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Interactive comment on "Saturated CO_2 inhibits microbial processes in CO_2-vented deep-sea sediments" *by* D. de Beer et al.

Anonymous Referee #2

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This study was focused on biogeochemical processes and microbial activity in sediments of a natural deep-sea CO2 seepage area of Yonaguni hydrothermal system. The aim was to assess the influence of the geochemical conditions occurring in acidic and CO2 / free carbonic acid saturated sediments on sulphate reduction (SR) and anaerobic methane oxidation (AOM). Without a doubt we are dealing with interesting manuscript dedicated to a very actual and important topic, i.e. CO2 leakage associated with CCS in the deep-sea floor and its possible influence on ecosystem functioning.

General comments.

– Why traditional molecular techniques were not applied, such as the isolation of rRNA and mRNA, analysis of lipids? Simple analysis of pooled environmental RNA collected from different depths at venting site supported by simple cultivation/enrichment

attempts would significantly strengthen the outcomes of manuscript.

– The energy yield of anaerobic methane oxidation with sulfate as electron acceptor is extremely low (-16.6 kJ). Based on thermodynamic considerations, AOM is not a process to be expected to occur at low pH and at high concentration of the end product(s). Thus, Impact of CO2 leakage on AOM would be easily explained by the end-product inhibition. The Authors are referring to presence of hydrogen at venting site, but did not indicate the H2 concentration. It could be very useful to have an idea about the in situ concentration. Regarding the very low free energy calculation and the elevated presence of one of the end products, AOM would be feasible only at one important caveat – at an extremely low ambient concentration of hydrogen, which means the presence of microorganisms, actively scavenging this important donor of electrons from the environment. So, to significantly improve the manuscript, the Authors should demonstrate these data.

– More attention has to be dedicated to statistic analysis of present data. Where are the standard errors/deviations? These values should be mentioned at least in Methods.

Specific comments.

1913, lines 8-9, lines 17-19. Much more references are needed for this statement. I assume, the transport of undissociated carbonic acid through the cell membranes is not such a simple process as stated and referring to the article of Terada (1990) only without providing other experimental evidences is not sufficient.

1914. lines 1-15. As above, all these statements require much more deeply-grounded studies and experimental data. Observed inhibition of AOM and SR might also be affected both by (i) high ambient concentration of the end product(s) and/or by slightly acidic conditions (majority of AOM archaea and SRB are neutrophiles) (see comments above). What about to analyse the eventual presence of active either sulphur-oxidizing chemolithoauto- or heterotrophic microaerophilic organisms and fermenting anaerobes? Lack of AOM and SR activities is not convincing enough to declare that at

high concentration of free carbonic acid we are dealing with complete suppression of ALL microbial activities.

Technical corrections.

1908, lines 3-5. Please, rephrase this sentence for clarity that oxygen is fuelling the respiration process, but not as an electron donor.

1914. lines 7-9. Please, rephrase this sentence: "Thus, the presence of liquid or supercritical CO2 in sediments will completely suppress microbial activity and conclusively change ecosystem function as observed in the Yonaguni subsurface sediments for anaerobic microbial respiration and microbial sulphide oxidation"... As it stated by the Authors, as far as high CO2 / free carbonic acid concentration suppresses any metabolic activities, the ecosystem function can not be changed. It turns to do not be an ecosystem anymore...

Fig. 6B. Please, change the axis for MUC10 values to separate them more evidently from the rest of data.

Interactive comment on Biogeosciences Discuss., 10, 1899, 2013.