

Interactive comment on “Groundwater seepage landscapes from local or distal sources in experiments and on Mars” by W. A. Marra et al.

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General comments:

Potentially this is a useful contribution to the literature on seepage channels both on Earth and on Mars. The experiments are simple but well designed to address key questions as to the nature of channel network development due to local or distal seepage. The illustrations are informative and of very good quality. However I found the text obfuscated in places and below I try to explain how a clearer argument could be constructed such that the work will be accessible to a wide readership.

Specific comments:

1) A crux issue is the conditions which lead to either theatre-headed channels or V-slot

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headed channels. The difference in the planform nature of these two morphologies is outlined in Results and the Discussion and the difference in process controls is also alluded to throughout the work. However it would be much better if these two morphologies could be defined in the Introduction together with a planview definition diagram of the channel head morphologies and the likely channel network configurations. The processes which are known to lead to theatre-head or V-shaped channel heads also need introducing at this point. Distinctive hypotheses could then be stated and explored using the data obtained in the experiments. Instead I found the Introduction to be less than specific in orientating the reader as to what to expect in this manuscript.

2) Although the two basic experiments are distinctive I am unsure about the names given to each type as the issues of how to define ‘local’ and ‘distal’ are not considered carefully enough and references to ‘local groundwater source’ as at line 19 Page 132, amongst others, are difficult to evaluate as it is not clear just what ‘local’ means. The distal experiment consists of flow emanating from a reservoir ‘far’ upstream from the break of slope. In contrast the ‘local’ experiment consists of rainfall evenly distributed over the whole experimental sand box with infiltration occurring but in addition in some experiments overland flow occurred (e.g. line 8 Page 141) so the control is not purely groundwater. Although these two basic experimental conditions provide useful contrasting environments I am not sure if the latter should be termed a local groundwater control. A local groundwater control to me would consist of up-welling of water locally close to the break of slope rather than due to infiltrated rainfall across the whole domain (and with no overland flow). It is not evident why rainfall universally applied over the whole terrain should be termed a ‘local’ source (line 15 Page 133). 3) The results in the large are qualitative and this is not a problem but it does lead to problems with the Discussion. I found that the Discussion could have been more focussed and less speculative. The experimental conditions are necessarily constrained and thus these constraints induce limitations to the possible morphological outcomes. It would have been useful if the Discussion could have considered these limitations and further made suggestions as to what additional set-ups might prove additional insight. 4) Line

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12 Page 137 you introduce bifurcation angles here but do not provide a methodological reference until the next page. It is important to know just how these are defined. Further in the introduction we have no idea how these should vary between different process domains and so the bifurcation results are difficult to evaluate. 5) Line 20 Page 23 and Line 3 Page 140 - this cannot be a mudflow as you have sand for a bed. Revise. 6) Line 26 Page 139 here you indicate the processes show cyclic behaviour. You need to explain why this should be the case and expand on this point in the Discussion 7) Lines 5 to 6 Page 143. I have some problems here. It is not clear how the water comes to be ponded and then released. Also at line 9 we have pressurized groundwater introduced as a possible explanation. This is very vague and needs further amplification of argument for it to be accepted as a reasonable explanation. 8) Lines 20 to 25 Page 145. In the results there is no mention of hyper-concentrated flows or how this was defined. You cannot argue that this is the controlling process for morphological transition in the Discussion without providing the evidence in the Results prior. 9) Lines 12 to 15 page 151. Your argument re Martian channels presupposes they have a uniform geology as in your experiments whereas in reality structural controls might control valley alignment. In addition the meaning is not clear. Higher order channels might have a gradient that is opposite to the main channels though I cannot envisage how this is possible but if they have the 'opposite direction' then they have an identical alignment. Indeed you note structural controls latterly at line 8 page 152 Revise to clarify. 10) The Discussion re the Martian systems assumes the reader is familiar with the published arguments as to sources of (ground)water on Mars. However in places it is not clear what arguments are referring to published papers – such as the source of groundwater for Nirgal Vallis (line 9 Page 152) or if this is your speculation. Thus speculation and 'fact' are mixed up – additional citations to Martian literature are required.

Technical points:

The text uses American English spellings – I am unsure if this is journal style. Line 3 Page 130. It is not 'morphological ambiguity' – the morphology is distinct – it is the

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process uncertainty which is the limiting factor. The link between this clause and the issue of climatic implications is vague and needs clarification. Line 7 Page 130 delete 'in' and insert 'into' Line 11 Page 130 delete 'of' and insert 'for' Line 17 Page 131 delete 'by' and insert 'of' Line 27 delete 'since' and insert 'because' Line 28 Page 131 'surrounding' should be plural Line 6 Page 132 Line beginning 'Particularly' is not a sentence but a clause and needs revising. Line 12 Page 132 here and elsewhere you use 'alternate' when you mean 'alternative' – the meanings are quite different. Line 20 Page 132 delete 'to' and insert 'with' Line 21 Page 132 delete 'Since' and insert 'Because' Line 2 Page 133 'distribution' should be plural Lines 14 to 16 Page 133 there is some repetition of this information c Line 10 on Page 134 Line 7 Page 134 here and in many places you start a sentence with 'This' but no subject word. As a consequence you produce a clause and not a sentence. You either have to precede 'this' with a semicolon and not a fullstop or better add a subject word after 'This'. In this case you could add 'measure' after 'This' Line 22 Page 134 insert 'the' before 'boundary' and before 'initial' Line 24 Page 134 experiments should be singular Line 10 Page 135 delete the possessive apostrophe Line 24 Page 135 insert full stop after 'SfM'. Line 6 Page 137 insert 'is' after 'n' Line 8 Page 137 delete 'to' and insert 'with' Line 9 Page 138 delete 'slits' and insert 'splits' Line 15 Page 138 close the parenthesis Line 22 Page 138 insert 'the' before 'downstream' Line 7 Page 139 insert 'the' before 'upstream' Line 18 Page 139 and Line 9 Page 140 – insert 'walls' after 'head-' Line 22 Page 141 insert 'point' after 'This' Line 25 Page 141 'change indicates change' is awkward and also vague. I suggest you delete the first 'change' and insert 'transformation' but also explain why this morphological development is regarded as a change-point in process – this vagueness links back to the requirement to better introduce the process controls on morphology needed in the Introduction. Line 4 Page 142 delete 'to' and insert 'with' Line 5 Page 142 the meaning of 'the valleys develop around the groundwater table' is not clear and difficult to imagine – revise Line 12 Page 142 insert 'outcome' after 'This' Line 24 Page 142 delete 'instable' and insert 'unstable' Line 24 Page 142 insert 'process' after 'This' Line 26 insert 'being' before 'reactivated' and delete the Line 27 delete 'to' and insert

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'with. It is 'compared with' or 'contrasted to' you cannot mix it. Line 23 some word is missing after 'slow' Line 25 Page 143 insert 'be' after 'not' Line 8 Page 144 delete 'shows' and insert 'marks' Line 18 Page 144 insert 'order' after 'third-' Line 25 Page 144 move 'more than 500km long' to after 'valley' Line 4 Page 145 insert 'wards' after north-' Line 7 Page 145 delete full stop and insert semi-colon before 'This results' Line 8 Page 146 insert 'argument' after 'that' Line 9 insert 'those' after 'between' Line 19 Page 147 insert 'transport' after 'sediment' Line 3 Page 148 delete 'of' and insert 'to' Line 7 Page 148 insert 'portion' after 'This' Line 19 Page 148 delete 'for' and insert 'of' Line 24 Page 148 insert 'outcome' after 'This' Line 23 Page 149 insert 'the' before 'headward' Line 28 Page 149 insert 'a' before 'system' Line 5 Page 150 delete 'on' and insert 'over' Line 18 Page 150 delete 'with' and insert 'by' Line 20 Page 150 insert 'they are' before 'shallow' Line 20 Page 150 delete 'on' and insert 'of' Line 22 Page 150 delete 'Alternate' and insert 'Alternative' Line 1 Page 151 delete 'on' and insert 'for' Line 9 Page 151 insert 'a' after 'Such' Line 11 Page 151 insert 'outcome' after 'This' Line 13 Page 151 insert 'the' before 'opposite' Line 21 Page 151 a reference is needed after 'Marineris' Line 25 Page 151 – this reference to an alternative hypothesis due to glaciation cannot just be a throw-away comments. You need to address this hypothesis and refute it or excess the sentence altogether. Line 7 Page 152 insert 'a' before 'value' Line 10 Page 152 insert a reference after 'Tharsis' Line 3 Page 153 insert 'fed' after 'locally-' Line 13 Page 153 insert 'of' after 'range' Line 14 'promote' should be plural Line 23 insert 'a' after 'Such' Line 24 delete 'whos' and insert exhibits' Line 26 insert 'disposition' after 'This' Figure captions to Fig 1 and 2 delete 'photo' and insert 'photograph' Figure 3 delete 'time-lapses' and insert 'time-lapse photography'

Interactive comment on Earth Surf. Dynam. Discuss., 3, 129, 2015.