

Anonymous Referee #1

General Comment:

The authors focus on observed saline groundwater that extends far inland in the coastal zones, and investigate the origin of groundwater salinity and elucidate the major processes controlling salinized groundwater evolution in Luanhe River Delta using hydrochemical and isotopic methods and sedimentary characteristics. The method for interpreting the data is relatively standard. The text is well structured and well supported by the figures. The evolutionary pattern of saline groundwater is innovative, and can be used to better understand groundwater evolution in coastal zone. I would like to recommend the acceptance of the manuscript for publication after minor revisions. Below are my comments that may help with this process.

Response: Thank you for your general comments concerning our manuscript. The manuscript will be further improved and polished carefully for readability and English language. We will implement the following specific comments more in depth.

Specific comments:

The introduction provides a comprehensive summary of the groundwater salinization in coastal zones due to Quaternary transgression. The relevant study of similar coastal zones could be expended a little as it is contributed to more valuable scientific significance in International Journals.

Response: We will improve this section to introduce more relevant study in other similar areas globally.

Hydrogeology: this paper is aimed to saline groundwater in coastal aquifer of Luanhe River Delta. However, I cannot find more information about water quality in this section. And how about the hydraulic connection between shallow and deep aquifers? The authors should introduce more details here.

Response: We will add the information of groundwater quality in this section, and further interpret the hydraulic connection between shallow and deep aquifers.

Page 9, line 6, "MIS5". The first abbreviations need to be explained in detail.

Response: The first abbreviations will be re-check, and explained clearly.

Page 9, lines 19-21. How much is the depth of interface of salt-fresh groundwater? And

I cannot find any reference to support “salt groundwater primarily occurring in the first aquifer of the delta area” in this part.

Response: We will introduce more detail of the location of salt-fresh interface, and add references (Li et al., 2013; Ma et al., 2014) to support “salt groundwater primarily occurring in the first aquifer of the delta area” in this part.

Page 10, line 2, remove “Holocene sea-land transition facies” and write “Holocene delta facies” .

Response: Change made.

Page 10, Line 1-3, the sedimentary phases in Fig. 2 should correspond to description of stratigraphic architecture.

Response: We will recheck and revise the text and Fig. 2.

Page 10, line 12, “7 ka BP”. Abbreviations need to be checked, please check throughout the paper.

Response: We will recheck and revise abbreviations throughout the paper.

Page 12, line 5, “Daqingher”. Do you mean Daqinghe?

Response: We are sorry for the negligence of writing. Change made.

Page 12, line 19, and Table 1, which water samples does “P18” represent? “CSW”? Please explain in the text.

Response: The “P18” represent “CSW”, we will explain in the text.

Try to report Table 1 and 2 as online supplementary material.

Response: Table 1 and 2 will be reported as online supplementary material.

1a: The figure shows there are river samples “L01...” or “S01...”, but I cannot find these samples in Table 1, please check.

Response: We will recheck and revise the sample label in Fig. 1a.

Some figure labels / legends are rather small and hard to read, e.g., figures 4, 6.

Response: The figures in paper will be further improve.

Page 26, Line 9-11, changing “palaeo-coast zone” to “palaeo-coast line” maybe more

appropriate. In addition, there need more international references to support “100 m depth below present sea level”.

Response: Change made. Adding the references (Liu et al., 2020; Li et al., 2014) to support “100 m depth below present sea level”.

Page 26, Line 2-7, there are summary of coastal brine groundwater formation, I agree with most of the interpretations. However, how about brine groundwater in other coastal aquifer? Whether these brines have similar formation processes? Appropriate extended discussion could further convey some new understanding that ideally is applicable to other study areas.

Response: The brine groundwater have been found in global coast areas such as Nile delta (van Engelen et al., 2019), Mediterranean (Antonellini et al., 2008; Sola et al., 2014) and Bohai Sea coast (Han et al., 2014; Li et al., 2017). Many researchers believe the hypersaline (or brine) groundwater are associated with fine sediments of barrier-lagoon environments during Middle Holocene (Giambastiani et al., 2013; Vallejos et al., 2018). We will improve this section to convey how the insights of this study improve understanding of brine groundwater in other coast areas.

Page 33, Line 18-19, “Laizhou Bay” is not covered in any part of the article, please delete.

Response: According to comments raised by Anonymous Referee #2, we decided to rewrite the last paragraph to highlight how our results contribute to the similar research in salinized coast aquifers, to increase the global relevance of the paper.

Reference:

- Antonellini, M., Mollema, P., Giambastiani B., et al. 2008. Salt water intrusion in the coastal aquifer of the southern Po Plain, Italy. *Hydrogeology Journal*, (2008) 16:1541-1556.
- Giambastiani, B., Colombani, N., Mastrocicco, M., et al., 2013. Characterization of the lowland coastal aquifer of Comacchio (Ferrara, Italy): Hydrology, hydrochemistry and evolution of the system. *Journal of Hydrology*, 501: 35-44.
- Han, D. M., Song, X. F., Currell, M. J., et al., 2014. Chemical and isotopic constraints on the evolution of groundwater salinization in the coastal plain aquifer of Laizhou Bay, China, *Journal of Hydrology*, 508, 12-27.
- Li, J., Liang, X., Jin, M. G., et al., 2012. Geochemical signature of aquitard pore water and its paleo-environment implications in Caofeidian Harbor, China. *Geochemical Journal*, 47, 37–50.
- Li, J., Liang, X., Jin, M. G., et al., 2017. Origin and Evolution of Aquitard Porewater in the Western Coastal Plain of Bohai Bay, China. *Groundwater*, 55(6):917-925.
- Li, G.X., Li, P., Liu, Y., et al., 2014. Sedimentary system response to the global sea level change in

- the East China Seas since the last glacial maximum. *Earth-Science Reviews*, 139 (2014), 390–405.
- Liu, J., Qiu, J., Saito, Y., et al., 2020. Formation of the Yangtze Shoal in response to the post-glacial transgression of the paleo-Yangtze (Changjiang) estuary, China. *Marine Geology*, 423(2020), 106080.
- Ma, F. S., Wei, A. H., Deng, Q. H., et. al., 2014. Hydrochemical Characteristics and the Suitability of Groundwater in the Coastal Region of Tangshan, China. *Journal of Earth Science*, 26 (6), 1067–1075.
- Vallejos, A., Sola, F., Yechieli, Y., Pulido-Bosch, A., 2018. Influence of the paleogeographic evolution on the groundwater salinity in a coastal aquifer. Cabo de Gata aquifer, SE Spain. *Journal of Hydrology*, 557 (2018) 55-66.
- van Engelen, J., Verkaik, J., King, J., et al., 2019. A three-dimensional palaeohydrogeological reconstruction of the groundwater salinity distribution in the Nile Delta Aquifer. *Hydrology and Earth System Sciences*, 23, 5175-5198.
- Sola, F., Vallejos, A., Daniele, L., Pulido-Bosch, A., 2014. Identification of a Holocene aquifer–lagoon system using hydrogeochemical data. *Quaternary Research*, 82 (2014) 121-131.