



Interactive comment on “Identifying the origin and geochemical evolution of groundwater using hydrochemistry and stable isotopes in Subei Lake Basin, Ordos energy base, Northwestern China” by F. Liu et al.

Anonymous Referee #2

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General Comments

This is not a paper that I can recommend be published in an international journal such as HESS. While I think I agree with most of the interpretations, the paper is almost wholly parochial and describes processes in one small part of a regional-scale basin. The interpretation of the geochemistry is relatively straightforward and follows a recipe that has been well described in many papers and textbooks; there is nothing in this interpretation that provides geochemical researchers with any better general under-

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standing of processes or how to interpret them.

The paper commences with a discussion of the study area and then proceeds to look at data from a small part of it. Even if it is accepted that it is important to understand processes in that particular area (which is not justified), then it needs to be explained at the end of the paper how the results from this study fit in with the broader hydrogeology of the region. As it is, the paper just describes processes in this small sub-basin in isolation. It is also mentioned that this work is required to manage the water resources, but it is never explained how.

There is also a reliance on geochemistry alone. Figure 3 shows a flow map, but this is only used as background. It would be much better to discuss the geochemistry in the context of flow within the aquifers.

If the paper put the results from the hydrogeology of the Subei Basin into a broader regional framework then it would be better, but I still can't see how it would be of interest to researchers working in other areas and as such it probably belongs in a regional journal.

I understand that negative reviews are never pleasant but for work to have impact it needs to be well framed and say something new. I have made a number of specific comments below that I hope will be of use to the authors in revamping this paper.

Specific Comments

Abstract

The abstract is a clear summary of what the paper addresses, however, try to put a few more results in here. For example, by how much do the stable isotopes differ between the groundwater from the various aquifers? How much evaporation do you think has taken place? In general, where possible avoid qualitative descriptors such as higher, lower, strong etc as they are not that meaningful. Also, there are a couple of probably superfluous pieces of information in here; is it really necessary to say that the water is

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meteoric (99.9% of groundwater is)?

1. Introduction

The introduction starts off with a description of the study area and aside from a few sentences (lines 12-17) that outline the general background, it is almost entirely focussed on the Ordos Basin. Given that HESS is an international journal with a broad readership, you need to add a few lines showing what is of general importance (i.e. what is the relevance of this study to researchers who are not interested in this area); as it is the study is framed very parochially. Try to outline what you think the major general scientific questions are that you are answering and make sure that they are addressed within the paper.

There seems to have been a considerable amount of work done on this area, is the study of a small region within this basin really going to improve the scientific understanding and water management. I flicked through to the conclusions and can see no discussion of how this study fits into the bigger picture of the Ordos Basin – at the very least this needs to be discussed. At the moment, the paper is written from the viewpoint that it is important to understand processes in individual small basins to provide a better overall understanding of hydrogeology. However, this does not seem to have been followed through with in the paper and what comes across is a small-scale study with little context that has been done without much consideration of the larger picture.

Some minor comments

Pg 5711, several places. Researches (should be research) – change throughout the paper.

Pg 5711, lines 18-20. Why is the research on the lake basins urgently needed? (needs more context).

2. Study area

There is a lot of comprehensive information here, but some of it (such as the location:

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Pg 5713, lines 5-10) duplicates the early part of the introduction. Try to group this material a little better.

Pg 5713, lines 24-26. I am confused what is meant by “geomorphic types here”. Are you describing the basin as a whole, different lakes, or features around an individual lake?

Pg. 5714, lines 1-5. Are there ephemeral rivers feeding the lakes during we periods, or is all the surface water inputs via more diffuse overland flow?

Pg 5714, line 8. What is “relatively closed” – either it is closed or it is not.

Section 2.2 (Pgs 5714-5716) is not very clearly written. It oscillates between describing the stratigraphy and the hydrogeology. I suggest that you re-order this. Discuss the stratigraphy first and then the hydrogeology. Also there is a lack of referencing in much of this section (e.g. for the statements about recharge and discharge, confined vs. unconfined aquifers, groundwater flow directions).

Section 2.2 (Pgs 5714-5716). Some more hydrogeological details are also needed. Please include information on hydraulic conductivities, head gradients, porosities etc as these are important for understanding flow. I presume that such data exist given the amount of work done on the area.

3 Methods

Pg 5716. Some more details on the bores would be useful. Specifically, what are the typical screened intervals? Domestic and irrigation bores commonly have long and/or multiple screens and are a poor choice for obtaining geochemical samples as they may sample across multiple aquifers. Can you provide details so that we can be sure that your bores sample what you think that they do?

Pg 5716, lines 16-17. It is not the total depth that is important but the screen depths (are these the same) and how did you assign depths to your samples (bottom of screen, middle of screen, top of screen?).

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Pg 5717. Lines 18-19. In alkaline samples ($\text{pH} > 8$ or 9) there are two components to the alkalinity – the CO_3 and HCO_3 . These are normally titrated separately (this is discussed in many common Geochemistry texts such as Drever). Alternatively, since we know the speciation of C well, you can assign the relative HCO_3 and CO_3 activities from the pH. However, it is incorrect to assume that all alkalinity is HCO_3 .

4 Results

This section is presented in a logical manner but suffers from the geochemistry being described only in relative terms. For example Na & Cl are described as being the dominant ions (Pg 5718, lines 9-10), but we have to look at Fig. 6 to understand what is meant by that. Similar with the description of pH as being relatively stable (Pg 5718, lines 11-12), downward trends in major ions (Pg 5718, lines 19-20) etc. While I can see that the data are in the various figures and tables, this section would be much easier to read with key values quoted in the text (especially where you are describing something as stable or varying).

Pg 5719 (lines 1-13). I am not sure of the value of classifying the waters in this way. Unless you use it later to describe the processes, it seems a bit unnecessary. If you do want to include this classification, you can skip the explanation of how a Piper Diagram works and also you do not need Hardness measures as well.

Pg 5720 (line 1-5). As with the previous section, you need not introduce stable isotopes as tracers here (you did so in the introduction). Just go ahead and tell us about your data.

Pg 5720 (lines 17-18). Unnecessary – all groundwater is expected to be meteoric.

Pg 5720-5721. Quote isotope data with appropriate decimal places given the precision of the analyses (i.e., 1 decimal place for ^{18}O , whole numbers for 2H).

Page 5721 (lines 9-16). The slope of the regression line from the lake water is very low. Theoretically, the slope decreases with humidity, but even at 0% it is ~ 4 (this is

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discussed in Clarke & Fritz). Do you have an explanation for this; is it possible that the line is a combination of mixing and evaporation rather than just mixing?

5. Discussion

In many ways this is a disappointing section. The interpretation of many of the parameters has been done in a standard textbook way (as the authors state on Pg 5721, lines 17-20, most groundwater systems behave the same). While looking at geochemical processes in this way is a necessary part of chemical hydrogeology, it shouldn't be the major part. Aside from a relative straightforward interpretation of processes, how does this information help us understand anything more broad or wide-ranging about the hydrogeology of this area or processes in groundwater in general?

Pg 5722, lines 6-7. If you are going to make these conclusions, you need to specify what the slope is and what the reaction is that you envisage. Also it would help to plot the major ions on Fig. 8 in moles/L as that makes it simpler to relate the trends to the reactions.

Pg 5722, lines 7-20. The same comment applies to the rest of this discussion; it is not just the correlations but the particular slopes that are important.

Pg 5722, lines 21-27. Na/Cl ratios are NOT a good indication of halite dissolution. Rainfall in most parts of the world has molar Na/Cl ratios of 0.7 to 0.9 and evaporation of this rainfall would produce waters with Na/Cl ratios that are similar to those resulting from halite dissolution ($\text{Na/Cl} = 1$). Bearing in mind that there is always some ion exchange or feldspar dissolution, the only reliable indication of halite dissolution is Cl/Br ratios (see the geochemistry chapter in Cook & Herczeg).

Pg 5723, lines 4-16. I don't see what the point of this discussion is. All groundwater pretty much derives some of its DIC from the soil zone (so that is not surprising). However, above you invoke dolomite and calcite dissolution as sources of HCO_3^- , so how can you say much about the details of soil-zone processes? Do you have ^{13}C

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data to help with this?

Pg. 5723. R1. As written this reaction does not change pH (lines 19-20).

Pg. 5724. Again I am unsure of what the purpose of the cation exchange discussion is. Why are the CAI values calculated (i.e., what do they tell us). All groundwater and surface water undergoes some cation exchange, so all of this is unsurprising.

6. Conclusions

This is just a brief summary of the specific conclusions. After reading through the whole paper I cannot see how this study advances our understanding of the hydrology of this region as a whole, much less how it would be relevant to researchers working elsewhere. As with the introduction, there is no context for the study and no indication that the researchers are answering any questions that are of great scientific importance. Without this general discussion, this paper does not belong in an international journal such as HESS.

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