Hydrology and Earth System Sciences

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Discussions

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Interactive comment on "Identification of anthropogenic and natural inputs of sulfate into a karstic coastal groundwater system in northeast China: evidence from major ions, δ^{13}**C**$_{\mathrm{DIC}}$ and δ^{34}**S**$_{\mathrm{SO_4}}$" *by* D. Han et al.

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This is an interesting and generally well-written paper that makes a good contribution to the competing impacts of seawater intrusion and anthropogenic inputs in coastal aquifers. It is suitable for publication in HESS following moderate revision as outlined below, I think that the paper requires

a) A rethink about what material is strictly necessary in Section 5 and/or better guidance to how the information addresses the main points of the paper. This is probably

the major concern.

b) More consideration as to how this study can inform others elsewhere in the world.

c) Some reorganisation of the introduction and results section.

I hope that the comments are useful to the authors in revising this study.

Specific Comments

Abstract

The abstract provides a clear and concise summary of the aims of the paper together with the key results.

Introduction

The introduction provides good background to the study and places it in an international context. Some of the referencing appears to be getting a little dated (mostly before 2012), and I'd suggest that the authors consider whether there are any important more recent papers that they can cite.

The first paragraph on pg. 11334 could use a few more details. Specifically, it is not clear what is meant by "more serious" and "a range of strategies" etc. Without a detailed knowledge of the area it is difficult to assess exactly the extent of the problem or what has been done to address it. If you provide a few more details, the context will be clearer.

There is also some repetition of ideas in this section. The statements regarding the need to distinguish seawater intrusion from anthropogenic activity and the use of tracers appear both in the last paragraph on pg. 11333 and the final paragraph in this section. I think the flow of the paper would be improved if the paragraph on seawater intrusion in the Dalian area (top pg. 11334) was merged into Section 2 (as it is really a detail about the study area) and have the introduction focus on the broader issues; the statement of aims at the end of the introduction provided sufficient information about

the specifics of the study.

Study Area

The statement regarding the natural flow in the area (top of pg. 11335) should be referenced.

Pg. 11335 line 9. Define m.a.s.l on first usage.

The description of the geological framework on pg. 11335 would be much easier to follow with a cross-section. I'd suggest adding a stratigraphic cross-section to Fig. 1 or if that information is on Fig. 9 to move that figure to earlier in the paper and use it to also illustrate the geology.

The last paragraph (pg. 11336) just compares averages, which may or may not be informative. For example, if one area increased in salinity by say 10 fold but the rest of the areas remained similar, the average salinity has increased but the pattern is skewed by a small subset of data. Try to put more details around this as it is the main rationale for doing this study, so consider the ranges as well as the averages. If the data comes from the same suite of bores then you can apply t-tests or Z scores (or something similar) to assess this; at the very least report the ranges.

Methods

Section 3.1. Most of the methods are appropriately described, a few additional details on the C-13 analysis (specifically the preparation device, I assume automated headspace analysis using continuous flow) and the S-34 analysis (probably combustion in an EA) would be good.

Section 3.2. The assumption of Cl being conservative (pg. 11137, line 25) should be better justified. In addition to halite from the aquifer matrix, there is the possibility that contaminant sources introduce Cl. Did you analyse Br, in which case the Cl/Br ratios can be used. Otherwise, you need to be more definitive in ruling out addition of Cl from other sources.

Results

The results section is comprehensive and the data is well described. There is a tendency, however to mix observations and interpretations, for example:

Pg. 11339, line 6 – calculated seawater fractions

Pg. 11139, line 13 – inference of anthropogenic inputs

Pg. 11140, line 12 – interpretation of the C-13 data

This interpretations would be better in Section 5 where you interpret the data.

Discussion

Section 5.1. The start of this section is where the discussion of seawater mixing from Section 4 belongs.

Page 11341 last paragraph. I struggled to understand the argument here. Surely this approach is just dealing with the details of the chemistry and whether or not major salinization is occurring should be apparent from TDS or Cl changes. I'm not sure that this adds much and it could be replaced with a statement just reiterating the changes to TDS over time (which is in Section 2).

Overall, Section 5 is too long and tries to describe too many things. The thrust of this paper is to distinguish between anthropogenic inputs and seawater intrusion and you should try to keep this as the main focus of the paper. You do get to this at the end of Section 5 but there is a lot of other material in this section that looks to be in there in order to provide a full geochemical interpretation. While that is OK, it does detract from the main message. I'm not convinced that the carbon story is central to answering your main questions and that section probably could be omitted or shortened substantially. If you can keep this section focussed, you can make a more convincing case as to the importance of anthropogenic inputs.

It may be that you need to discuss processes such as ion exchange or mineral disso-

lution in order to fully understand mixing, in which case you need to guide the reader through the process better. For example, Section 5.2 discusses the interaction with carbonate minerals and while it represents a comprehensive analysis, it is not immediately clear how understanding this helps us with the question of mixing vs. anthropogenic inputs.

Try to assess critically how each piece of information informs your key hypotheses and then omit or shorten sections that might be just interesting but peripheral but explain more fully how the others relate to the key issues. The main question that you are answering seems to be that while the salinity is decreasing following a cessation of pumping, the sulfate and nitrate are behaving differently and it is important to know whether that is due to contamination – so try to keep everything focussed on that.

Conclusions

This section just summarises the main findings of the project. In the introduction you make some general statements about the need to understand processes in these impacted coastal aquifers in general. In this section explain in more detail how your project helps us to understand processes in these environments more broadly; the paper will have more impact if researchers from elsewhere in the world can see relevance to their studies and a paper in a major international journal such as HESS needs to have broad appeal.

Figures

Fig. 1. Make sure that the localities that you discuss in the text are on this Figure (or the inset) and add latitude and longitudes as you also use these in the text.

Figures 2-4 & 6-8. I really struggled with the difference in colours (light blue vs. grey), either make these more contrasting (e.g. dark colour vs grey) or use different symbols

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