This is very interesting study of sediments from lake El'gygytgyn, NE Asia. Different magnetic parameters were analysed and allowed the identification of magnetic and paramagnetic iron minerals present in the sediment. The gool was the understanding of the relation between ferromagnetic (and paramagnetic) minerals variation and climate changes for the last 70 kyrs. Nevertheless the manuscript has to be improved in order to provide better presentation of the work. I have a lot of remarks and questions and there are many faults, which need to be corrected - this manuscript needs major revision in form and in content.

To simplify, authors want to explain the changes of the magnetic mineralogy observed, by changes in the intensity of detrital input to the lake and processes of dissolution and authigenesis in the basin, both processes acting in different climate conditions. To identify magnetic minerals, their contents and size as well as to identify some paramagnetic minerals, authors used parameters as magnetic susceptibility, magnetic hysteresis and low temperature analyses. It is very interesting, however I think, that you could explore more your results, particularly from magnetic hysteresis. Also, the probable identification of paramagnetic at room temperature minerals by in low temperature analyses should be confirmed and precised by other methods. Magnetic susceptibility is not so easy parameter to interpret. It is not only related to detrital input to the sedimentary basins, as it is often used, and as point authors, but also it depends on the processes during and after deposition. These processes can alter or even destroy terrestrial signal through magnetic minerals. In discussion about authigenesis of iron minerals in anoxic conditions, it is important to see the difference between anoxia on the bottom of the lake and in the sediment. This is also related to the time of the authigenesis – syn or post depositionary. In the case of this study, the discussion on it is extremly important since you correlate low values of the magnetic susceptibility (interpreted as due to the magnetite dissolution and the authigenesis of paramagnetic at room temperature iron minerals) with cold climate and high values of the magnetic susceptibility with detrital magnetite. Organic geochemistry is exploited just a little.

Specific (no exhaustifs) comments on form and content are below.

Introduction:

Presentation of magnetic susceptibility (k) and its relation with climate: inverse order is to be adopted – because:

*) k reflects magnetic minerals, their content and size in sediment.

**) magnetic minerals, their content and size in sediment depend on the conditions in the catchment area leading to the detrital input and in the basin – during and after deposition (early

diagenesis with transformation, dissolution, authigenese, time of modifications can be syn or postdepositional).
***) detrital input and conditions during and after deposition depend on the geological and geomorphological setting and climate.
So, the k high or low reflects local conditions, and sometime can be low during warm periods and sometime high..., what is important, is to have a look, if the magnetic mineralogy changes, why and in which way with climatic changes. It is therefore evident, that you will find in the litterature examples of the high magnetic susceptibility during warm and during cold climates. You can even find two areas close one to the second, with low magnetic susceptibility in one and high in the second during exactly the same time (Tudryn et al., 2010).

In the studied here lake, the changes in the magnetic susceptibility were recorded, and correspond to the climate changes, on line 25- "high k values can be attributed to the..." – is it an interpretation or demonstarated?
What is LZ1029-7?

2. Background
Ones more, what is LZ1029-7? (I have seen what it is later, but it needs to be introduced quickly).
From which depth cores were collected?

2.1 general geology

the correct map of the lake catchment (and more) is necessary, if possible, with geology. Different rocks of magmatic origin described can have different contents of magnetic minerals, and be present in specific areas; it would be interesting to say something about that : there are possibly different sources for detrital material and possibly different directions of the detrital input.
Todays freeze up - what is the thickness of the ice cover?
What about permafrost?

2.2 Previous magnetic analyses

Ones more, line 9-10: high susceptibility can be explained with occurrence of volcanic rocks or is due to?
I dont understand why there is no discussion about obvious changes in the sedimantion intensity and type between periods of the froozen lake and desappear of the ice cover? It operates now annualy and on a longer time scale – between cold and hot climate periods.
The time-scale has to be more preciselly described (in the chronology chapter) – what are absolute ages (how many points, in which core) and what is just correlated by magnetic susceptibility or

other parameters.

It could be useful to present TiO2 on fig. 3 with magnetic susceptibility and organic carbon.

But generally, title of this chapter is “previous magnetic analyses”, while you are speaking about organic matter, chronology and other non magnetic proxies.

2.4 – 2.5 Lake sediment core LZ1029-7 and Chronology

The description of the lithology is needed, with details used to correlation with other cores.

As asked above, you need to precise the quality of the time-scale – which and how many absolute ages were obtained in others, and which cores. How sedimentary rates are obtained for different parts of the presented here core? I understand the difficulty to obtain robust chronology and the adoption of the linear change of the age between different correlated points, but a little discussion on the very probable changes of sedimentary rate during periods with ice cover and without it has to be done.

3. Methodes

3.1 Rock magnetic measurements. What for are you speaking about ARM? You never use, never show this parameter.

3.1.1

please identify better the initial and low frequency susceptibility. If it is the same (as I understand), use just systematically one symbol for that with or without “lf” index (in volume and in mass normalized parameter). See also comments for figs 4 and 5. What for you are speaking about high frequency susceptibility?

3.1.2

hysteresis: please precise obtained from hysteresis and saturation curve magnetic parameters – you use them after.

3.2 Organic geochemistry

what for are you speaking abour δD?

4. Results

as before, be carreful with susceptibility indexes

Hysteresis :

Analyses were done on LZ1029 or on LZ1029-7? It is confusing when you compare the text of chapter with figures description.

For these analases you should present Ms/mass to show the magnetic particles content changes

through depth, Bcr and Bc (versus depth) to show if you have only “soft” magnetic minerals and slope correction/mass (with depth) – to have a look for possible paramagnetic fraction changes.

Lines 5-6 – no, it does not show magnetite, it shows soft magnetic minerals, such as magnetite, but also possibly maghemite and even iron sulphide-greigite. You can not distinguish with the shape, and generally with magnetic histeresis parameters, the magnetite from others soft- ferrimagnetic minerals.
Information on lines 8-9 about MD size is incoherent.
Line 12- grain-sizes are not on nm here, but on µm!?
Why PSD is consistent with detrital input of magnetite from the crater surrounding the lake? Different magnetic rocks from the catchment area were studied for that or not?

Low temperature analyses :
Which samples were analysed at low temperature – levels with high or low magnetic susceptibility? On Fig. 8 are presented 4 samples of the core LZ1029, from its part caracterised by generally high values of the susceptibility (if levels compared with fig 4) and 2 samples from deeper, not considered here (?) parts of the core PG1351. Where are samples from core LZ1029-7? What about samples from part with low values of the susceptibility, as between 100 and 150 cm in the presented here core LZ1029? There is not possible to observe graduations of X and Y scales on the figure. The presence of magnetite is shown by low temperature analyses. So the hysteresis above can suggest magnetite as dominant mineral, while Verwey transition here identify well its presence!
Line 23-24 Vivianite: you tell, that it was visibly observed in the lake sediment – if you add lithology in the above part, you can precise that information. Was vivianite observed in the studed here core or not, was it in particular depths or everywhere? Vivianite forms bleu dots, levels in the sediment, so was certainly observed after opening of the core. Nevertheless it is unstable at air atmosphere...Also, I am not sur if the change on 12K is indicative or only suggestive for the presence of vivianite...
Line 27 reference is needed for the possible identification of pyrrhotite, siderite and rhodochrosite.
line 29: pyrrhotite – you need to precise, because there are two pyrrhotites; hexagonale is non magnetic at ambient temperature and the monoclinic one is magnetic.
This identification of paramagnetic minerals is « delicate » and I think that it would be better if you could present others analyses to proof, to confirm the presence of these minerals. Sometime it is not easy, but for example pyrrhotite and siderite, and also pyrite, which is not searched here, have particular behaviour during Curie Balance experiment due to transformations on heating til more than 600°C.

Line 9 (page 4577): ones more – in the part with lithology description, you must add information about coring disturbances.

5. Discussion

page 4577 :
line 13 : it is not really high resolution- you have 3 m for 70 kyrs, and be carreful because your chronology is not so good.
Lines 13-15 : magnetic susceptibility is not so marked as organic matter on fig 5. Low values of the magnetic susceptibility cover larger depths zone than organic matter change.
from line 19 : no : you need to show what changes in the magnetic mineralogy and why and not just tell, that you have an evidence of the LGM, because from other proxies you know that.
Line 23-26 : Fig 9 with Mr/Ms and Bcr/Bc presents exactly the same as Day plot, and obviously for that rason there is consistency!!!! The marked point on fig 9a as showing LGM is very close to others, as you see on Day plot, on fig. 9 is so "important" due to the Bcr/Bc scale. What else do you know about this point? Is it analysed because for instance, of the particular lithology here?

Line 26-28 and page 4578 line 1-4 : it is confusing: χhf you identified in "methods – magnetic susceptibility" as high frequency magnetic susceptibility mass normalised, on discrete samples from LZ1029-7, and it is never used. Here you explain that χhf is high field magnetic susceptibility obtained from hysteresis!!! So what is it?
Last sentence (line 3-4) is incomlet.

From line 20 : yes, the same changes and ranges of susceptibility values show that its variations are not local, but affect larger area and are related to the climate/environmental change. I understand that you want to explain low magnetic contents during glacial period by anaerobic conditions and magnetite dissolution, and it is highly probable, but why you do not consider certainly different supply methods from the catchment during specific periods? You explain below, that even if there is ice cover during glaciation, there is still detrital arrival, maybe this arrival transports different kind of particles than during warm, without ice cover periods?

Page 4579 : your discussion about organic matter and anoxic conditions – lamination is the good indicator for anoxic bottom conditions, so, of you observed that, you need to precise in the lithological description of the core (above, as already suggested for other informations).

Page 4580 discussion about magnetic susceptibility : sentence : “magnetic susceptibility is typically...” is wrong, because magnetic susceptibility is an indicator of terrestial input AND processus in the basin – during and after deposition. These post depositional processes can deeply modify detrital fraction, and in that case you observe, for specific (warm or cold) period, high or low magnetic susceptibility values.

MPMS and discussion after, on pages 4581-4582 : you can not clearly identify paramagnetic iron minerals which you present here, just “suspect their presence”. Why you dont use other methods to clearly demonstrate at least one of these minerals? Just one is enough to support early diagenesis in anoxic conditions.

Your discussion about pyrrhotite -what about hexagonal pyrrhotite?

You discuss unprobability for pyrrhotite presence, but in freshwater sediments iron monosulphides (greigite), and even pyrite can be present. Why you did not just veryfy that?

You admit, that your processes of authigenesis (siderite et al.) and magnetite dissolution are synsedimentary, and you do not discuss, that it can be produced after, even a long time after deposition, in sediment. Here, the discussion about laminae (and possibly organic carbon) as indicator of anoxic bottom conditions can be useful to support the synsedimentary process. But for that, you need to show, ones more – type of sediments and lamination on lithology chapter. Is lamination just in supported by you as anoxic sequence or also elswhere? You explain, that in this core, laminae are not clearly visibles – is it because of the oxidation after extraction of the core or it is not clearly laminated?

Yes, iron carbonate appear in non sulfidic environments, but it do not excludes the first step of early diagenesis by sulphato-reduction in poorly sulfidic environment and sulfides appearance, and when sulfur is removed, iron carbonate can appear during methanogenesis.

Conclusions – I thing that it can be rewriten after corrections of the text above.

References – some references are missing

Figures

Fig. 1 : There is too general localisation map, is needed a catchment area and simplified geological map (if possible) of immediate vicinity of lake. Long cores are described in the fig description, but are not on a figure.

Fig. 2 : from which levels are photomicrographs?

Fig. 3 : X axis on both graphs are not well done; there is no mark for different scale points. On age graph there is not possible to estimate the sedimentary rates. In the text are needed sedimentary rates. What was really dated with absolute ages (in other cores) and what was just correlated? How is obtained the age of the presented sequence base? Points used for correlation have to be clearly visible, I think, that there are 3, but is it exact?
As far as you used sedimentology and stratigraphic markers to correlate with other cores, you need to add this information on the figure, photograph of the lithology is not very clear. Lithology has to be described in the text – for instance with chronology.

Fig. 4 and Fig. 5 : put the same name for the parameter – magnetic susceptibility.
The index "lf" is used for k in Fig. 5 but not in Fig. 4., and in the legend of Fig. 5 there is no "lf". Please homogeneise that.
For organic matter isotope in the graph you can add in index "org" : δ13Corg, as in the fig description.
Which core is presented on Fig. 5?

Figs 6-7-8: results are for core LZ1029 and PG1351 Where are results for LZ1029-7, announced in the title of the paper?

Fig. 6 : Day plot needs to be corrected: in the text and after you use Bcr/Bc and on figure – Hcr/Hc; the limits are not on 2 and 5 for Bcr/Bc but at 1,5 and 4. For Mr/Ms lower line is at 0,05. Add to the figure information about SD, PSD and MD magnetic grain size zones.

Fig. 7 : figures are too small and what is on x and y axis – is not liseable. There are hysteresis loops before and after slope corrections, add this information. What else is there – I can see it with difficulties after enlargement – is it saturation curve?

Fig. 8 : the same problems for lecture of the the figure – too small legend – after grosisement - -it is not readable.

Fig. 9 : Which core is it? Fig. 9 a) : Mr/Ms is lower scale and Bcr/Bc is upper, not as presented on this figure. "The most significant" point is just one, so is it really so significant for LGM? If you look on Day plot it is not so different from others. On the organic matter change you tell, that LGM is between ~100-150 cm, even if you have 140 cm max change, it operates on the sequence of ~50 cm. What about the correlation between org matter and Fig. 9c? Fig 9c is not described on the legend, what is this parameter?

Fig. 10 – which core is it?