Clim. Past Discuss., 8, C2925–C2930, 2012
www.clim-past-discuss.net/8/C2925/2012/

Climate of the Past Discussions

Interactive comment on "Testing the potential of OSL, TT-OSL, IRSL and post-IR IRSL luminescence dating on a Middle Pleistocene sediment record of Lake El'gygytgyn, Russia" *by* A. Zander and A. Hilgers

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Received and published: 20 December 2012

Answers to the referees' comments We thank the referee for her attentive and detailed review and her constructive feedback. In the following, we respond to her questions and remarks one by one into her text which is labelled with "...".

"I agree with the comments already posted by FP that this is an important paper and holds a lot of information for each of the luminescence methods applied. It will make it easier for the reader to take out the information they need if each of the methods is

presented in the same way, and so I would endorse those comments, in light of this important work."

We will rework and restructure the whole paper and add some more sections.

"I understand that material is very precious from records such as this, but it is a pity that a couple of younger samples could not have been added to this to be able to map the effective running out of the reliability of the quartz OSL, rather than only being able to show that it is not working at De values of _ 400 Gy."

The main aim of the study was to provide chronological information on the sediment record of Lake El'gygytgyn and not to conduct a comprehensive methodological study on the applicability of various luminescene dating techniques over a broad age range. The project provided a selection of samples for dating and with respect to the very time consuming measurements we had to stick to the aim – to finally deliver reliable ages for the samples. Of course, it would be more than interesting and exciting to extend the study on a broader range of samples covering a broader time window, but this would be a project of its own. In addition, the quartz content of the samples was very low and often did not even allowed for preparation of more than 10 dics.

"Perhaps as the IRSL seems problematic anyway, it may not have helped with this either. It is a little worrying that the IRSL50 was so problematic and yet the pIRIR protocol seems to be successful."

We have repeated the DRT-PHP test in the meantime. This new plateau test resulted in a stable PHP between 250 and 290 °C and measured to given dose ratios between 1.01 and 1.05. We therefore assume a technical problem during the measurement of the first pre-heat plateau and decided to measure the samples with the standard SAR-IRSL50.

"As you have a figure with the dose recovery results of the IRSL, I would recommend that you also show the same for the pIRIR."

We have not measured a dose DRT-PHP for post-IR IRSL because we have applied the post-IR IRSL protocol proposed by Thiel et al. (2010) which was designed and successfully applied to Upper and Middle Pleistocene polymineral fine grain samples and operates with a 320°C pre-heat temperature and a 290°C measuring temperature.

"4786, 8: as FP requested you should be more specific regarding the statement. The fact that an EBG subtraction does not change the values calculated using a LBG, suggests that you have successfully isolated the fast component. Then using a LBG will give you a bigger signal, and reduce uncertainties."

We will follow your suggestion and specify this statement.

"4787, 19. Would deconvolution of the Lx/Tx signal be a better way to describe it? This is an excellent way to investigate the high dose region of the quartz OSL dose response curve and seems to beautifully identify a problem. I am already applying it to older samples and intend to recommend it as an additional performance criterion for samples in this problematic region."

We will follow your suggestion and rename this observation as "deconvolution".

"Chapot et al., (A comparison of natural- and laboratory-generated dose response curves for quartz optically stimulated luminescence signals from Chinese Loess Original Research Article. Radiation Measurements, In Press, Corrected Proof, Available online 7 September 2012. M.S. Chapot, H.M. Roberts, G.A.T. Duller, Z.P. Lai) also show a very nice plot to help us identify problems with older samples. As they have an accepted chronology for the profile from which they have taken their samples, they were able to plot Ln/Tn against expected De value in their Figure 2. It would be very useful if you were to plot the same for your data for each of the protocols you apply, as you have an expected age. I suspect that even Ln/Tn against depth would be enough to highlight limits on each of the signals, but you have the benefit of a chronology already. I would recommend you try plotting the deconvolution of Lx/Tx for each of the methods as hopefully it will illustrate its usefulness. And also try plotting Ln/Tn against

depth of expected De for each of the methods aswell. I'm not sure if this will be useful for all of them (eg the quartz OSL is already in saturation so it may not show so much), but it would be good to see if it gives you more information."

We do not have the data set of all nine samples for all the different methods but we will prepare at least an overview of the Ln/Tn data against the expected age, following the example of Chapot et al. (2012) as you suggested. The deconvoluted OSL quartz dose response curve was measured as a saturation dose test at fine grain quartz. A saturation dose curve measured with the pIRIR protocol at polymineral fine grain from sample 1A6H1B is also available, showing a similar decrease of the test dose signal above 1460 Gy for the IR50 measurement and a rising test dose signal up to 1950 Gy with a following plateau up to 2920 Gy. We can put this picture in the supplementary material.

"4788, 26. Modern test quartz, can you explain exactly what this is."

This is a fairly bright ($\sim$120000 cts/0.4 s/60 Gy beta) and well behaving natural 4-11 μm quartz sample with a natural dose of 59.8 $\pm$ 3.1 Gy, which was extracted from a loess of the vicinity of Cologne. A larger quantity of this quartz was reset by heating to 500 °C for 1 hr and this material is now used as a standard sample for experiments, protocol tests and cross calibrations in our lab.

"4790, 20. More detail on fading tests." Anomalous fading was analysed using the fading tests after Auclair et al. (2003) and Huntley & Lamothe (2001).

"4791, 25. References for bleaching characteristics of feldspars."

Will be added.

"4792, 22. Should you include some discussion of the fact that 6 months storage resulted in a successful dose recovery test. Doesn't this suggest that if De values are measured immediately they may overestimate to the same extent, and that a more realistic De value may be measured after 6 months storage. This seems quite impor-

tant when we know it is difficult to separate out what exactly is contributing to a pIRIR signal."

We admit that this observation requires further investigations and repeated measurements at different samples but they would presumably go beyond the scope of this paper. We intent to prepare a methodological paper in the future to investigate this performance more detailed. We have no satisfactory explanation yet for this performance and why storage time between bleaching and irradiation is the crucial factor but we wonder if it could be induced by some kind of phosphorescence. But we do not presume that this effect has any influence on De determination because under natural conditions - as in our storage experiment - the minerals receive no large radiation dose within a short time but are re-deposited in the sedimentary body after bleaching and very slowly accumulate a new dose. Apart from the storing experiment, we were also able to recover an artificial dose after a hot bleach was administered in the reader prior to the first radiation dose, so we do not expect a problem with our measuring protocol.

"4794, 10. It's a shame that you didn't add some more regenerative doses to these measurement in order to bracket the De measured, so I understand why you can only interpret these as minimum ages. If it was possible it would be best to measure some De values that have been bracketed. If not, it would be still be useful to properly characterise a pIRIR dose response at least up to doses beyond those De values measured; you could then hopefully show that the De values would not change so much."

From the methodological point of view, we agree that it is desirable to obtain De values that have been bracketed but with regard to the limited time and the need to meet the deadline given for the special issue, we will unfortunately not be able to carry out more measurements.

Auclair, M., Lamothe, M., Huot, S., 2003. Measurement of anomalous fading for feldspar IRSL using SAR. Radiation Measurements 37, 487-492.

Chapot, M. S., Roberts, H. M., Duller, G. A. T. and Lai, Z. P.: "A comparison of natural and laboratory-generated dose response curves for quartz optically stimulated luminescence signals from chinese loess. Radiation Measurements, 2012, in press.

Huntley, D.J., Lamothe, M., 2001. Ubiquity of anomalous fading in K-feldspars and the measurement and correction for it in optical dating. Canadian Journal of Earth Sciences 38, 1093-1106.

Interactive comment on Clim. Past Discuss., 8, 4779, 2012.