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Earth Surface Dynamics Discussions

Interactive comment on "Arctic-alpine blockfields in northern Sweden: Quaternary not Neogene" *by* B. W. Goodfellow et al.

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Responses to comments from Henriette Linge on "Arctic-alpine blockfields in northern Sweden: Quaternary not Neogene."

Responses by Bradley Goodfellow (on behalf of all contributing authors).

We thank the two referees and the editor for their insightful comments. We have modified the manuscript accordingly and our responses to Henriette Linge are outlined below.

Specific comments:

A) p. 67, l. 8-9: rephrasing is suggested for this sentence: 'Because nuclides have

likely accumulated in surface regolith at a faster rate than provided for in our model and nuclide decay has likely been less.' Rates for accumulation and decay cannot vary, but the duration of exposure and burial can?

To clarify this issue the text has been rewritten as: The key consequences of this for our subsequent analysis of regolith residence durations are that the lengths of the ice-free periods during which cosmogenic nuclides accumulate are likely underestimated, whereas nuclide decay periods during ice sheet burial are likely overestimated. If nuclides have accumulated in surface regolith more quickly than provided for in our model and nuclide decay has been less, inferred maximum erosion rates will be underestimated and regolith residence durations, for a given erosion rate, will be overestimated in our analyses.

B) p. 67, l. 26: consider rephrasing, 2x offers/offered.

Done!

C) p. 70: Clarification of what implications that can be inferred from the presence of gibbsite is important and welcomed.

The presence of gibbsite in alpine regoliths has been a highly misleading indicator of the climate under which an alpine regolith may have originated and, subsequently, its age. Because of this and the reviewer comment we have added additional text to further clarify why limited gibbsite quantities commonly form in alpine regoliths. Furthermore, we added a figure showing thermostability relationships between feldspars, weathering solutions, and gibbsite, and also the relationship between gibbsite solubility and pH.

D) p. 71-72, evidence against the glacial 'buzz-saw': Early glacial erosion of the uplands in Norway was suggested by Reusch in 1910 (Effects of glacial erosion in Norway, 11th international geology congress) as an explanation for the existence of flat upland surfaces. The modelling study of Pedersen & Egholm (2013, Nature 493, 206-210)

also suggests that glacial erosion formed the flat upland surfaces in alpine settings prior to the mid-Pleistocene transition (950 ka). Except for the predicted (and logically explained) resistance to formation of blockfields on glacially-eroded surfaces, it seems that there is not necessarily any conflict between the results of Pedersen & Egholm (2013) and the modelled total surface histories (p. 67) 'suggesting evidence that the late Quaternary has offered sufficient time for the present regolith mantles: : :to gain their respective 10Be inventories'. I think it is important to clarify why the glacial/periglacial buzz-saw model is not compatible with the findings from northern Sweden, despite the apparent agreement in timing.

This is a good point. We have modified our text to firstly highlight that the residence times and geochemical features of present blockfield regolith are compatible with the model of Pedersen and Egholm but that we consider possible early Quaternary erosion of now blockfield-mantled surfaces to have more likely been through periglacial, rather than glacial, processes.

Interactive comment on Earth Surf. Dynam. Discuss., 2, 47, 2014.