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Climate of the Past Discussions

Interactive comment on "Inorganic data from El'gygytgyn Lake sediments: stages 6–11" *by* P. S. Minyuk et al.

Anonymous Referee #2

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This manuscript attempts to present a data set of inorganic geochemical analyses of sediments from a selected time interval in Lake El'gygytgyn cores. The data set itself appears to be valid and valuable. Some of the ideas related to the data are also interesting. For example, the observation that samples from the glacial intervals are more depleted in mobile elements than those in interglacial is interesting and surprising, despite never being clearly explained. However, the discussion is wandering, incomplete, and deeply flawed scientifically, and it is nearly unreadable. Overall, I cannot recommend it for publication.

Even making allowances for the fact that the authors' first language is not English, the manuscript is in poor shape. Almost half the sentences have grammatical errors, commonly involving misuse of articles; agreements among subjects, objects, and verbs;

and verb tense. Beyond grammatical problems, ideas are poorly expressed or are expressed in language that is idiomatically incorrect. For example, in the title, what are "inorganic data?" – presumably this means inorganic elemental analyses of sediment geochemistry. And "sand and gravel that are supposed to be formed by ice-rafting" does not idiomatically mean what is intended. Many of these problems could be greatly improved by a thorough editing, but much of the discussion is unfocussed and poorly organized, which cannot be easily fixed.

Perhaps the biggest weakness of the paper is that the differences in geochemistry between the glacial and interglacial intervals are never adequately explained. The paper argues convincingly that neither differential weathering nor different source area are sufficient to explain the observations. Grain-size effects and diagenetic processes are offered as alternatives, but clear explanations of how these factors would produce the observed geochemical differences are not given.

A few specific comments and questions will illustrate the level of problems with the manuscript. This is by no means a complete list.

1. Why was the interval from MIS 6 to 11 chosen? As the penultimate interglaciation, the absence of MIS 5 is especially troubling. This choice seems quite fundamental, but is never mentioned.

2. P395:7-9. No units are given with the water chemistry.

3. Two different XRF methods were used to analyze for major and minor elements, yielding data that are expressed in weight percentages and parts per million, respectively. I suppose this is sufficient for comparison purposes, but it would have been nice if the analyses were recalculated to a common scale and if there were some discussion of this.

4. Sec. 3.1.1. Because biogenic silica is such an important component of the sediments, it is absolutely essential that the published BSi data be plotted along with the

other geochemical data, including SiO2 and Si/Ti in Figures 3, 5, 7, and 9. The dilution effect of BSi is mentioned in passing several times, but in reality, it has a major effect on all of the data, and it is never discussed in a coherent way.

5. P398:20-25. There is no mention of the complications involved with BSi, such as volcanic amorphous silica or non-diatom productivity. Presumably these are covered by Melles et al. (2012). The original use of Si/Ti as an index of biogenic silica was in Lake Malawi (Brown et al.), which is not referenced. After discussing Si/Ti, the text switches to SiO2/TiO2, which should be similar, but which is not the same.

6. P399:1-5. I don't understand most of this paragraph. The difference in correlation between Si and Ti in glacials and interglacials is interesting, and it may mean that BSi dilution is only significant in the warmest of the interglacials. However, I don't know how to interpret the correlation between SiO2/TiO2 and TiO2/Al2O3âĂŤthe most stable element is in the denominator of the first ratio and the numerator of the second. The discussion of this relationship being due to alteration of sediment is not only vague, it seems simplistic.

7. P399: 10-12. An assumed relation between grain size and geochemistry is referred to several times, but it is never explained. In this low temperature environment, it is not clear why there should be such a relationship.

8. P400: 1. A weak correlation between Si and Ti would imply strong and variable dilution by BSiâĂŤthis line says just the opposite.

9. P400: 18. I think that significant removal of Al by weathering in this frigid environment is highly unlikely.

10. P400: 27. The discussion of the relation between Fe and Ti contents and magnetic properties is a good idea, and the relation to MS is fairly straightforward. However, magnetic mineralogy and its relation to magnetic measurements and elemental chemistry is a very complex subject that is incomplete here.

11. P402: 3. There is a good story here concerning redox conditions and vivianite, but was vivianite actually observed or measured (the ms doesn't say)? Vivianite is readily identifiable in smear slides.

12. 3.1.4. This discussion of Cr and Ni is very hard to follow, and I am not sure it adds much to the story.

13 3.1.5. Why are Zr, Rb, Sr, and Ba discussed as a group? Zr behaves much like Ti, and Sr behaves like Ca (as implied by the correlations mentioned in the text), but why discuss them together? Rb/Sr has been used as an index of weathering, but there are far simpler ratios (e.g. K/Ti) that are easier to interpret.

14. 3.2. Geochemical indices. The first paragraph of this section is a good description of what these indices are and how they can be used, but the subsequent discussion is useless. Why discuss every index that has ever been proposed? Most are redundant and only a few have real meaning for El'gygytgyn.

15. P408: 20-23. This is one of the key observations of the paper, even if it is not in correct English. However, a convincing alternative to weathering is never described.

16. P409: 29. The difference in clay minerals between glacial and interglacial sediments might be important for the geochemistry, but what produced the difference in clays, if not weathering? Secondary clay mineral formation in this environment is highly unlikely.

17. P410: 27. Major changes in redox sensitive elements and related mineralogy can occur without changing much of the rest of the geochemistry, such as the weathering indices or the depletion of cations. This is a key uncertainty in suggesting diagenesis as an explanation for the differences between glacials and interglacials.

18. 4. Stages 11, 6.6, and 7.4. Why were these stages chosen for detailed discussion? The descriptions are interesting, but the treatments of magnetic mineralogy and diatom dissolution are oversimplified.

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