Biogeosciences Discuss., 9, C2443–C2445, 2012
www.biogeosciences-discuss.net/9/C2443/2012/

Biogeosciences Discussions

Interactive comment on "Modelling the impact of Siboglinids on the biogeochemistry of the Captain Arutyunov mud volcano (Gulf of Cadiz)" *by* K. Soetaert et al.

Anonymous Referee #1

Received and published: 16 July 2012

Modelling the impact of Siboglinids on the biogeochemistry of the Captain Arutyunov mud volcano (Gulf of Cadiz)

By Soetaert, van Oevelen & Sommer

Major comment

The authors present a biogeochemical model in which the small, but abundant tube-worm Siboglinum is explicitly described. The crucial feature of this model is that the worm in its burrow is represented as a well-mixed cylinder with intense solute exchange with the overlying water and the surrounding sediment. The model allows testing for effects of worm length, worm abundance, and upward advection velocity in seep sed-

Full Screen / Esc
Printer-friendly Version
Interactive Discussion
Discussion Paper

iments on anaerobic oxidation of methane (AOM) and sulfide re-oxidation. It turns out that a major fraction of total sulfide oxidation in the sediment of a mud volcano is mediated by the endosymbionts of Siboglinum. Furthermore, it shows that the worm's "bio-ventilation" activity homogenizes the porewater of the upper 10 cm of the sediment, pushes the AOM zone deeper into the sediment, and separates the concentration fronts of oxygen and sulfide. Thereby, the Siboglinum symbiosis successfully competes with free-living bacteria for sulfide, one of the major energy sources of mud volcanoes. The model has particular importance for AOM-dominated seep sediments, but could potentially be applied to other scenarios. The model and the model results are presented in a convincing way, the text is easy to follow and mature. I recommend the manuscript for publication in Biogeosciences Discussions and only have few suggestions for improvements.

Minor comments

P6685 L2: I suggest specifying in which sediments significant amounts of methane are produced, as this is not a general feature of aquatic sediments.

P6685 L22ff: I have the impression that the possibility of anaerobic sulfide oxidation with nitrate is played down a bit – maybe because the corresponding microbial pathways were not included in the model presented here. Beggiatoa (mentioned in L24) and other large sulfur bacteria are well known to use intracellularly stored nitrate for sulfide oxidation (e.g. Schulz & Jørgensen 2001). I also don't agree with the statement that free-living bacteria are generally unable to bridge the gap between the concentration fronts of oxygen/nitrate and sulfide. Thioploca, Beggiatoa and others show intense and large-scale vertical migration activity (e.g. Huettel et al. 1996, Kamp et al. 2006).

P6686 L20ff: I suggest including a little more detail on the biology of Siboglinum. Is it, for instance, known whether the individuals indeed vary in body length or even have the means to "adjust" their body length to the biogeochemical needs in their sediment environment? If you do not give the details here, it will later sound like a modeler's trick

BGD

9, C2443–C2445, 2012

to vary the length of the worms (i.e. “playing around with the length of the worms, until the model fits”).

P6687 L9: I suggest using the term “bio-ventilation” again.

P6689 L4: I guess again due to “bio-ventilation”.

P6691 L17: The Results and Discussion section starts with the weaknesses of the model in a very explicit way. I appreciate that the authors discuss the limitations of their model, but suggest doing this at a later stage of the Discussion. This section is almost a bit discouraging and will prevent some people from reading the rest of the manuscript.

P6692 L6: One may want to combine this section with the last paragraph of the Introduction.

P6692 L21: I find “where sulfate consumes methane” a bit too sloppy.

P6698 L13: “for worms of 11 cm in length”

P6700 L10ff: The model might also be applied to benthic macrofauna species that stimulate the efflux of N2O or CH4 from aquatic sediments AND emit N2O or CH4 due to bacterial activities directly associated with their body (Stief et al. 2009, Figueiredo-Barros et al. 2009).

Interactive comment on Biogeosciences Discuss., 9, 6683, 2012.