Biogeosciences Discuss., 8, C4119–C4124, 2011
www.biogeosciences-discuss.net/8/C4119/2011/

Biogeosciences Discussions

Interactive comment on "Interaction between hydrocarbon seepage, chemosynthetic communities and bottom water redox at cold seeps of the Makran accretionary prism: insights from habitat-specific pore water sampling and modeling" *by* D. Fischer et al.

Anonymous Referee #1

Received and published: 4 November 2011

Fischer and co-workers present sulfate and sulfide contents in sediment pore waters (PWs) from several cold seeps that are located in the oxygen minimum zone (OMZ) at the Makran subduction zone / accretionary prism. Sediment sampling was video-controlled (ROV), so that additional information on habitat structure are available. The sediment cores were collected around gas escape pathways according to visual observations showing a "concentric" habitat arrangement; typically with thiotrophic giant bacteria in the closer vicinity of the orifice and, at seeps that were located below the (core)

OMZ, with seep-associated macrofauna (polychaetes, clams) at further distance.

From the decrease in sulfate and the accumulation in sulfide, Fischer et al. conclude that the anaerobic oxidation of methane with sulfate as the terminal electron acceptor is a/the major pathway of sulfide production. With respect to the (more or less) matching sulfate and sulfide fluxes and according to literature data on cold seep biogeochemistry, particularly AOM, this assumption is sound. However, I would have liked to see a bit more discussion on this matter. Along these lines, it also appears logical that the escaping gas is methane but if available, the authors should show data on this or explain their assumption.

Generally, the authors found a progression of the methane-sulfate-transition-zone (here depicted as a sulfide-sulfate-transition-zone) to greater sediment depth with distance to the gas escape, particularly at the seeps below the OMZ where macrofauna was present. As correctly argued in the text, the deepening of the SMTZ is in this case not, as one would expect at first glance, related to a general decrease in methane availability and thus a decrease in AOM activity. The shape of the PW data as well as the model-approach (using the CoTReM software package) indicate that, in addition to diffusion, bioirrigation can be a controlling transport mechanism for PW constituents leading to a “hot zone” of microbial activity at comparably great sediment depth. With respect to the visual observations made, the polychaetes and clams ventilate subsurface sediments with sulfate that fuels AOM together with the upward flux of methane. Consequently, the macrofauna species function as habitat engineers, a role that is from a physical perspective as important as upward fluid flux.

The data and the conclusions drawn are of general interest to the readership of BG and beyond. However, the manuscript needs revisions before publication. Unfortunately, these are not so much on the scientific level, i.e., there is (almost) nothing really wrong, but rather related to style and grammar. This is somewhat annoying because there are a number of very well established scientists listed as co-authors who could and should have corrected this!

BGD

8, C4119–C4124, 2011

As it is now, the manuscript is sometimes a bit chaotic. While reading, I lost several times the connection between “Flare” and “GeoB-site”. As the authors targeted a variety of different seep sites, it is absolutely crucial that an easy-to-follow coding is applied. One possibility would be to drop GeoB and the 6 digits used for each core and to give the sites trivial names. The original core numbering can than be listed with these trivia in a table to provide further information on the core (that would be one more column in Tab 1).

I would further improve the text by highlighting the part about organisms/bioirrigation and putting this into the centre of the manuscript. Just the description of the cold seep alone is, from my point of view, not novel enough (anymore). However, comparably little has been published about the bio-engineering aspect and your data nicely show the importance of the macro fauna.

Further specific comments:

P9766, L20ff: This is a weak argument. Many seep biota use sulfide as an electron donor, they don’t detoxify their environment from it

P9767, L2-3: the sentence is crippled here

P9767, L19: Fig. 1 shows the bathymetry of the area but not the tectonics. I would also cut the lower part of the figure or include enlargements of the flare areas.

P9768, Section 3. I would suggest describing the sampling scheme with the different habitats etc. in greater detail and simplify as much as possible (see my comments above). It would be unfortunate if the reader gets lost here (as I did), because the rest of the paper will not be understandable anymore.

P9768, L24: give reference to Fig. 1, here it really fits.

P9768, L24: add a comma after “these four seep sites”. Orthography of the entire manuscript, particularly punctuation needs a polish.

BGD

8, C4119–C4124, 2011

P9770 first paragraph: now the reader gets the first time an idea about the logic of your sampling scheme and habitat coding... (this is one example where the text is a bit chaotic). I would move this information upwards to the beginning of section 3.

P9770, L7: this sentence is odd. I'd change to something like: After ROV and MUC retrieval...

P9770, L17: also this sentence is odd. I suggest to change it to: The reproducibility of the above methods was verified by analyzing replicated standards.

P9770, L22: erase "according to Eq. (1)

P9771, L4: exchange "derived" with "determined"

P9771, L5: explain why you used the modeled and not the measured gradient.

P9771, L13: specify how far away your sampling was from Bohrmann's site(s).

P9771, L18-20: this sentence is not well connected to the previous paragraph.

P9771, L26ff: the referencing reads oddly. Firstly, it's only one other seep that is mentioned here; secondly, it would read better if the sentence would be rephrased to something like this: Notably, CoTReM has already been applied successfully for modeling transport processes and geochemical reactions in other seep systems, namely AOM-, advection- and bioirrigation rates at several (?) mud volcanoes in the Eastern Mediterranean (Haese et al., 2003, 2006).

P9772, L3ff: If you couldn't determine porosity (core dried after PW extraction?), then explain it here.

P9772, L8-10: I'd rephrase the sentence to something like this: Instrumental values for bottom water concentrations of sulfate, sulfide and methane (?) define the upper boundary conditions. Did you measure these in cores? from niskin bottles? If the first, then I would be careful with these values because you'll undoubtedly find leaking of PW into overlying bottom water if you retrieve a gassy core from such depth.

BGD

8, C4119–C4124, 2011

Interactive Comment

P9773, section 4.1: With respect to the lack of porosity data, how realistic is a decrease from 31 to 29 mM? Could this be in the range of error/noise?

P9774, L18-19: did you measure sulfide in the bottom water, or is it just the gradient?

P9776, L10ff where you describe data: Try grouping your results: i.e, habitats X at Flare Y and Z showed similar PW data, while habitat A at these flares where characterized by... Right now, it appears to me - after reading the text twice - that you just pile up facts/data without a recognizable order. I'm sure you had something in mid, but it is not apparent for the reader.

P9778, L1ff: I think the most obvious feature is that the central habitats are characterized by much higher gradients and that sediment surface sulfide concentrations are higher (thus indicating higher AOM rates). If fluid flow is the controlling factor limiting sulfate penetration into the sediment (as e.g at Mud Vulcanoes), then sulfide levels stay low (because AOM is hampered by not having access to sulfate).

P9778, L13ff. I don't understand the discussion about shifting OMZ depth resurrecting (?)macro fauna: you noticed alive macro fauna, correct? So, apparently, these organisms are active despite the low oxygen levels. I doubt that polychaetes and bivalves can "keep their breath" for extended time periods such as eg a monsoon cycle).

P9779, L18ff: this part about lateral flow fits to the Haeckel reference above. I'd either move it there or move the first part of this particular discussion from above to here.

P9780, L5: I'd not call 5 mM change "minor"

P9780, L27ff: You can not make this statement about sulfide tolerance: As it is now, you suggest that high H2S levels are toxic for the white mats whereas the orange mats tolerate this. However, as both are thiotrophs, it could also be that the distribution of orange and white types is controlled by competition FOR sulfide.

P9781, L5-6: I guess the tubes were still sticking in the sediments, thus the worms would still have access to sulfide.

BGD

8, C4119–C4124, 2011

P9783, L11: add de Beer et al., 2006 and Kaul et al., 2006

P9783, L27: again, be careful here. Many organisms responsible for bioirrigation at cold seeps live on H2S! and actively mine for it.

P9784, section 5.4. I really liked this section

P9784, L3: I am not a modeling expert but logically, I would think that it is a problem if the H2S sink is not included. Often, all H2S is consumed in a cold seep Habitat by thiotrophs.

P9784, L21: Add Niemann et al., 2006 here (bioirrigation at HMMV)

Interactive comment on Biogeosciences Discuss., 8, 9763, 2011.