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Interactive comment on “Geophysical and geochemical signatures of Gulf of Mexico seafloor brines” *by* S. B. Joye et al.

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General comments

Brine discharge through the seafloor has become a common observation in the Gulf of Mexico but also elsewhere such as in the eastern Mediterrnean sea, both on the Mediterranean ridge (e.g. MEDINAUT/MEDINETH, 2000) and the Nile deep sea fan (current studies in the frame of the Euromargins Programme). In the Gulf of Mexico, there has been a long time series of observations of brine accumulations, and in contrast to other areas such as the Mediterranean where investigations of brines started more recently, a vast amount of data has been collected over the years at a few brine sites, thus providing valuable information on the temporal dynamics at these sites. The temporal dimension is important to ecosystem studies. The paper by S. B. Joye et al is excellent in presenting a unique set of geophysical and geochemical data collected at two particular sites of seafloor brines along the continental slope in the Gulf of Mex-

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ico, GC233 and GB425, over a time period of several years (e.g. Temperature profiles measured between 1991 and 1998 shown in Figure 6). With time, observations have become sharper thanks to dedicated tools such as the “brine-trapper”.

Specific comments

What do the data tell us about the dynamics of the brine discharge process. Joye et al present theGC233 site as “a more stable, stratified brine pool whereas GB425 is a well mixed, mud volcano type fomation in which fluid discharge generates episodic temperature fluctuations in the overlying bottom water”. Is the contrast as strong as suggested? Clearly, temporal changes of the temperature profiles shown in Figure 6 suggest non-steady state flow regimes not only in GB425 but also in GC233. One may wonder how much we know about the brine flow at both sites. Does the strength of bubble streams reflect the strength of the brine flow? Does gas emission relate to brine seepage at all? Could we have missed mixing events in GC233 because of a loose time sampling? This is certainly an encouragement for the authors to develop long term monitoring experiments. From a geological viewpoint, the GC233 brine mound (Figure 3) has recorded several events of mud accumulation (eruption? I am not familiar with the area), which suggests a long history of episodic mud/brine/gas venting. Could the authors expand on “The elevation of the GC233 mound, sediment slides and bacterial matsĚ.and a raised dikeĚ.provide evidence that the pool was excavated by a vigorous discharge of fluid”? There is also a brine budget issue. Have brine overflows been observed at the edges of the brines, compensating for the brine input at the bottom?

The brine discharge process includes a fluid source at depth. Warm brines, up to 48°C, imply a source at a depth that may be several kilometers. As pointed out by the authors, salt tectonics induce active faulting and deep fluids may then migrate to the seafloor along fault networks. A simple model is that these warm fluids become enriched in salt from halite/evaporite dissolution during migration to the seafloor through salt layers. Salt layers are not necessarily at shallow depth (1-2 km depth in the eastern Med). This model appears to broaden the view that “When salt diapis breach the sediment-water interface or extend to the shallow sub-bottom depths (<50m), brine dominated seepage drives formation of brinefilled basins or smaller brine pools". It would be worth deepening the discussion of the geochemical data in terms of brine transport processes. One may also suspect that microbial activity plays a major role in the geochemical budget.

Any estimate of the depth of the brines?

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