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Discussions

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

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Dr. Burnol argues that our sites differ in some aspects from deep sea CO2 storage sites. We agree that hydrothermal vents emitting CO2, such as those investigated in the Yonaguni Knoll IV field are no examples for the storage itself, but are certainly useful natural analogues for the leakage of CO2 from an offshore CO2 storage site e.g. for the effects on sediment microbiology.

Based on the physical conditions indeed leakage of CO2 from sub-seafloor formations in >3000 m water depth is limited to diffusion of dissolved CO2, which is slow and ineffective, because at these pressures and the typical low temperatures in the surface sediments the density of the (liquid) CO2 is higher than that of seawater and surrounding porewater and hence, the pure CO2 phase will not rise towards the seafloor and

will form solid gas hydrate with the porewater. This has been discussed in detail in the paper by House et al. (2006)to which we have referred. So here we agree to the comment of Dr. Burnol.

However, all offshore CO2 storage sites, either in operation (Sleipner, Snohvit, Otway) or in the planning (Don Valley, Roads, Gorgon etc), are in much shallower water depths. This will very likely also be the case for all future offshore projects because of the tremendously high costs for sites in >3000 m water depth, arising mainly from the transport distances for the CO2 from shore (see cost estimates in the IPCC 2005 report). Thus, we believe that investigating analogues in shallower water depths is useful for the CCS discussion.

The two investigated seep sites, Abyss Vent and Swallow Chimney, represent suitable analogues for studying CO2 leakage under p-T conditions without and with the possibility of CO2 hydrate formation, respectively. At Abyss Vent the temperatures are too high for CO2 hydrate to be stable, i.e. >11 °C, even up to ∼100 °C where the CO2 is even in supercritical state (> 31 °C and >74 bar). At Swallow Chimney the temperatures drop below 11 °C a few decimeters below the seafloor and CO2 hydrates can form; geochemical details will be discussed in a separate paper. However, this does not change the environmental impact that arises from the extreme dissolved CO2 concentrations (low pH and high amount of H2CO3), because the solubility of CO2 remains in the same range for the liquid, supercritical and hydrate phase under the p-T-S conditions of the study area, i.e. 1-1.7 M.

We thank Dr. Burnol for drawing our attention to the paper of Eccles et al. on the storage options of CO2. However, the focus of our study is rather on the environmental impacts from potential CO2 leakage. We are grateful for Dr. Burnol's knowledgeable comments and will use them to improve our final manuscript.

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