Biogeosciences Discussions

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# Comment on bg-2022-205

Anonymous Referee #1

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Referee comment on "Alkalinity generation from carbonate weathering in a silicate-dominated headwater catchment at Iskorasfjellet, northern Norway" by Nele Lehmann et al., Biogeosciences Discuss., https://doi.org/10.5194/bg-2022-205-RC1, 2022

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Very nice paper!  Overall, it is a very well written, high quality original contribution to the field.

First, I response to the standard questions for reviewers:

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| 1. Does the paper address relevant scientific questions within the scope of BG? | Yes |
| 2. Does the paper present novel concepts, ideas, tools, or data? | Yes – nice set up at end of introduction. |

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| 3. Are substantial conclusions reached? | Yes |
| 4. Are the scientific methods and assumptions valid and clearly outlined? | Yes |
| 5. Are the results sufficient to support the interpretations and conclusions? | Yes – with the note that the conclusions related to hydrological flowpaths need to be fixed. |
| 6. Is the description of experiments and calculations sufficiently complete and precise to allow their reproduction by fellow scientists (traceability of results)? | yes |
| 7. Do the authors give proper credit to related work and clearly indicate their own new/original contribution? | yes |
| 8. Does the title clearly reflect the contents of the paper? | yes |

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| 9. Does the abstract provide a concise and complete summary? | Yes. |
| 10. Is the overall presentation well structured and clear? | yes |
| 11. Is the language fluent and precise? | yes |
| 12. Are mathematical formulae, symbols, abbreviations, and units correctly defined and used? | yes |
| 13. Should any parts of the paper (text, formulae, figures, tables) be clarified, reduced, combined, or eliminated? | no |
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| 14. Are the number and quality of references appropriate? | yes |
| 15. Is the amount and quality of supplementary material appropriate? | yes |

Other comments.

- L32, L73, L340 – sulphur is not only derived from pyrite oxidation as stated here, but also from oxidation of stores of reduced sulphur in wetlands (including permafrost), accumulated during anoxic breakdown of organic matter (accumulated through anaerobic microbial metabolic processes). During dry periods or permafrost melting, reduced sulphur is oxidized to $SO_4^{2-}$ and then is typically released in the next flushing event to drainage waters.

- L74, L345, L348 – acid rain is more precisely referred to as "acid deposition"
- L75 – similarly, $NO_3^-$, which can form nitric acid, can also be released through nitrification of reduced nitrogen stores in soils, and not only through fertilizer application or acid deposition.
- L36 – "decreasing permafrost probability" is not clear. Does it mean likelihood of permafrost loss?
- L86 – Not clear that this sentence includes DIC generated from heterotrophic respiration, so consider: "biogenic DIC originates from autotrophic respiration, heterotrophic respiration and organic matter mineralization (e.g., photooxidation of

DOC)".

- L120 – fix punctuation: a clause before a semicolon needs to be independent
- L121 – awkward sentence: "Especially carbonate weathering was found to be very responsive to contemporary environmental changes."
- L123 – For the sentence: "Besides the tropical region, northern high latitudes are expected in the future to experience enhanced carbonate weathering and thus a higher carbon-sink function due to increased soil $CO_2$ partial pressures and temperatures". Clarify the driver of increased soil pCO2: do you mean that it is caused by increased atmospheric $CO_2$ or from another source?
- L130 – rapid warming also can affect soil carbon stores.
- L175 – information on the soil types would be helpful.
- L200 – verb tense inconsistent
- L202-203, semi-colons should not be used here as clauses are not independent.
- L247 – should be "enhanced vegetation"
- L260 –a unique method for defining riparian zone – is there a reference for this method?
- L270 – how realistic are these assumptions? For discussion - how might alternative values affect the results?
- L276 – spelling error: should be "reasonable"
- L298 – for "Furthermore, it also showed a distinctly higher turbidity." Clarify what "it" refers to.
- L398 – the reference weathering processes in riparian zones is not fully correct. Considering that riparian zones are typically defined as linear vegetation zones (often 20 m on either side of watercourses), underlying bedrock doesn't usually follow the riparian zone exactly. Also, please clarify which disturbance of the riparian zone would change the weathering processes or hydrological connectivity. And instead stating that the riparian zone is "responsible for the alkalinity signal", it would be more accurate to state that weathering processes in the carbonate rock located in the lower reaches of the catchment is responsible for this alkalinity signal (L 404).
- L402, L443-452 – the description of hydrologic pathways here isn't fully correct and needs fixing to support conclusions, as described below in more detail. In general, to fix this issue, I would suggest replacing "riparian zone" with more precise descriptors of hydrologic pathways.

i. E.g., RE: "Increased soil moisture and shallower water tables near the stream enable both the transport of weathering agent, in the form of soil respired $CO_2$, to the weatherable material and the transport of weathered products from the groundwater to the stream." The water table doesn't enable the transport of the weathering agent; rather, weathering agent transport is a function of the hydrological flowpaths in the area.
ii. E.g., the statement that riparian zones do not respond more strongly to water infiltration than deeper water tables doesn't make sense hydrologically.
iii. The description of riparian zones collecting water for the stream isn't fully correct, as they are typically discharge zones rather than recharge zones.
iv. The conclusions in L449, L536, and L631 should be revisited after correcting the hydrological concepts..

- L470 – tunnel flow is more commonly referred to as throughflow or piping.
- L474 – should be " products' " on second instance
- L475 – statement needs to be clarified and supported better.
- L541 – need to explain why the dilution effect would be more pronounced in some catchments than others. Or consider deleting.
- L554 – could the higher AT concentration be due to lower presence of strong acids, and therefore a result of a higher percentage of weathering being derived from $CO_2$*?
- L586 – should clarify suspended sediment supply, if based on observations of turbidity. "Substrate" often refers to bed material instead of suspended material, so I suggest removing that term for clarity.
- L634 – it is more accurate to state that groundwater flows to the stream through the hyporheic zone, not the riparian zone.