Biogeosciences Discussions

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Comment on bg-2021-330

Eyal Wurgaft

Community comment on "Ocean alkalinity enhancement – avoiding runaway $CaCO_3$ precipitation during quick and hydrated lime dissolution" by Charly A. Moras et al., Biogeosciences Discuss., https://doi.org/10.5194/bg-2021-330-CC1, 2021

Dear Mr. Moras and co-authors,

Means to counter the anthropogenic increase in atmospheric CO_2 and its effects on the global climate and on the ocean chemistry, are urgently needed. The ocean, being the largest CO_2 reservoir that is in direct contact with the atmosphere, has the potential to absorb the excess-CO_2, and later counter it by increased weathering of carbonate and silicate rocks. The problem, is that these processes occur on time-scales of 10,000 – 100,000 years, while the threats posed by atmospheric CO_2 increase are immediate. Consequently, several mechanisms for accelerating the natural processes have been suggested in the past two decades. As mentioned in the introduction to your manuscript, Ocean Alkalinity Enhancement (OAE) has been pointed as one of the more promising mechanisms. Nevertheless, there is a surprisingly small number of published studies that tested OAE and associated processes in laboratory experiments. In particular, the problem of "runaway $CaCO_3$", which can dramatically reduce the CO_2-removal efficiency of OAE, has never (to the best of our knowledge) been properly addressed in controlled laboratory experiments. Given all that, we found your manuscript, entitled "Ocean Alkalinity Enhancement – Avoiding runaway $CaCO_3$ precipitation during quick and hydrated lime dissolution" very important. We found the manuscript well-organized, and we enjoyed reading it.

Below, we list several questions and suggestions that came up during the reading of the manuscript. We hope that you will find them useful.

Sincerely,

Eyal Wurgaft and Noga Moran

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Comments, questions, and suggestions:

Line 52: It is somewhat unclear to what processes do you refer. We assume that you refer to the small fraction of the acidity created by the added CO_2, that would be countered by proton acceptors other than CO_3^{2-}. For example, borate:

$CO_2 + B(OH)_4^- \square B(OH)_3 + HCO_3^-$

For which, ΔTA = 0 and ΔDIC = +1. Whether we are correct or not, we believe that a more explicit description of the processes you had in mind would make this part clearer.

Lines 65-66: since the increase in $[CO_3^{2-}]$ results from the increase in pH, we suggest re-phrasing this sentence to: "Furthermore, dissolving…and raising the calcium carbonate saturation state by increasing $[Ca^{2+}]$.

Line 106: "calculated" or "weighed" amounts?

Line 114: What is the rationale for sieving the CaO and $Ca(OH)_2$? Why 63 μm?

Lines 154-163: While the variations in DIC and TA you measured are very large, mentioning the analytical precision and accuracy of these parameters would make the methods section more complete. Were the experiments conducted in duplicate bottles? We found no mention of that.

Line 194: Morse et al., (1997) should also be cited here.

Line 335: $\Omega_{aragonite}$~2 as a lower threshold for heterogeneous precipitation was also reported by Morse et al., 2003, for the Great Bahama Banks seawater and sediment (see Fig. 5 in their paper).

Line 355: We suggest re-writing to "…$CaCO_3$ precipitation on quartz particles did occur (Figure 3).", for better clarity.

Lines 378-384: During the production of CaO, CO_2 is produced both by the breaking of $CaCO_3$, and by the production of energy required to heat the $CaCO_3$ to 1200 °C. Do these estimations take into account this accompanied CO_2 production?