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

**Dario Fussmann et al.**

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Dear anonymous Referee #1,

we thank you for the clear and thorough review. The authors agree that the displayed XRD Spectra do not provide unequivocal evidence regarding a possible cation ordering of the VHMC phase. However, the supposed 01.5 dolomite ordering peak in figure 6 rather belongs to phyllosilicate phases like muscovite and illite. Furthermore, the 10.1 reflection belongs to Ca-Na feldspar phases. To support this statement, an excel file with XY-Processed XRD data and a figure with peaks of abundant mineral phases is added to the digital supplement folder. Nevertheless, as the sediment-powder spectra include a certain amount of noise, a "non-stoichiometric-dolomite" as defined by Sibley



et al. (1994) cannot be fully excluded in this study.

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 2$\Theta$ values (if Ca mole > 50%) or for higher 2$\Theta$ values (if Ca mole < 50%).

Reply: The authors agree that the shift of the 10.4 peak alone is not evidence enough to prove the absence of dolomite. A new figure, added to the digital supplement folder, indicates all identified mineral peaks. In this figure, no superstructural ordering peak of dolomite is observed.

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.

Reply: An excel file with XY processed XRD data and a figure with peaks of abundant mineral phases has been added. It clearly shows that the peaks found at 22 and 35° 2$\Theta$ belong to detrital phyllosilicates (muscovite, illite) and Ca-Na feldspar (anorthite), but do not represent the dolomite ordering peaks 10.1 and 01.5.

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).

Reply: Caption is now changed to “Position of dolomite peaks. . .”

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 âĹij6 (CO2 bubbling) to âĹij8 (degas) and during degasification process solutions were kept at 38âŮęC. Changes on these conditions can result in longer times for dolomite precipitation. Interestingly, recent papers claim that dolomite formation could require several million years (Zohdiet 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

Reply: The statement about fluctuating hydrochemical conditions is based upon observations by Wolfram and Herzig (2013), who processed monitoring data obtained by the “Biologische Station Neusiedler See”. These authors noticed temperature and pH changes during the winter months. They provide a mean value of 8.8 for the years 1998-2009 and mention fluctuations between annual pH values of 8.0-9.1. Unfortunately, Wolfram and Herzig did not publish the processed monitoring data set. Nevertheless, the attached table ("figure-2.pdf) provides examples of accessible pH data, which were taken in the open water of Lake Neusiedl. These data e. g. show a pH difference of 0.6 (8.5-9.1) within the year 1959.

On the one hand, the authors did not analyze deeper sediments of Lake Neusiedl, because the unconsolidated, lacustrine mud is placed directly upon coarse, semi-consolidated Pannonian strata (Loisl et al., 2018). The latter substrate was simply too hard to penetrate with the applied coring method. On the other hand, Lake Neusiedl is only of Holocene age and its sedimentary record thus comprises approximately 13000 years (Herzig and Dokulil, 2001). Based on this fact, deeper authigenic sediments and longer precipitation- or maturation times of Ca-Mg-carbonates to dolomite, as mentioned by Zohdi et al. (2014) can be excluded in this study.



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Please also note the supplement to this comment:
https://www.biogeosciences-discuss.net/bg-2019-449/bg-2019-449-AC1-supplement.zip

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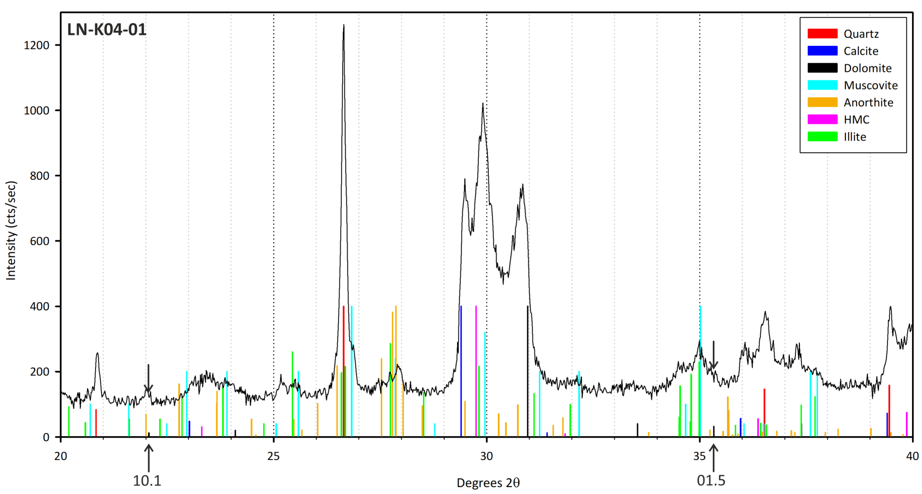


**Fig. 1.**

| pH | Date [month/year] | Data type | Reference |
|---|---|---|---|
| 8.8 | 1958 | annual mean | Schroll and |
| 8.8 | 09/1958 | single value | Stehlik (197 |
| 8.75 | 12/1958 | single value | Stehlik (197 |
| 8.5 | 02/1959 | single value | Stehlik (197 |
| 8.97 | 07/1959 | single value | Stehlik (197 |
| 9.0 | 09/1959 | single value | Stehlik (197 |
| 8.9 | 10/1959 | single value | Stehlik (197 |
| 9.1 | 11/1959 | single value | Stehlik (197 |
| 8.7 | 06/1970 | single value | Stehlik (197 |
| 8.63 | 12/1971 | single value | Stehlik (197 |
| 8.44 | 12/1972 | single value | Stehlik (197 |
| 8.62 | 02/1974 | single value | Stehlik (197 |
| 8.7 | 11/1974 | single value | Stehlik (197 |
| 9.0 | 07/1991 | single value | Dinka (1993 |
| 8.9 | 08/1991 | single value | Dinka (1993 |
| 8.5 | 07/1994 | single value | Dinka et al., |
| 8.1 | 07/1996 | single value | Dinka et al., |
| 9.5 | 07/2002 | single value | Dinka et al., |
| 8.7 | 1998-2009 | mean value from 11 annual means | Wolfram an |
| 9.02 | 08/2017 | single value | this study |