

Interactive comment on “Thermomagnetic properties of vivianite nodules, Lake El’gygytyn, Northeast Russia” by P. S. Minyuk et al.

Anonymous Referee #1

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A. General comments

Does the paper address relevant scientific questions within the scope of CP?

Yes: Rock magnetic properties of sediments are widely used in paleoclimatic research. In numerous examples they provide detailed and comprehensive information on (paleo)environmental conditions. But an inherent question often is, to which extent the results actually reflect a (paleo)environmental signal or whether the signal is biased by post-depositional processes. One of these processes might be the post-depositional formation of vivianite. Therefore, it is of wider interest to study possible effects of the presence of vivianite on rock magnetic properties of sediments and their interpretation.

Does the paper present novel concepts, ideas, tools, or data?

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Tools and interpretation approaches used are well established and not new. But this is not a disadvantage. The authors round up a variety of different methods and try to interpret the results under different aspects. This was, at least to my knowledge, not performed before on vivianite bearing sediments.

Are substantial conclusions reached?

The authors made several reasonable and plausible conclusions. But some of the results stay ambiguous without stringent conclusions with respect to the question, in how far these results query the interpretation of rock magnetic properties of vivianite bearing sediments as proxies for the paleoclimatic evolution of Lake El’gygytyn. This is a bit non-satisfying since this is one point mentioned as a motivation for the study, although it is not included in the title. Furthermore, a statement concerning the relevance of rock magnetic parameters as paleoclimatic proxies would make the manuscript more valuable for CP. If the conclusions focus on the physical interpretation of the data, the manuscript might be submitted to another journal than CP. But, one has to be fair, some of the results are difficult to explain, at least at the moment. Nevertheless the results are important (enough) to report on them, in particular under the aspect of publishing the manuscript in a special issue that will contain related articles dealing with the magnetic properties of sediments from Lake El’gygytyn.

Are the scientific methods and assumptions valid and clearly outlined?

Yes

Are the results sufficient to support the interpretations and conclusions?

Yes

Is the description of experiments and calculations sufficiently complete and precise to allow their reproduction by fellow scientists (traceability of results)?

Yes

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Do the authors give proper credit to related work and clearly indicate their own new/original contribution?

Yes

Does the title clearly reflect the contents of the paper?

I made a suggestion for a minor change to the title. Please refer to my specific comments.

Does the abstract provide a concise and complete summary?

Yes

Is the overall presentation well structured and clear?

I think in a few (minor) parts the manuscript could be a bit more concise. Some of the aspects mentioned in paragraphs results and discussion appear to be redundant.

Is the language fluent and precise?

In some instances the description of the results, in particular when mentioning details of the diagrams, is not precise enough. Sometimes it is, at least to me, not clear which part of a curve is discussed. One has to read these parts repeatedly. Finally, the reader understands what is meant by the authors, but this could be improved. (see specific comments to page 4999, line 9 - 14)

Are mathematical formulae, symbols, abbreviations, and units correctly defined and used?

In general yes, if not, I made comments under Technical comments.

Should any parts of the paper (text, formulae, figures, tables) be clarified, reduced, combined, or eliminated?

At least Figures 3 and the diagrams of Fig. 4 should be enlarged. They are really hard to read. As mentioned before, maybe parts of the results and the discussion could be

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merged and thus shortened.

Are the number and quality of references appropriate?

Yes

Is the amount and quality of supplementary material appropriate?

Does not apply.

B. Specific comments (Page numbers refer to PDF version of the manuscript)

Please add the term "high-temperature" to the title of the manuscript such that it will be read as 'High-temperature thermomagnetic...'. Otherwise the reader would expect, at least I would, that the study is about low-temperature measurements since vivianite acts as a remanence carrying mineral only at very low temperature as the authors correctly mention.

Page 4999, line 4: To me, the 'slight increase' in magnetization is rather a change in slope than a real increase, only for sample EV294 there is a very minor increase in Js. Please explain this a bit more precise.

9 - 14: Which curves of susceptibility are meant, 1st, 2nd or 3rd; to which curves of Js are they compared? This needs to be expressed more precise.

Page 5002, 19: I did not really get the point: I cannot recognize significantly increased susceptibilities in core interval 7.05-7.26m from Fig. 3 ; also for interval 9.13-9.33 m MS is not distinctly increased, it might be slightly higher than the lowest values throughout the core but are much lower than MS during, e.g., sub-stage 6.5. How does your findings correlate with the, at least from my perspective, significantly increased MS during cold stage 8.2 at about 12.75-13.00 m core depth? In this interval neither P2O5 nor MnO show increased values. Consequently vivianite is not present. Does this mean that the increased MS in this interval reflects a true paleoclimatic signal? But why is it almost as high as for warm intervals? Compared to this effect, the presence

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of vivianite seems to affect MS to only a minor extent. The argumentation needs to be clarified here. Please explain how a SIGNIFICANT increase of MS (caused by the presence of vivianite in contrast to a true climatically induced increase) is defined. Perhaps cross-plots of MS vs. P205 and MS vs. MnO could also strengthen your findings. Nevertheless: in general, I agree to your conclusion that the presence of vivianite aggregates may affect the reliability of rock magnetic parameters in terms of environmental proxies and thus has to be evaluated.

C. Technical corrections (Page numbers refer to PDF version)

Page 4990, line 4: Please replace 'weight' by 'mass-specific'

5: add hyphen to 'field-dependent'

6: omit 'the' before 'saturation magnetization'

12: replace 'product' by 'the respective products'

13: add hyphen to 'high-temperature'

14: replace '#dependence' by 'dependent'

17: replace 'mixture' by 'mixtures'

19: replace 'produces' by 'lead to'

24: insert 'a' between 'in' and 'variety'

26: replace 'phosphorous' by 'phosphorus'

Page 4991, lines 24-27: Give a more detailed motivation for the outcome of your study

Page 4992, line 2: turn 'El'gygytgyn Lake' into 'Lake El'gygytgyn'

Page 4993, line 7: Please replace 'weight' by 'mass-specific'

8: replace 'field dependent and frequency dependent' by 'field-dependent and frequency-dependent'

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10: omit 'the' before 'magnetization'

13: omit 'the' before 'saturation'

14: replace 'in field 500 mT' by 'in a field of 500 mT'

15: is it really 100°/min?

21: add the term 'microprobe' after 'CAMEBAX' if this is correct

Page 4994, line 6: Please replace 'Surface of nodules is' by 'Surfaces of nodules are'

22: replace 'phosphorous' by 'phosphorus'

22/23: replace 'coefficient correlation' by 'correlation coefficient'

23: is it really 0.55 in both cases

24: replace 'phosphorous' by 'phosphorus'

Page 4995, line 1: Interval is 24.31 – 24.73 not very prominent

8: replace 'polish' by 'polished'

13: 'attracted to a magnet in hand samples' ? Is this meant? Please reword this.

16: replace 'phosphorous' by 'phosphorus'

23: replace 'included' by 'include' and 'content' by 'contents'

24: Suggestion: 'show' or 'appear in' instead of 'take on'

Page 4996, line 7: replace 'low MS intervals' by 'intervals of low MS'

8: replace 'low magnetic' by 'low-magnetic'

9: replace 'high magnetic' by 'high-magnetic'

12: omit 'the' before 'magnetic'

14: replace 'susceptibility' by 'susceptibilities'

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19: replace 'mA' by 'A/m'
21: omit 'the' before 'very'
Page 4997, line 1: replace 'High temperature' by 'High-temperature'
5: Suggestion 'split' instead of 'broken down'
9: omit 'the' before 'heating'
15/16: replace 'curves' by 'curve'
20: insert 'the' between 'have' and 'same', insert 'the' before 'cooling'
21: replace 'curves' by 'curve', insert 'the' before 'second', insert 'the' before 'sharp'
23: Omit 'the' before 'samples'; replace 'mA' by 'A/m'
24: replace 'mA' by 'A/m'
25: is it really 'higher temperature'? Or was meant 'higher-coercive'?
Page 4998, line 1: replace 'Non reversible' by 'Non-reversible'
2: omit 'the' before 'heating'
3: replace 'shows' by 'show'
4: replace 'a presence' by 'the presence', replace 'curves' by 'curve'
5: replace 'after' by 'below'
6: omit 'the' before 'susceptibility'
7: replace 'curves of the second run are similar as for 1st type curve and display' by 'curve of the 2nd run is similar to that of the 1st run and displays'
10: omit 'the' before 'susceptibility'
16: replace 'In the samples shown In Fig. 7e the initial heating and cooling curves ' by

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'For the sample shown In Fig. 7e the initial heating and cooling curves of the 1st run'
25/26: There is no data of sample EV621 listed in Table 4. Even if this is just a typo (EV622 in Table 4) there is no Hcr/Hc for the first run. Thus it's hard to assess, which kind of particles have formed. Please clarify that.

26: insert 'a' after 'of'

Page 4999, 7: omit 'the'

9: delete 's' in 'temperatures'

12: replace 'hump' by 'humps'

15: replace 'High temperature' by 'High-temperature'

17: replace 'High temperature' by 'High-temperature'

23: omit 'and cooling' since cooling curve of sample EVSM+C (Fig. 9b) is different from those of samples EVSM and EVSM+N as is described on page 5000 lines 1 and 2

27: replace 'as the temperature decrease' by 'as temperature decreases'

Page 5000, line 3: replace 'greater' by 'higher'

7: omit 'there' after 'although'

7/8: replace 'temperature' by 'temperatures'

8: omit 'the' before 'arsenic'

10: suggestion: replace to 'sample does form magnetite' to 'sample indicates the formation of magnetite'

28: please turn it around '580°C and 685°C' instead of '685°C and 580°C'

Page 5001, line 22-24: Suggestion: reword sentence into 'On the cooling curves on both runs, no visible increase in susceptibility at the Curie temperature of monoclinic pyrrhotite is visible.'

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Page 5002, line 1: replace 'El'gygytgyn Lake' by 'Lake El'gygytgyn'

4/5: Suggestion: Reword sentence into 'The nodules and concretions of vivianite amount to a few grams per sample along the core profile (..'

8: insert 'the' before 'center'

12: replace 'proxies' by 'archives'

13: suggestion: change into 'core description, correlation and dating'

15: replace 'antiferromagnetic' by 'anti-ferromagnetic'

16: replace 'susceptibility' by 'susceptibilities'

17: suggestion: replace 'lake sediments' by 'bulk sediments'

18: omit 'the' before 'cold intervals'

24: replace 'fine grained' by 'fine-grained'

Page 5003, line 1: omit 'the' before vivianite

6: suggestion: replace 'indicates' by 'reports'

8: suggestion: replace 'indicate' by 'mention'

14: replace 'low field' by 'low-field'

15: replace 'antiferromagnetic' by 'anti-ferromagnetic'

20: Shouldn't it be the other way around: magnetic susceptibility is increased and, thus, the attraction to a magnet is increased

24: replace 'low magnetic' by 'low-magnetic'

26: insert 'the' before 'behavior', omit 'the' before 'mineralogical'

26-29: This happens during heating experiments in the lab, but will it occur also under

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natural conditions. Please comment on this.

29: change into 'heated and cooled between room temperature and 700°C'

Page 5004, line 7: insert 'of' before 'Fe²⁺'

10/11: change 'temperature' into 'temperatures of'

11: replace 'marks' by 'mark'

15: replace 'α-FePO₄' by 'alpha-FePO₄'

24: reword into 'monoclinic or hexagonal pyrrhotite is produced'

Page 5005, line 2: reword into 'On the third run the temperature has increased to 650°C.'

3: replace 'then' by 'than that of hematite and closer to that of maghemite'

4: omit 'the' before 'single'

16:/17: reword into '..at higher temperatures is of the same amount as that which had formed ...'

25: replace 'indicates' by 'indicate'

28: reword into '..at a temperature of 320°C, is formed'

Page 5006, line3: replace 'diagnostic' by 'diagnose'

11: replace 'mixture' by 'mixture'

23: omit 'the' before 'cold'; replace 'can then' by 'may'

26: please rephrase 'due to the respective products of oxidation'

Page 5007, line 1: add hyphen to 'high temperature'

3: replace 'act' by 'acts'

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7: replace 'shows' by 'show'

Tables and Figures:

Table 1: replace 'El'gygytgyn Lake' by 'Lake El'gygytgyn'

Table 2: Why are Mn and Fe not both normalized by P?

Table 4: Please add units for hysteresis parameters; EV-622-1 is EV-621-1 in Fig. 7f, please check

Fig. 3: From my perspective, this diagram is too small to see much from it. Omit all depth scales or at least tick labels except the left most one. Caption: replace 'sediments samples' by 'sediment samples'. Why is the topmost 5 m sediment missing? Thus it is not 28 m of core material but 23 m.

Fig. 4: The diagrams, not the photographs, are much too small

Fig. 5: It seems that there is only a poor linear correlation. Thus R2 may be not much meaningful. Please add how R2 was calculated (Pearson's r?)

Fig. 6: What does 'representative' means? Please explain.

Fig. 7: Run 2 is missing in Fig. 7d). Please add an explanation for the dashed lines. Caption: replace 'cursive number shows' by 'cursive numbers show'

Fig. 8: 'mA/m2' is not a unit for 'magnetization', please correct. Caption: replace 'cursive number shows' by 'cursive numbers show'

Fig. 10: Caption: Replace 'indicates' by 'indicate'

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