Geophysical Research Abstracts
Vol. 18, EGU2016-3273, 2016
EGU General Assembly 2016

Chasing waterfalls: Experimental controls on knickpoint form and migration processes

Edwin Baynes (1,2), Dimitri Lague (3), and Mikael Attal (1)

(1) School of GeoSciences, University of Edinburgh, UK, (2) Department of Geography, Environment and Earth Sciences, University of Hull, UK, (3) CNRS, Géosciences, Université de Rennes 1, France

As the link between the fluvial network and hillslopes, bedrock channels mediate the response of the landscape to changing boundary conditions, such as tectonics and climate. Such signals of transient forcing are manifested in bedrock river profiles through migrating ‘knickzones’ or ‘knickpoints’, that separate a downstream reach broadly in equilibrium with the new conditions and an upstream reach which is yet to adjust. Knickpoints therefore mark a dynamic boundary location within mountain landscapes, yet the complexities of the mechanisms of knickpoint retreat are often ignored in studies of landscape evolution.

We carried out a series of box flume experiments (65 cm long, 30 cm wide) to explore the importance of knickpoint geometry, mean discharge and substrate strength on the form and migration of knickpoints in a cohesive homogenous substrate. The retreat rate of knickpoints is found to be independent of mean discharge. Knickpoints retreat faster through a weaker substrate. The dominant control on knickpoint retreat, when discharge and substrate strength are constant, is the knickpoint form which is set by the ratio of channel flow depth to knickpoint height. Where the knickpoint height is five times greater than the flow depth, the knickpoints develop undercutting plunge pools, accelerating the removal of material from the knickpoint base and the overall retreat rate, possibly due to the trajectory of the jet at the knickpoint lip. Smaller knickpoints relative to the flow depth are more likely to diffuse from a vertical step into a steepened reach or completely as the knickpoint retreats up channel.

These experiments challenge the established assumption in models of landscape evolution that a simple relationship exists between knickpoint retreat rate and discharge/drainage area. In order to fully understand how bedrock channels, and thus mountain landscapes, respond to transient forcing, further detailed study of the mechanics of erosion processes at knickpoints, both experimentally and at the field/landscape scale, is required.