Reply on RC2
Beatriz Gill-Olivas et al.

As with reviewer one, we would like to thank Simon Bottrell for taking the time to review this manuscript, and for their evident engagement with the content. Their commentary is very helpful in improving the manuscript. We have addressed their concerns either by amending the text or by, hopefully, pushing back constructively to others. A point-by-point response to each of the comments is given below.

--

Simon Bottrell comments:

This study uses simplified model lab experiments to assess the potential of comminution of materials by glacial abrasion as a source of hydrogen peroxide and nutrients to the subglacial environment. This is presented in the context of “standard” models for subglacial solute acquisition. The manuscript is well organized and written and the processes and logic are clear and easy to follow. This is work that will be significant to those interested in subglacial weathering and biogeochemistry as it opens up the potential of some novel possibilities. In this respect this seems to me to be a valuable “reconnaissance” study that should inspire future work on these possibilities.

Major comments:

LL 234-239 – the r-values presented don’t carry much weight without associated P-values! We have added p values to the figures for all R² values (these were all p<0.05 or p<0.01).

L330 et seq. This discussion about the fate of radicals is a kind of “post-hoc” discussion. It relies quite heavily on the mineralogical composition of the materials tested but I don’t see that data clearly presented – was there petrographic and/or XRD characterization? Or does this rely on previous studies? (and NB: these may have been made with very different objectives in mind). To my mind this needs to be clarified and reported much more explicitly here (indeed, future work might require experiments on single minerals/model mixtures to unambiguously identify mechanisms but this present work has great value in identifying that these interesting new possibilities exist in “real” materials). The mineralogical composition of these samples was not characterized via XRD, identification was conducted using established physical properties of minerals...
that were visible with the naked-eye or with a hand-lens (x10 magnification) and further informed by descriptions of the rock outcrops in the respective catchments. We used the data provided by the elemental analyser to quantify the inorganic and organic carbon fractions in the sample as well as the S content. This, together with the mapped geologic data provide a reasonable estimate for the pyrite content of these rocks.

Minor comments:

L60 . . . of which is . . . (NOT . . . of which, are . . .) (knowledge is singular) This has been corrected in the updated manuscript.

L157 – I’m not sure that the word “furnace” can be used as a verb in this way. This has been changed in the updated manuscript to” then maintained at 450 °C for 4 hours in a muffle furnace.” (L164)

L304. Lab air contamination is mentioned – at what stage in the process was this entrained in the sample and what background/blank analyses were made?? These experiments were conducted under lab air, procedural blanks (consisting of serum vials which underwent the same treatment and sampling as those containing rock and sediment samples) were taken at each stage of the incubation. Gas samples were also taken from the headspace of the ball mill prior to crushing and interpreted as blanks. These data can be added to the data repository if the reviewers and editor think it will be useful.

LL354-5 – Previous crushing experiments . . . S L Whillans . . . provide appropriate reference to the source of these data here. The data source has been added.

LL378-380. This is the one place where the otherwise excellent organization of the text breaks down. There is a hierarchy of links here that is presented in an ambiguous and confusing way. Apparently the hydrological system of SLM is fed by the Whillans ice stream, and glaciers on Svalbard!! Need to make it clear that:

- methanogens have been found in (geographically) diverse subglacial environments (Robertson, Svalbard, SLW);
- SLW and SLM share a similar hydrological regime.

Simply putting the Svalbard example first in the current structure would help.

This has been re-arranged to make it clearer, it now reads:

“Methanogens have been found in many subglacial systems, including glaciers on Svalbard (Stibal et al., 2012; Kaštovská et al., 2007), Robertson Glacier (Boyd et al., 2010), SLW (Michaud et al., 2017), which is within the same broad hydrological system as SLM (Carter et al., 2013).” (L397-399)

We hope the amendments suggested and replies to these comments will satisfy the concerns highlighted.