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Biogeosciences Discussions

Interactive comment on "Limitations of microbial hydrocarbon degradation at the Amon Mud Volcano (Nile Deep Sea Fan)" *by* J. Felden et al.

Anonymous Referee #1

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The manuscript described the shifts of sedimentary microbial activities, geochemistry and temperature associated with activity of a mud volcano within 3 years, and discussed about factors that regulate microbial hydrocarbon degradation especially for anaerobic methane oxidation. Observation of activity changes of deep-sea cold seep environments including mud volcano is interesting, and this study provide novel insights into geochemical and microbiological processes of surface and subsurface hydrocarbon degradation in mud volcano environments. On the other hand, observation for transition of geochemical fluxes in subseafloor environments associated with cold seep environments including mud volcano is a challenging project because geochemical fluxes in cold seep sedimentary environments sometimes vary within a meter even at the same expedition as the authors described in 3.2 (Methane and other pore water constituents) of the manuscript. I think the information of each sampling and sample

characterization presented in this manuscript is not sufficient to conclude that the observed differences between 2006 and 2009 were the results of activity changes of the mud volcano but not the local variation of each site.

Specific comments History of the mud volcano should be described and summarized in the introduction, results or discussion section. The presence of long tubeworm (Duperron et al. 2009) and carbonate crusts on the mud volcano suggests the activity of the mud volcano has been continued more than a few decades. On the other hand, mud breccia on the central dome site indicates the occurrence of recent mud eruption, and the project described here was focused on the microbial ecosystems influenced by the recent activity changes of the mud volcano.

2.1 Sampling site Were the sediment cores taken from the "same" sampling sites in 2006 and 2009? Did the authors determine specific sampling site by deploying markers or apply another technique to determine the exact sampling site? Especially for the central dome site, only the map presented in Fig1 is not likely sufficient, and more precise information about the sampling sites and sampling strategies should be given in this section.

3 Results The presence of mud blocks in the central dome area is described in this section. Such blocks may differ from surrounding sediments in physical properties and sedimentological features (grain size etc.) that influence pore water chemistry and/or heat flow (temperature gradient). Moreover such mud blocks could also be taken by both ROV and gravity core operations. Thus, sediment description in gravity coring including temperature measurements, and seafloor observation in PC sampling are important for data interpretation. I am also interested in the origin of the mud blocks. The mud volcano activity has likely continued in tens of years as described below while mud blocks we observed might recently occur.

3.2 Methane efflux and temperature gradients P345, L27: Authors concluded that microbial activity in the bacterial mat zone in 2009 was higher than in 2006. Considering

BGD

10, C4–C6, 2013

the heterogeneity of subseafloor environments in such area, number of samples used for the comparison; just one and two cores (Fig 3) in 2009 and 2006, is not likely sufficient. Additional information such as seafloor observation in the microbial mat site, sampling location, methane efflux in water column etc. that suggest the increasing microbial activity in 2009 should be given for this discussion if possible.

4.1.2 P351, L12-: The site description should be given as an independent paragraph. I believe the finding such as tubeworm and carbonate crust did not occur after 2006 but the structure of the paragraph may mislead the interpretation of the discussion.

4.2 Kinetic limitation by disturbance and heat in the central area. Sedimentary characterization of sediment cores is very important for the discussion in this section. If the sediments taken from consolidated mud blocks or lacked enough pore space for microbial life, such structure could also influence subseafloor anaerobic microbial community (eg. Rebata-Landa V & Santamarina JC 2006).

P353, L5-: Authors concluded that the temperature changes influence microbial biomass. However, they did not provide exact temperature of each sample, and temperature at seafloor at 2006 might be not too high for the growth of methanotrophs. In addition, SR in 2009 was generally lower than that in 2006, data from activity measurement were not provided at the center dome site for the 2009 samples, and cell abundance was measured for each only one PC in both years. Therefore, the data presented here is not enough to lead the conclusion. Constrains of habitability for subsurface life such as pore space and availability of organic compounds also could explain the difference between the cores in 2006 and 2009.

Table 2 Some of the AOM and SR rates present minus values (eg. 0.6 ± 6.6). Do they mean methane and sulfate production?

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