

***Interactive comment on* “Morphological dynamics of an englacial channel” by G. Vatne and T. D. L. Irvine-Fynn**

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REVIEWER: PAUL CARLING

"general comments"

I found this manuscript to be a potential useful contribution to the understanding of the evolution and function of englacial streams. The authors should be congratulated for obtaining survey data over many years in a demanding environment. The introduction and theoretical context are thorough and it is especially useful to draw analogy with the development of channels in homogeneous bedrock. However, the degree of detail provided in some sections reduces to vague speculation and the manuscript would make a better and more impactful paper if some of this additional information was

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excised. I provide examples below.

"specific comments"

It was not clear to me why this example of a englacial stream should be of the cut-and-close kind, rather than an engacial conduit developed along fissures. Detail of the channel morphology is diffuse within the manuscript. It is not clear if at times the conduit is surcharged (cf phreatic) or always 'vadose'. Thus it is not clear what portion of the conduit is actually part of the wetted channel. For example at line 14 Page 7628 the depth of the conduit is c. 10m giving areas of 5m² but how much of this actually conveys water? A better introduction to channel morphology could be included early in the manuscript that includes mention of meandering and cave development. Then the issues of meandering and cave development could be dropped from the later discussion tightening the work considerably. The issue of groove development is interesting but without better characterization and referencing this detail adds little. You need to improve the detail of grooving or just give it a mention in the description of the channel morphology and then leave it at that. Without a strong relation to discharge or slope the grooving is a distraction to the main thrust of the manuscript.

At line 14 page 7622 (and elsewhere) the useful comment is made that little has been said about different step morphologies and the authors split the morphologies into channel-supported and ballistic nappe flow. The reviewer made prior comment on this classification in: Carling, P.A., Tych, W. and Richardson, K. 2005. The hydraulic scaling of step-pool systems. pp 55-63 in G. Parker and M.H. Garcia (eds) River, Coastal and Estuarine Morphodynamics. Vol 1. Balkema, Taylor and Francis, NY, ISBN: 0 415 39375 2. which the authors might find useful in their revision. This paper deals with bedrock channels in homogeneous media and includes breaching of steps by low-flow channels which is a subject mentioned elsewhere in the current submission. Note that you refer to breaching by low flows at line 6 Page 7639.

At line 9 Page 7624 it is implied that there is a clear transition from meandering channel

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habit to a step-pool habit. However, as noted elsewhere in the submission the two channel forms are not exclusive - as you note at line 27 Page 7628. In passing I found the reference to certain aspects of meandering of the channels and the development of caves to be distracting. I say this because often the authors do not have detailed data to support statements which end up being vague and speculative. I provide examples below. To my mind the detail actually distracts from the main thrust of the argument of the manuscript and a better paper would result if speculation was excised.

At line 1 Page 7628 it is not evident why the submerged portion of the step height is inversely related to the step height. You need to explain this reasoning and possibly provide a diagram to support the argument.

Detail of grooves and their physical relation to steps and step walls I found confusing. In places the grooves are referred to as 'cusate'. Some information is provided on Page 7628 in Section 3 and the subject is returned to on Page 7630. From Fig 5 the grooves look very much like chute furrows described and illustrated by Richardson, K. and Carling, P.A. (2005) A typology of sculpted forms in open bedrock channels. Geological Society of America Special Paper 392, 108pp. See R& C Figs 53 & 54 & 56. Several authors commenting on bedrock channels have noted such grooving develops just above steps (probably due to the well-known draw-down of the water surface above falls) and R&C supply references on their page 40. Note that Ikeda (1978) cited in R&C relates the spacing of grooves to formative discharge. You try to suggest a relationship between grooves and a dominant discharge at line 6 Page 7636 but do not supply any justification and on Page 7638 you imply a relationship between grooves and slope (once again speculative). To illustrate these grooves a summary cartoon might be more useful to visualize them than the single Fig. 5 which does not seem to reflect the descriptions in the text.

I found that lines 13 Page 7635 to line 26 Page 7636 became vague and often included unsupported speculation. Lines 8 to 17 Page 7639 also are vague. It is not clear at all what the relationship of caves to step-pools and meandering might be from the

information you have and I would not engage in such speculation until you have better morphological data.

Much of this vague text could be excised and a stronger paper would result.

"technical corrections"

At line 6 page 7618 and at many other places in the manuscript the authors start a sentence with 'This' but do not include a subject word. Consequently a phrase and not a sentence is produced. In this case I suggest inserting the word 'observation' after 'This. ditto: line 11 page 7618 line 3 page 7628 line 23 Page 7629 line 17 Page 7633 line 25 Page 7634 line 24 Page 7636 line 8 Page 7640 line 6 Page 7641 line 2 Page 7642

At line 6 page 7620 and at line 2 page 7636 and at line 27 Page 7642 replace 'comparable to' with 'comparable with' It is 'compare with' or contrast to' not a mix....

At line 24 page 7624 delete "at depth'

At line 26 Page 7628 delete 'is' and insert 'are'

At line 7 Page 7630 delete 'groves' and insert 'grooves'

At line 9 Page 7632 parentheses around Baynes needs correcting

At line 20 Page 7634 delete 'evidenced' and insert 'demonstrated'. There is no English word 'evidenced'

At line 6 Page 7635 delete the extra 'that'

At line 5 Page 7639 delete 'less' and insert 'lesser'

At line 8 Page 7640 delete 'being' and insert 'is'

At line 11 Page 7640 delete the extra 'erosion' and 'surface'

At line 16 Page 7641 delete the reference to unpublished data. Unpublished data

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effectively do not exist and the inclusion is not helpful to the reader.

Flow directions are required in Figs. 4, 5, 7 and 8.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 12, 7615, 2015.

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