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Biogeosciences Discussions

Interactive comment on "Authigenic formation of Ca-Mg carbonates in the shallow alkaline Lake Neusiedl, Austria" *by* Dario Fussmann et al.

Anonymous Referee #1

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In this work, Fussmann and couathors studied the formation of Ca-Mg carbonates in a shallow lake in Austria combining a classical geological approach and microbiology studies. They used a wide vary of methods to study the lake sediments, lake water and pore water: optical microscopy, SEM, EDX, XRD, ion chromatography and ICP-MS. Furthermore, they also studied the bacterial communities on lake water and sediments (but this is beyond my field of expertise). They obtained interesting results on the Ca-Mg carbonate formation of Lake Neusiedl. They proved that Ca-Mg carbonate minerals are formed on the water column and not as post-sedimentary process. After minor corrections this work merits publication in Biogeosciences. Below, I have listed some specific comments that might be helpful for such revision.

General comments: Authors should increase evidence to claim that dolomite is not

present on lake sediments. The evidence provided is not clear enough to distinguish between VHMC and dolomite in the diffractograms shown (see comments below). I am not convinced that the precipitate is VHMC and not dolomite (even when I expect sediments to be VHMC and not dolomite). Failure to demonstrate that precipitates are not dolomite would require rewriting part of the discussion.

Specific comments: Page 9, lines 294-306: What was the criterion to determine that the precipitate was VHMC and not dolomite? Authors claim that due to the shift of 10.4 peak of ordered dolomite, lake sediments are VHMC. However, non-stoichiometric ordered dolomites also occur in nature, showing a shift of 10.4 for lower 2thetha values (if Ca mole > 50%) or for higher 2thetha values (if Ca mole < 50%).

Page 13, figure 6: Looking at this figure, where authors marked the position of dolomite "ordering peaks", one might think that samples have dolomite. As can be seen in both diffractograms, dolomite ordering peaks (i.e., 10.1 and 01.5) seem to be present, indicating that order dolomite can be found on the lake sediments. Could those peaks belong to other phases? A complete list of identified diffraction peaks could be provided in the supplementary material to demonstrate that such peaks do not belong to dolomite. In figure caption should be indicated that such list can be found in supplementary material.

Page 13, caption figure 6: Please change "Positions of dolomite ordering peaks. . ." for "Position of ordered dolomite peaks. . ." or "Position of dolomite peaks. . .". Ordering peaks are the superstructure peaks, i.e., those that are present in dolomite diffractograms but not in calcite diffractograms. Such peaks are reflections with h0.l and 0k.l, with odd-numbered l (Lippmann, 1973).

Page 25, lines 582-590: What are daily and/or seasonal pH variations of the lake? Deelman (1999) performed experiments with variations of pH from $\sim$6 (CO_2 bubbling) to $\sim$8 (degas) and during degasification process solutions were kept at 38°C. Changes on these conditions can result in longer times for dolomite precipitation. Interestingly,

recent papers claim that dolomite formation could require several million years (Zohdi et al., 2014; Kell-Duivestein et al.,2019). In other words, dolomite could be found in deeper sediments of Lake Neusiedl. Did authors analyse deeper sediments? If not, I hope authors will continue to investigate this interesting lake in the future.

References: Kell-Duivestein, I. J., Baldermann, A., Mavromatis, V., Dietzel, M. Controls of temperature, alkalinity and calcium carbonate reactant on the evolution of dolomite and magnesite stoichiometry and dolomite cation ordering degree - An experimental approach. Chemical geology (In press).

Zohdi, A., Moallemi, S. A., Moussavi-Harami, R., Mahboudi, A., Richter, D. K., Geske, A., Nickandish, A. A., Immenhauser, A. (2014) Shallow burial dolomitization of an Eocene carbonate platform, southeast Zagros Basin, Iran. GeoArabia, 19(4), 17-54.

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