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Dynamics and steady-state geometry of an experimental channel incising cohesive material

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We present the results of new experiments investigating the relationship between channel geometry and tectonic forcing of single channels with constant discharge. The experimental set up consists of a box of $40\times40\text{cm}^2$ surface area filled with silica paste (mean grain size 10μm) to a depth of about 15cm. Tectonic uplift is simulated by a sinking base level and the inlet is arranged such that the channel slope can adjust itself. Discharge varies between 0.1 and 1 l/min and uplift rate between 0.05 and 1 cm/hr, leading to channels between about 1 and 5cm wide with flow velocities of order of 10cm/s.

The evolution of the channel was monitored by series of digital pictures in regular intervals (every six minutes) and high-resolution digital elevation models (pixel size 0.5mm) taken with stereometric cameras once the topography reached a dynamic steady state. Most channels reach a dynamic steady state, where the channel shifts laterally, but flow width and channel slope do not change over time and the channel floor is completely covered by alluvium. Within the channel we observe changing alluviated and 'bedrock' stretches, during its evolution we see terrace formation, knick point formation and retreat and undercutting followed by slope failures through slumping. The channel meanders at high uplift rates. Channel slope increases with uplift rate while the flow width decreases.