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Biogeosciences Discussions

Interactive comment on "Constraints on Enhanced Weathering and related carbon sequestration – a cropland mesocosm approach" *by* Thorben Amann et al.

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Dear David, we are grateful for your thorough review of our manuscript. In the following we document the changes that we made according to your suggestions.

Reviewers comment

Our reply

1) 22kg/m2 (page 4) is a very high application rate! The plants will be growing in olivine. Is this the correct application rate or has a gremlin affected the units?

The number is correct. A high application rate was chosen for this experiment, to

induce strong and quickly observable effects. The value is similar to the maximum amount applied in a pot experiment by ten Berge et al. (2012). We added an explanatory sentence, to make sure no one stumbles upon this value. It is safe to say the Gremlins behaved well here.

2) I note you state the source of the olivine. Are there any references to other pub- lished descriptions of the material in the AÌŁheim deposit? It would be good if these could be provided, as you only give basic information concerning the mineralogy and geochemistry.

We adapted the text to a more scientific term for the origin of the sample (Almklovdalen peridotite complex) and added a few references discussing the geological and geochemical background of the material (L 2-10ff)

3) With that in mind, a good reference to the deposit might address these queries concerning Table 1: a) why is the LOI so high?; b) could you recalculate the mineral composition that the chemical analysis represents?; c) is any asbestos associated with this material?; d) total iron is given as Fe2O3 (this should be stated), yet olivine contains divalent iron. What is the iron mineral in this material?

Ad a) We assume that the comparably high LOI can be explained by the abundance of hydroxide bearing minerals like lizardite, chlorite, and amphibole, as well as hydration water bearing chabazite. A study of serpentinites of an ophiolite complex further north shows even higher LOIs of around 11Ad b) It would be possible to calculate the mineral composition based on certain norms like CIPW, however, due to the transitional characteristic of the material, a metamorphically altered magmatite, it seems unlikely that results will be interpretable. The standard CIPW norm does not consider the water content and will as such not deliver the observed minerals, listed in a). We therefore believe that our observations from the XRD analyses are more reliable. Ad c) We identified lizardite by XRD analyses. Lizardite falls into the group of asbestos minerals. Ad

d) As the XRF analysis conventionally reports the Fe content as Fe2O3, the exact split between Fe2+ and Fe3+ is unknown. Most of the iron is probably divalent, from olivine and chlorites.

4) Some typos: p4 line 15 - X-ray not x-ray; p5 line 10: magnesium not Magnesium; p6 line 21: through not trough. Check once more for other typos elsewhere!

We took care of this and checked the text once more.

5) Back to the science: do you have Si and Mg data for the plant biomass? I think this is important to give a mass balance of removal of these elements from the soil and its constituent minerals. The original study for which the experimental setup was designed deals with the effect of the olivine application on plant growth and productivity. Results are processed in another MS that is currently being finalized. We can therefore not include them in the present MS. Moreover, the present MS focusses on the weathering rates and potential for inorganic carbon sequestration and adding information about the plants would distract from the main focus. It will also elaborate the paper considerably (more material and methods, more figures, more discussion points, etc.) which is not desirable and is the main reason for us to divide the results in 2 publications.

6) Did you find any evidence of precipitation of Mg carbonate minerals, as reported for 'similar' rocks by Dipple's group? Did you look for these minerals?

As we looked only into the aquatic phase, we have no evidence of Mg mineral precipitation. During the summer the mesocosms upper parts dried out fully. Therefore, temporary precipitation is very likely. As we explained in the response to reviewer 1, the experiment was originally designed as a plant experiment, and no soil samples were taken during the summer period.

7) Both Cr and Ni are essential nutrients for a range of biological processes. I'd

prefer to avoid the use of the emotive word 'contaminant' as we'd all be dead without sufficient of these elements in our diet.

We fully agree. This is why we avoided the word. We were not able to find any occurrence in the manuscript.

8) Again, do you have any evidence for differential uptake of these elements into the crops? If there is no significant difference between treatment and control, then you have no evidence of a problem.

In the manuscript, we only discuss the release and mobility of Cr and Ni in the water phase. ICP analysis shows indeed, that concentrations of Cr or Ni in any analysed plant part (stem, leave, grain) is below the detection limit of about 2 ppm.

9) What was the mineralogical composition of the soil that was used? This should be stated, to ensure that any confounding factors (such as preferential weathering of a soil mineral already there) can be assessed. I appreciate the design of the study would avoid such factors, but it would be very useful to know. For example, does the soil contain carbonate minerals?

All data available to us was added to Suppl. Mat. S1 to generate a more detailed characterisation of the used soil.

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