

## ***Interactive comment on “Experimental migration of knickpoints: influence of style of base-level fall and bed lithology” by J.-L. Grimaud et al.***

**Anonymous Referee #2**

Received and published: 6 November 2015

This is a really wonderful and novel experimental paper that demonstrates a mechanism to explain how and why autogenic knickpoints can form in river systems. Understanding how to disentangle external and internal influences when interpreting the morphology of bedrock channels is key to tectonic geomorphology. Consequently, this paper should be of central interest to the readership of ESURF. The novelty of this paper derives largely from the fact that this is the first time anyone has examined experimentally (and I should add in considerable detail) the controls on knickpoint form and dynamics.

The main conclusions of this paper are that knickpoint form and retreat rate primarily reflect rock type and discharge, whereas the frequency of knickpoint generation emerges from the combination of downstream alluvial thickness and this characteristic

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knickpoint form. This is a well-substantiated and yet provocative conclusion that suggests that we should be extremely cautious in the significance we attribute to discrete erosional steps observed commonly on rivers.

I think this is a fantastic paper. I just have a few points that I would suggest that the authors expand on and/or clarify that I think will help contextualize the results better and hence increase the impact here.

1. Not all knickpoints are waterfalls, and not all waterfalls form from abrasion and necessarily have plunge pools. This is not to diminish the results here. Rather, I think the MS would be improved by noting the processes and morphologies that the results bear directly on. For example, knickpoints to many people simply mean a transition in slope area space from one normalized steepness to a different one. How this type of transition propagates into a river may occur due to different processes and different physics. Alternatively, when plucking is the primary mode of waterfall retreat, as is observed in many locations, again different physics are at play. Although some of the general results may hold, it would benefit this paper to perhaps delve a little more deeply into waterfall retreat mechanics and what has been written about them. For example, people will I think be surprised to find that Mike Lamb is cited nowhere in this paper despite many very insightful papers on waterfall processes. In addition, Seidl et al (1994) hypothesized long ago that alluvial cover played an important role in the dynamics of knickpoint retreat in that it inhibits bed erosion, thereby leading to propagation of knickpoints under the armor layer. This should also undoubtedly be referenced here.

2. The conclusion that only base-level drops that exceed the alluvial cover thickness can be directly recorded by a river is really important. That said, the corollary is also worth emphasizing. The alluvial cover thickness acts like a filter on the base-level fall such that we will never see base-level fall events smaller than the alluvial cover thickness. Except in exceptional places like Taiwan, or during exceptional events like glacial floods, this means that for most rivers impulsive base-level falls are not directly

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recorded. Or, put another way, the depth of alluvial cover provides a simple metric to use in order to determine whether a knickpoint is autogenic or might contain base-level fall information directly (though even here, figure 10 suggests we should be extremely cautious).

In addition to these comments, I made the following line edits.

Page 774, Line 2 – change “influences” to “influence”

Page 780, Line 12 – change “experiments” to “experimental”

Page 780, Line 26 – do you mean Figure 7B?

Page 781, Line 16 – do you mean Figure 7C? How do we know this is exponential? It doesn't look exponential. Do you mean power-law? Should show fit here.

Page 781, Line 19 Do you mean Figures 7A and 7C?

Page 783, line 4, change “remains” to “remain”

Page 783, line 4, change “exhibits” to “exhibit”

Page 784, line 5, “militates?”

Page 785, line 22, delete one “comparison”

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Interactive comment on Earth Surf. Dynam. Discuss., 3, 773, 2015.