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Solid particle impact abrasion and the formation of bedrock bedforms

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Erosion laws used in landscape evolution modelling should capture the physics of key processes such as fluvial bedrock incision. Wear resulting from bedload particle impact abrasion is a dominant mode of erosion in many mountain bedrock rivers and plays a key role in the formation of some types of sculpted bedrock bedforms. Little work exists on pebble impact wear in geological contexts and modellers have had to rely on studies of engineering materials abraded with sand grade particles in high velocity flows.

We present results from single impact experiments and multiple impact flume studies which give insights into the mechanisms of impact erosion, the controls on erosion rate, and the formation of bedrock bedforms.

Single impact experiments with quartz spheres on marble targets quantitatively demonstrate the controls of particle size (20 to 35mm diameter), impact velocity (2 to 5ms^{-1}) and impact angle (15 to 90˚) on microtopography of impact sites and the formation of wear particles.

Flume experiments with natural pebbles produce bedrock bedforms similar in appearance to upstream facing convex surfaces observed in the field. High resolution 3D laser scanning is utilised to map changes in morphology of marble flow obstacles, or artificial bedrock bedforms, throughout exposure to erosive flows of up to 11.5hrs in duration, observed in incremental steps of 10 to 90 minutes. The controls of initial bedrock bedform shape, pebble size distribution and pebble lithology are quantita-

tively described and rates in some cases are found to be comparable to yearly incision in natural settings.