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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Reliable reference for the methane concentrations in Lake Kivu at the beginning of industrial exploitation" *by* Bertram Boehrer et al.

Bertram Boehrer et al.

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Reply to short comment by Casey Quinn casey.quinn@colostate.edu Received and published: 5 August 2019

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Overall the authors have presented interesting data of Lake Kivu gas content that is needed for the evaluation of the threat those gases pose to the local communities and the potential energy resource.

We appreciate very much that the relevance for science and local communities is em-

phasized.

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Comment 1: It would be helpful to reader if the data displayed in figures 3 (Temperature, Conductivity, pH, DO), 4 (CH4/CO2 concentrations and partial pressures), and 6 (CO2 concentrations) could also be displayed in tabular form in a supplementary document or in an online database.

We are very happy to share our measurements once the manuscript has been accepted for publication and proper referencing is possible. We also appreciate the request, as it shows that the presented measurements are relevant and will be used and cited. It also confirms that the data and the measurement techniques will form the reference we intend to produce. In the final version in HESS, we can include the tabled values in a supplement, if this is requested. The display of values of probe profiles is not possible as each profile has around 10000 lines.

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Comment 2: The Figure 6 x-axis label should be CO2 not CH4

This is correct, thanks for pointing this out. We will do the correction.

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Comment 3: In section 4.3 a sentence states a quick calculation based on henry coefficients were made. In the methods section there is a reference to other manuscripts and pK values, but it would be helpful for the reader if the authors could further clarify either the Henry coefficients used in this work or improve the description of the methods used to calculate/estimate the partial pressure contributions to the total gas pressure.

The conversion of gas concentration into gas pressures is complex. However, we felt a connection between the measured gases and gas pressures should be presented to prove that the data are consistent. On purpose we did not include details as we were

aware that the conversion could be done more accurately, but this was too complex to be included in this manuscript. We will NOT present coefficients which are not optimal for calculating gas pressures. Henry coefficients for methane, carbon dioxide and nitrogen at atmospheric pressures are easily available in the literature (e.g. Sander et al 1999) also including temperature dependence. We rather refer to Bärenbold et al, a manuscript that has been submitted a few days ago, which shows what is believed to be the most accurate way to convert concentrations to gas pressures for Kivu conditions.

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Comment 4: The authors state that: "The major contributors were methane, carbon dioxide and nitrogen. While we had good measurements of methane and carbon dioxide, we missed data of similar quality for nitrogen: hence, we could not give a proper calculation of gas pressure from gas concentrations." Can the authors elaborate on what issues attributed to the missing data of nitrogen?

The sampling technique aimes at getting CH4 and CO2 concentrations measured reliably and accurately. No doubt, N2 measurements are important, but they were not the topic of this investigation. The difficulty with measuring N2 is the relatively low concentration: The forming headspace in the sampling bags consists mainly of CO2 and CH4. N2 (and H2O) form a small portion. Hence also the N2-peak in each GC diagramme is small and hence the relative error is high. In addition, air consists mainly of N2 (and O2 and little Ar). Hence a small contamination affects the N2 measurement enormously, while the effect on CH4 or CO2 is marginal. In general, the sampling bag approach is also suited for N2 quantification as shown in Horn et al, 2016. However it requires further effort to quantify the contribution of air contamination and measurement accuracy of the GC before such samples can be used for a reliable N2 quantification.

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