

Interactive comment on “How significant is submarine groundwater discharge and its associated dissolved inorganic carbon in a river-dominated shelf system-the northern South China Sea?” by Q. Liu et al.

Anonymous Referee #2

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This is an interesting paper suggesting that groundwater may play a major role on the carbon cycle off the Pearl River. I welcome this contribution since the last (and perhaps the only one!) major paper on SGD/DIC was Cai's 03 GCA paper. The sampling strategy was appropriate and the conclusions are overall sound. While I believe this paper should be ultimately published, I have a series of concerns/suggestions roughly in this order of importance:

1) The three endmember mixing model relies heavily on alkalinity under the assumption that alkalinity is conservative. However, SGD is suggested to be a source of alkalinity

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and many other processes may drive non-conservative alkalinity behaviour both in the estuary and on the shelf. This assumption needs to be clearly stated and discussed in the manuscript. The authors briefly state in page 12394 that alkalinity was conservative, but later claim that SGD is a source of alkalinity – this contradiction needs to be reconciled. I feel that a simple alkalinity versus salinity plot would better support their model and allow the reader to judge this assumption.

2) The groundwater endmember is a major problem in the paper (as in most SGD investigations). In this case, the authors are relying only on nearshore samples. I would be surprised if their nearshore groundwater samples have the same composition of offshore groundwater that is presumably discharging to the shelf. At least some comments on that would be helpful. My guess is that their nearshore deep groundwaters would be much more enriched in radium isotopes than offshore groundwaters discharging on the shelf; if this is the case, their SGD estimates may be very conservative.

3) I missed reference to Burnett's FSU group Yellow River work – another Chinese river-dominated margin. Peterson has used radium isotopes to estimate SGD nutrient fluxes and mixing rates off the Yellow River. As there are very few studies in Chinese systems and river dominated margins in general, I feel that Peterson's study could be used to put the Pearl River in a broader regional/global perspective. Peterson, R.N. et al. 2008. Radon and radium isotope assessment of submarine groundwater discharge in the Yellow River Delta, China. *Journal of Geophysical Research* 113, C09021. Peterson, R.N. et al. 2008. Determination of transport rates in the Yellow River-Bohai Sea mixing zone via natural geochemical tracers. *Continental Shelf Research* 28, 2700-2707.

4) Abstract, line 5: I suggest replacing “carbon dioxide parameters” with “carbonate system parameters”.

5) Page 12388, line 22: I find hard to digest that the increase in radium with distance offshore could be simply related to the dispersal of river plume. Can you provide stronger/clearer support for that?

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- 6) Page 12391, line 6-7: I believe this belongs to discussion.
- 7) Page 12392: How have you obtained uncertainties for the radium-derived water ages? Please be clear.
- 8) Equation 1: I suggest the addition of a note on why the ratios between other isotopes (such as $^{224}/^{228}$ or $^{224}/^{223}$) were not attempted. Larger analytical uncertainties? Do they compare well?
- 9) Page 12395: I suggest omitting most of the text about endmembers (lines 5-15) and show these values in a table.
- 10) Page 12397, Line 7: More detail on Moore 07 approach would be useful.
- 11) Page 12400, Line 10: "Fresh SGD". As far as I understand, the authors claim to be quantifying saline SGD. How was fresh SGD estimated?
- 12) Page 12400, Line 20: When comparing the Pearl River to other systems, avoid vague terms such as "similar" and "higher". I suggest spelling out the values from the literature. In addition, Cai and Moore's estimates are for tidal creeks and estuaries – any comparison between shelf waters and creeks needs to be qualified.
- 13) Page 12401, Line 23: "...contributions from the river plume and coastal upwelling". The contribution of upwelling has not been quantified in this paper, so it is hard to follow how it can be compared to SGD. Please revise.

Overall an interesting contribution that should lead to further work on this timely topic.

END

Interactive comment on Biogeosciences Discuss., 8, 12381, 2011.

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