

Interactive comment on “Rock glacier characteristics serve as an indirect record of multiple alpine glacier advances in Taylor Valley, Antarctica” by Kelsey Winsor et al.

Anonymous Referee #1

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Summary: This article looks at a rock glacier in Taylor Valley and concludes that observed glacial successions are useful for studying past climates in the MDV. Overall, I think the article is well described and written, but I do have issues with their age estimate based on pond salts, as well as the description of the pond samples. Unfortunately, this is a key argument in the paper, so the lack of an age constraint requires changes to the discussion and conclusions. However, I don't think this greatly impacts the overall point.

Detailed comments:

Figure 2: I know that you can tell what is downhill from the contours, but at first glance

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the figure seems turned around and was quite confusing, until I realized it was oriented differently from Fig. 1. I recommend including a big bold arrow and 'downhill' text, so that this is immediately clear.

Section 3.2: I'm a little confused as to exactly what samples were collected from the ponds, so more clarity is needed. Were all the ponds frozen during sampling? If so, where were the samples taken? From the upper surface, from the margins? I'm particularly curious because some of the pond samples have remarkably high salt concentrations, which is difficult to reconcile with samples of surface ice, which I'd expect to have low concentrations.

Table 3: The authors should fully list all of the ions analyzed and their concentrations, as well as the listed total salt content. Assuming that the isotopes were analyzed for the same samples, these values should also be listed. I also recommend adding in the elevation to the table for easy reference.

Section 4.3: It's worth mentioning here that samples falling below the local water line suggest either evaporation or sublimation.

Section 5.3: The major source of ions to these ponds is likely dissolution and aeolian transport of salts from nearby soils, as well as inputs of snow and ice melt, and probably a small component due to direct weathering or atmospheric inputs. See the following references on Taylor Valley salts:

Keys, J. R. H. and K. Williams (1981). "Origin of crystalline, cold desert salts in the McMurdo region, Antarctica." *Geochimica et Cosmochimica Acta* 45(12): 2299-2309.

Toner, J. D., et al. (2013). "Soluble salt accumulations in Taylor Valley, Antarctica: Implications for paleolakes and Ross Sea Ice Sheet dynamics." *Journal of Geophysical Research* 118(1): 198-215.

In general, this section needs improvement. Part of the difficulty I'm having with it is that I don't know exactly what was sampled, and if only a surface ice sample was

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collected, then the measured chemistry would have little relation to the bulk pond composition/salinity. Also, the age analysis using Cl⁻ accumulation is poorly justified. First, only a snowfall source is invoked, but as I mention, this is probably minor relative to Cl⁻ fluxes from surrounding soils. Also, this assumes that the pond is a closed system, so that all the Cl⁻ that goes in does not come out, but this seems unlikely for a pond perched on a valley slope. Throw in the aforementioned uncertainty about how representative the samples are. Basically, I don't think you can come up with an age using snowfall. I recommend just removing this paragraph.

However, given that the age of these ponds is a major point in the article, this would involve some general restructuring of the later discussion and conclusions. On the whole, I find the argument for glacial successions is robust, but not the age estimate based on salt accumulation.

Interactive comment on The Cryosphere Discuss., <https://doi.org/10.5194/tc-2019-135>, 2019.

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