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Climate of the Past Discussions

Interactive comment on "Biogeochemical properties and diagenetic changes during the past 3.6 Ma recorded by FTIR spectroscopy in the sediment record of Lake El'gygytgyn, Far East Russian Arctic" *by* C. Meyer-Jacob et al.

Anonymous Referee #1

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This manuscript by Meyer-Jacob, Vogel, Melles and Rosen (MVMR) deals with the use of fourier transform infra red spectroscopy (FTIR) as a quick and efficient technique for inferring the concentration of biogenic silica (BSi), total organic carbon (TOC) and total inorganic carbon (TIC) in lake sediments. Specifically, MVMR develop internal calibration models for the application of FTIR to the sediments of Lake El'gygytgyn, which provides a 3.6 million year sediment record from the Russian arctic. The benefits of FTIR in this context are clear: it provides the means to derive basic sedimentary data from a long sediment core (> 300 m) at a spatial (temporal) resolution sufficient

to address questions concerning the onset of glacial climate and glacial-interglacial climate variability in this under-represented region. This manuscript provides the building blocks with which such future research can be conducted - it convincingly demonstrates that FTIR can be used to estimate BSi, TOC and TIC concentration in these sediments. The research appears to have been rigorously conducted, and the paper is very well written to the point that I was unable to identify any minor required edits. However, there are a couple of issues which for me hinder the publication of this manuscript in Climates of the Past (CP).

Firstly, I hold doubts that the content of this manuscript are well suited to CP. Although the remit of CP includes 'Development and Validation of New Proxies', in my mind, this relates to the development of techniques through which past climates can be inferred - namely considering the interaction between climate variability and sedimentary/geochemical/biological systems. By contrast, the MVMR manuscript deals specifically with the development of a geochemical technique for the primary purpose of geochemistry. Although BSi, TOC etc. can be used to infer past environmental change, that leap is not covered in this paper and nor should it be. I therefore consider this manuscript would be better suited to a more technical geological/geochemical journal.

In addition, I am not convinced that this manuscript is novel enough for a journal such as CP. As MVMR discuss, FTIR techniques have already been developed for, and applied to a variety of lake sedimentary systems. In some ways, this manuscript is essentially a repetition of those studies for a new site, and whilst this is an important and necessary step for future research, I do not consider it to be an extremely novel piece of research in it's own right.

The real novelty of this research from a FTIR development perspective is the question of sediment diagenesis and the robustness of FTIR inferred parameters in the face of diagenetic alteration. The 3.6 Ma old sediments of El'gygytgyn provide a valuable resource with which to examine these questions, and MVMR highlight this importance in the introductory material. However, ultimately, the section which deals with diagenesis

is very brief and warrants considerable expansion in my opinion. In particular, I was not convinced by the approach to assessing diagenetic change using FTIR - by 'calibrating' FTIR spectra against depth. Whilst diagenesis should be expected to increase with sediment depth, it is certainly not the only factor and the possibility that other factors could explain the FTIR spectral change with depth is discussed only briefly. I would have preferred a more detailed discussion and examination of specific diagenetic changes, such as the dehydration/maturation of silicate, as well as organic diagenetic processes and how they might affect the original FTIR -based inferences. Certainly, a FTIR based tool to explore diagenetic patterns would be of extreme value in it's own right.

More detail would be appreciated on the way Partial Least Squares was used to develop predictive models in this context. For example, what determines the number of components used in each model? Are the wavelengths chosen dependent entirely on improving the statistical fit, or is any prior knowledge used in the selection of these wavelengths?

The final interpretative section on the environmental significance of BSi, TOC and TIC changes is largely speculative, but no more so than other papers in this field. I question whether or not this section is entirely necessary, but in the most part found it useful to place the analyses in a paleoenvironmental context.

In Figure 6, AR-BSi and AR-TOC are plotted in a way that prevents the observation of any signal younger than $\sim$3 Ma due to the marked decline in these parameters. This should be re-plotted in a way that allows the reader to compare accumulation rates vs. % data for the whole record.

Interactive comment on Clim. Past Discuss., 9, 2489, 2013.