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Interactive comment on "Efficiency and adaptability of the benthic methane filter at Quepos Slide cold seeps, offshore Costa Rica" *by* P. Steeb et al.

Anonymous Referee #1

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The manuscript by Steeb et al. consists of two parts. One explores the current in situ methane geochemistry at two sites in the Quepos Slide (offshore Costa Rica) whilst the other uses sediments from these sites to simulate the effects of changing fluid flow conditions on the sedimentary biogeochemistry using a flow through reactor. The first part concludes that the benthic filter at these sites is highly efficient, with AOM serving as an effective barrier for methane seepage into the water column. Seepage velocities are also extracted from the numerical model. The second part concludes that, under the conditions of the flow-through experiment, the benthic filter can cope with a wide range of fluid flows (0.5-5 microL/min delivering 0.28-2.8 mmol m-2 d-1 methane, respectively) for up to 316 days, with a change in the flow regime at 260

days. The paper is well written and contains interesting insights. I think, however, that the manuscript could benefit from additional discussions and more emphasis on the assumptions behind both the numerical model and the experimental setup. The following summarizes some criticisms of specific sections:

Introduction: The introduction centred mainly on seeps and AOM, but only tangentially discusses the scientific question or the aims that the manuscript wants to address/achieve. Background information is good and important, but it is not until the last sentence in the introduction that the authors tacitly frame their research question. Further information that should go either in the introduction or in the Methods section should be the reason for the given approaches and how these approaches complement each other.

Numerical Model: The modelling exercise was performed in order to determine the site-specific areal AOM rates and fluid velocities. In general the model parameters are highly unconstrained, for example, what determines the lower boundary of the model? (i.e. What evidence exists for hydrates at 50-80 cmbsf?). Table 4 shows over 13 parameters are fitted, what procedure was used to determine a best fit? Some of the fitted values seem exceptional adn would thus require additional justification (i.e. 80 yr-1 non local mixing). Is the entire core length the mixing depth?) What evidence exists for steady state conditions? In the rate-fitting simulations, only AOM was taken into account while SRR was ignored. Justification for these assumptions and further clarifications are required in order to correctly interpret the results of the numerical model.

SLOT experiment: Maybe I missed it, but the dimensions of the SLOT cores should be given. I can infer them from the porosity data and the pore water residence time, but this does not allow for an independent assessment of the residence time. Consequently, it is also difficult to tell how much pore water was removed during the extractions with respect to the total volume of pore water. This is important to determine how the pore water concentrations may shift during the rhizon extractions. It would also help to es-

tablish to what extent the SBTZ movement is due to AOM vs. fluid displacement. A great deal of the discussion focuses on comparing the flux and AOM results of the SLOT experiment with those at other nearby sites. As the methane flux cannot be replicated due to pressure constraints, perhaps the authors could collect methane flux (both from the source and out of the sediment), AOM, fluid flow, and other environmental information from various seeps into a table to facilitate the comparison, especially as these results are at odds with the modelling and field observation of Karaca et al. (2012) and Bohrmann et al. (2002). It appears to me, based on the information provided in the manuscript, that the limitations of the experiment would make it impossible to extrapolate the results to field conditions, especially since at seeps sites methane is often found to bypass the anaerobic zone and supply energy for many aerobic communities (Boetius and Wenzhöfer, Nature Geoscience, 6, 725–734, 2013). I thus feel that better context of the experiment, such as the different methane to sulfate ratios possible in the SLOT experiment in comparison to field sites, warrants further scrutiny.

Minor revisions:

Page 16037 line 9 Parenthesis missing.

Page 16039 line 15 remove “by”.

Interactive comment on Biogeosciences Discuss., 11, 16033, 2014.