fire of at least moderate intensity, where all litter is burnt and the soil surface becomes non-cohesive. HDF are a threshold process, and runoff rates of less than 0.5 L s⁻¹ to more than 1 L s⁻¹ were required for their initiation during the experiments. Char and ash lower the threshold considerably. Our conceptual model highlights HDF as a geomorphic process distinct from channel debris flows and classical rill erosion. On a matrix of slope and grain size, HDF are enveloped between purely gravity-driven dry ravel, and mostly runoff-driven bedload transport in rills.