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Hydrology and Earth System Sciences
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Discussions

Interactive comment on "Direct or indirect recharge on groundwater in the middle-latitude desert of Otindag, China?" *by* Bing-Qi Zhu and Xiao-Zong Ren

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Comments from Referee #2 Interactive comment on "Direct or indirect recharge on groundwater in the middle-latitude desert of Otindag, China?" by Bing-Qi Zhu and Xiao-Zong Ren, Anonymous Referee #2, Received and published: 6 June 2018. Groundwater availability in arid and semi-arid regions is one of the key issues in hydrogeology and is becoming even more important because of the expected climate changes. Within this context, the contribution by Zhu and Ren provides an interesting analysis on the possible recharge supporting the availability of significant groundwater resources in the Otindag desert, north-eastern China. The analyses have been carried out using hy-

drogeochemical tracers and isotopic measurements on water samples collected from groundwater, surficial (river, lake, and spring) waters, and precipitation water, as well as in-situ records of temperature, pH, conductivity, and TDS concentration. The various steps implemented by the authors to reject possible hypotheses on the groundwater origin (e.g., water flowing from another nearby arid area, precipitation, paleo-water resources) are presented in detail and discussed. Zhu and Ren concludes that, based on the available evidences, the groundwater resources in this region are recharged by the leakage through the bed on incise rivers bounding the desert to the east and conveying downward the waters originated from the precipitation on Daxinganling Ranges. Hence, an "indirect" recharge is the main mechanism supporting the water availability in the study arid lands. Two are the main weaknesses of this ms: 1) the chemical/isotopic investigations seem not supported by a (at least minimum) knowledge of the hydrogeological setting. This is likely one of the reasons why the analyses carried out by the authors are mainly able to exclude recharge mechanisms, but not definitely explain from where this water is originated. The last part of Section 5.5 provides a list of speculative mechanisms (lines 614-652): how the Xilamulun river can recharge the Dali lake when Fig. 15 shows that the bed of the former is less elevated than that of the latter? What support the "speculation" about the "flash floods" in the southern portion of the desert? How you only "theoretically estimate" the isotopic firm of the precipitation on the Yinshan Ranges? 2) the contribution is over-long. The introduction addresses the topic with a too-wide perspective, concepts are repeated, with verbose descriptions. There are also too many figures that can be fruitfully combined. The English form must be improved too. Moreover, the location of the study area is unclear: Fig 1a is obscure, the various portions of the desert are not provided in the maps shown in Figs. 1b and 2, a large part of the toponymy cited in the text is not added to the maps. Because of this, the ms need a major revision. Interactive comment on Hydrol. Earth Syst. Sci. Discuss., https://doi.org/10.5194/hess-2018-71, 2018.

The authors' responses to the comments from Referee #2

Dear Dr/Professor Referee #2: On behalf of my co-authors, we thank you very much for giving us an opportunity to revise our manuscript. We appreciate you very much for your positive and constructive comments and suggestions on our manuscript (hess-2018-71). We have read your comments carefully and have made revision which marked in red in the revised manuscript. We tried our best to revise our manuscript according to your comments and suggestions one by one. Attached please find the revised version, which we would like to submit for your kind consideration. Thank you and best regards.

1) The chemical/isotopic investigations seem not supported by a (at least minimum) knowledge of the hydrogeological setting. This is likely one of the reasons why the analyses carried out by the authors are mainly able to exclude recharge mechanisms, but not definitely explain from where this water is originated. The last part of Section 5.5 provides a list of speculative mechanisms (lines 614-652): how the Xilamulun river can recharge the Dali lake when Fig. 15 shows that the bed of the former is less elevated than that of the latter? What support the "speculation" about the "flash floods" in the southern portion of the desert? How you only "theoretically estimate" the isotopic firm of the precipitation on the Yinshan Ranges? Our response: AGREE AND CHANGES MADE. We thank you very much for this comment. Yes, any chemical and isotopic investigations need to be supported by knowledge of the regional- and local-scale hydrogeological settings. According to this comment, we have added the specific information about the hydrogeological, geological (tectonic, lithological, sedimentological and structural), geomorphological, stratigraphical settings of the study area in the revised manuscript. Detailed changes and the added information can be seen from the section "2. Regional settings" and the section "4.5 remote water recharge on groundwater in the Otindag: mountains waters" in the revised manuscript (pages 2-4 lines 103-188 and pages 8-9 lines 441-483). Besides, two newly-built figures about the geological and hydrogeological maps of the study area are also provided as auxiliary instructions to illustrate the hydrogeological characteristics of the Otindag Desert in the revised manuscript. These figures are Figs. 2 and 3 in the revised manuscript. With

the help of these newly-added materials we believe that we can definitely and logically explain from where the groundwater in the Otindag is originated. About the Fig. 15 in the original manuscript (at present it is Fig. 11 in the revised manuscript) and the question "how the Xilamulun river can recharge the Dali lake when Fig. 15 shows that the bed of the former is less elevated than that of the latter?", our explanation is that: actually, the elevation of the Xilamulun river channel is not lower than the Dali lake. The recent elevation of the Dali Lake is 1,226 m above sea level (Xiao et al., 2008, J Paleolimnol, 40, 519-528). The elevations of the river samples collected from the Xilamulun River in this study ranges between 1360 and 1374 m (Table 1). The real elevation data (measured by handheld GPS in the field) for the river samples l1, l2, l3, l4, l5, l6 in this study are 1368 m, 1368m, 1365 m, 1366 m, 1360 m and 1374 m (Table 1), respectively. Thus, the elevation of the Xilamulun river channel is about 140 m higher than that of the Dali Lake. In Fig. 15 (Fig. 11 in the revised manuscript), it shows the variation of the topographical elevation along the section S1 (see Fig. 1b) from the upstream of the Dali Lake to the location site of the spring water samples s2. It does not show the elevations of the river samples from the Xilamulun River. Strictly speaking, however, this sketch map (Fig. 15) is likely to cause misunderstanding if we think about the river water but not the spring water. So we specially stated that "Note that no river water samples are shown in this figure" in the figure caption of Fig. 11 in the revised manuscript. About the question "What support the "speculation" about the "flash floods" in the southern portion of the desert?", we have added specific information about the hydrological settings of the flash foods derived from the Yinshan Piedmont in the section "2. Regional settings" in the revised manuscript (see pages 3-4 lines 157-188). About the question "How you only "theoretically estimate" the isotopic firm of the precipitation on the Yinshan Ranges?", we use the words "theoretically estimate" because we have not obtained the precipitation water samples from the Yinshan Mountains in this study. Thus the isotopic firm of the precipitation on the Yinshan Ranges is calculated based on the altitude effect of mountain temperature on stable isotopes fractionation in the original manuscript. It is thus a theoretical estimation. In order to avoid ambiguity, we deleted the discussion of this "theoretically estimation" in the revised manuscript.

2) The contribution is over-long. The introduction addresses the topic with a too-wide perspective, concepts are repeated, with verbose descriptions. There are also too many figures that can be fruitfully combined. The English form must be improved too. Our response: AGREE AND CHANGES MADE. We thank you very much for this comment. Yes, according to the comment that "the contribution is over-long", we have rewritten the manuscript and made an intensive compression on the length of the paper. At present the number of text words in the revised manuscript has been greatly decreased compared with the original manuscript. According to the comment that "The introduction addresses the topic with a too-wide perspective, concepts are repeated, with verbose descriptions", we have rewritten the introduction section of the manuscript to make the topic being specific and not being too broad in its perspective. We tried our best to avid repeat and verbose descriptions in the revised manuscript whatever on the concept or the context of this section. The detailed changes can be seen in pages 1-2 lines 32-101 in the revised manuscript. According to the comment that "There are also too many figures that can be fruitfully combined", we reduced the number of figures in the revised manuscript by putting some figures together and deleting several figures. At last the revised manuscript has 11 figures compared with the original manuscript that including 15 figures. For example, the Figs. 5, 11, 13, 14a in the original manuscript are deleted in the revised manuscript, and the Figs. 7 and 8, the Figs. 10, 12 and 14a are combined, respectively. In addition, two newly-built figures are added into the revised manuscript according to the first comment from the you (the detailed content of this comment can be seen above). The specific changes and the final results of these figures can be seen in the newly submitted revised manuscript. About the comment that "The English form must be improved too", we are very sorry for our poor and incorrect English writing in the original manuscript. For the shortcomings of the English presentation and the grammatical edit in the first paper, we have checked and revised the whole manuscript carefully to avoid language errors, and finally we have got the

help of a native English speaking professional to check and improve the English quality of the revised manuscript. We believe that the language is now acceptable for the publishing purpose.

Moreover, the location of the study area is unclear: Fig 1a is obscure, the various portions of the desert are not provided in the maps shown in Figs. 1b and 2, a large part of the toponymy cited in the text is not added to the maps. Our response: AGREE AND CHANGES MADE. We thank you very much for this comment. According to this comment, we have revised the Fig. 1a and 1b and Fig. 2 (now it is Fig. 4 in the revised manuscript) to make them clear and make sure that the various portions of the Otindag Desert are provided in the corresponding maps. We tried our best to add each of the toponymy cited in the text to be included in these maps. The specific changes and the final results of these figures can be seen in the newly submitted revised manuscript (Figs. 1-4).

Finally, we want to say that special thanks to you for your good comments. We have tried our best to improve the manuscript and made specific changes in the revised manuscript according to the comments from you one by one. These changes will not influence the content and framework of the paper. And here we did not list the changes but marked in red in the revised paper. We hope that the correction will meet with approval. Once again, thank you very much for your comments and suggestions.

Please also note the supplement to this comment:
https://www.hydrol-earth-syst-sci-discuss.net/hess-2018-71/hess-2018-71-AC2-supplement.pdf

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., https://doi.org/10.5194/hess-2018-71, 2018.

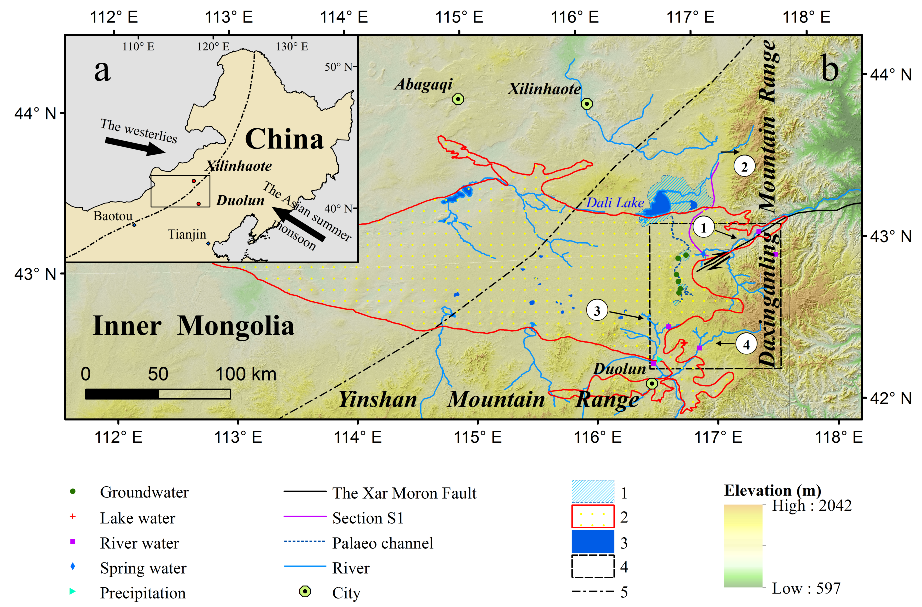

Fig. 1. Fig. 1. The Geographical location of the Otindag Desert in northern China. (a) The study area shown at a large scale, and (b) the study area shown at a smaller scale, with detailed information about t

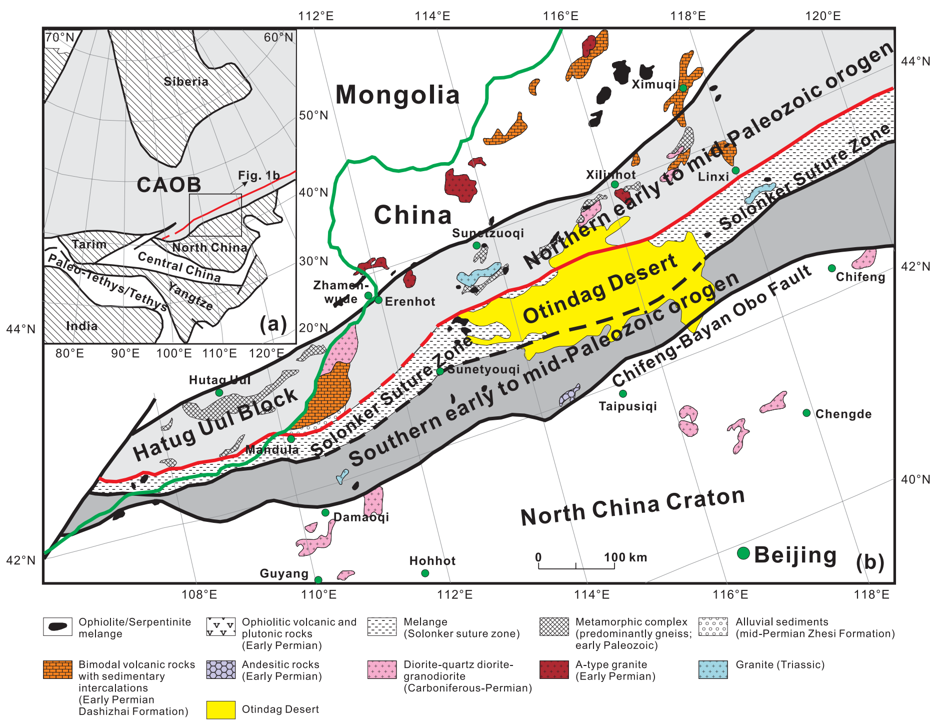

Fig. 2. Fig. 2. (a) Tectonic framework of the north China-Mongolian segment of the Central Asian Orogenic Belt (modified after Jahn, 2004). (b) Geological sketch map of the northern China-Mongolia tract (modi

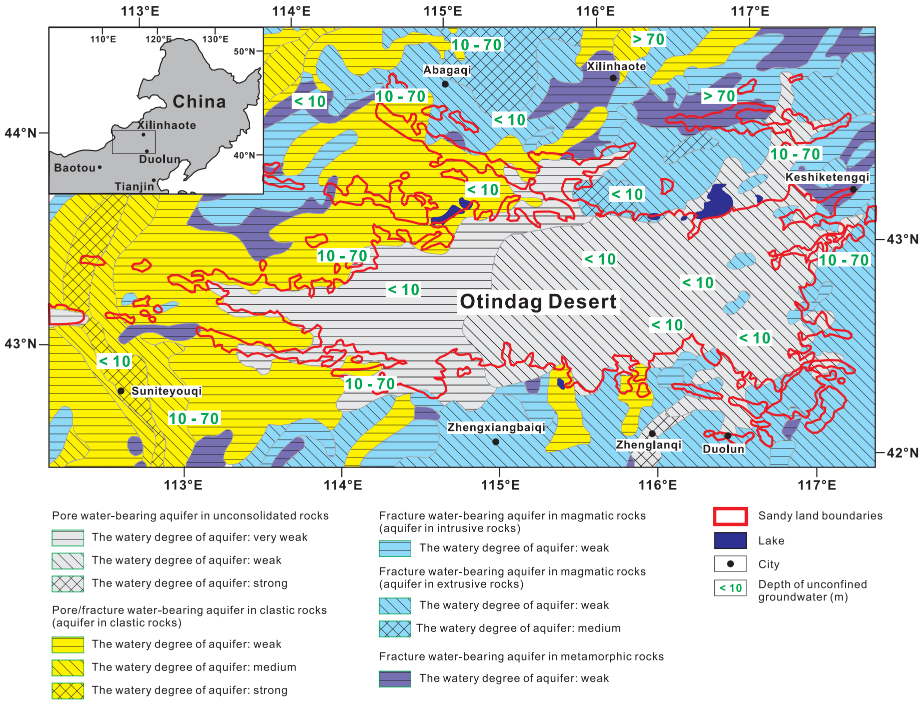

Fig. 3. Fig. 3. The hydrogeological division map of the Otindag Desert.

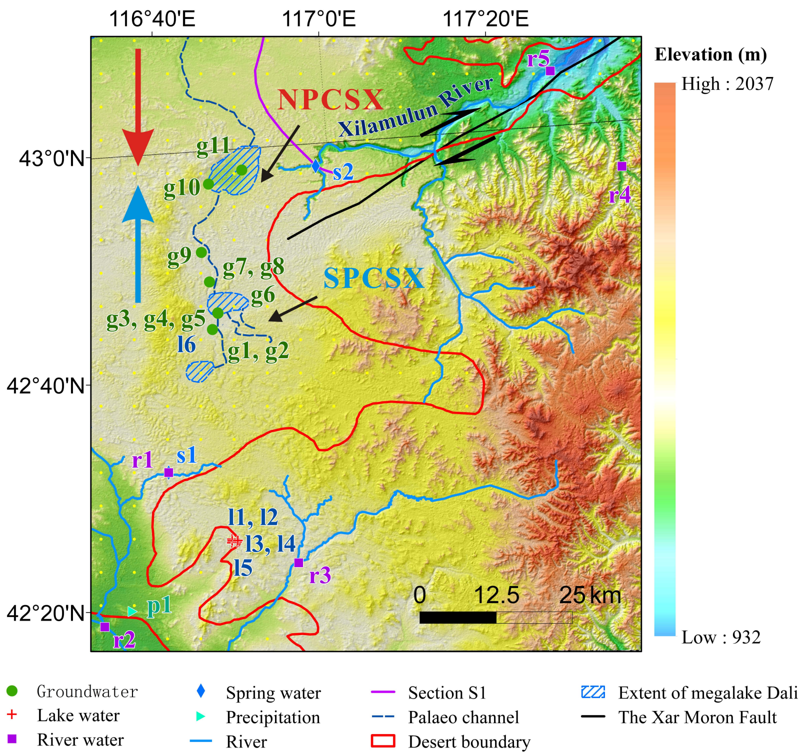

Fig. 4. Fig. 4. The locations of the water sampling sites in this study.

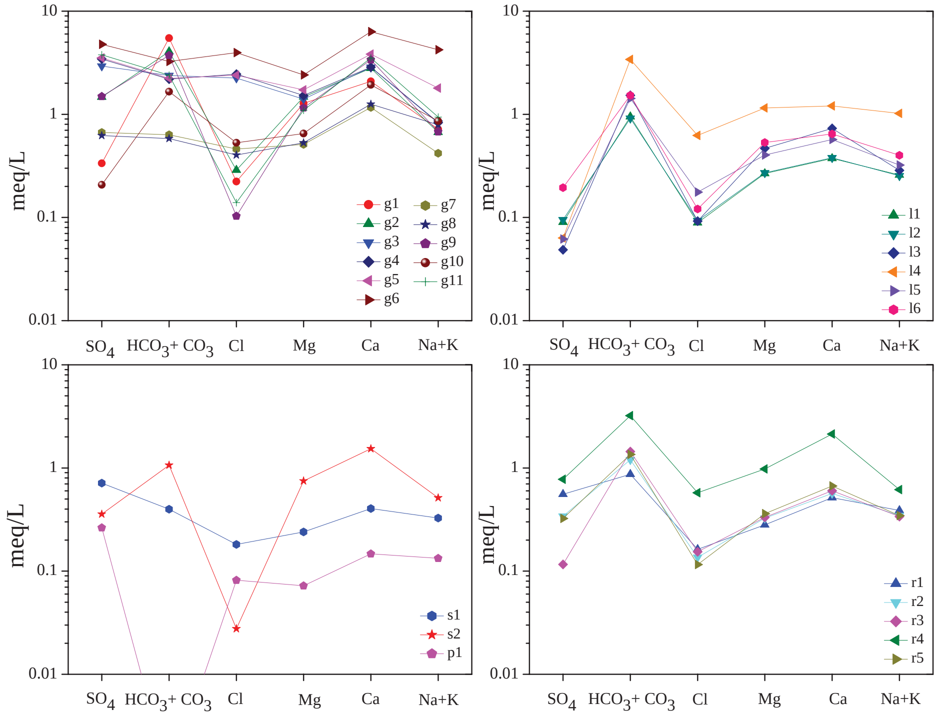

Fig. 5. Fig. 5. The fingerprint diagram showing the variations of multiple ions' concentrations in the studied water samples in an equivalent unit. The HCO3+CO3 concentration in the sample p1 was not shown, d

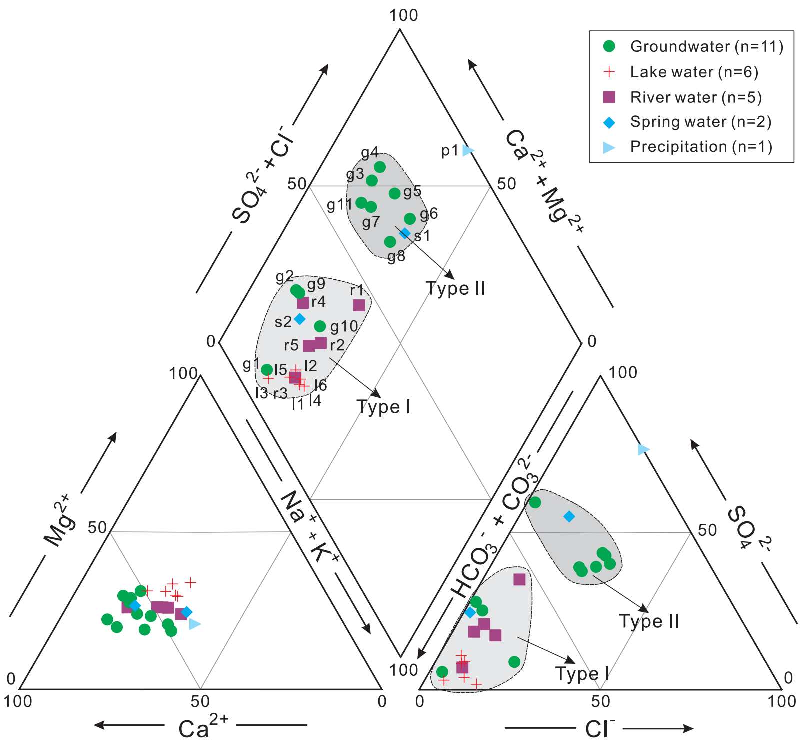

Fig. 6. Fig. 6. The Piper diagram showing the relative abundances of major cations and anions in the studied water samples. Major water types are also shown in this diagram.

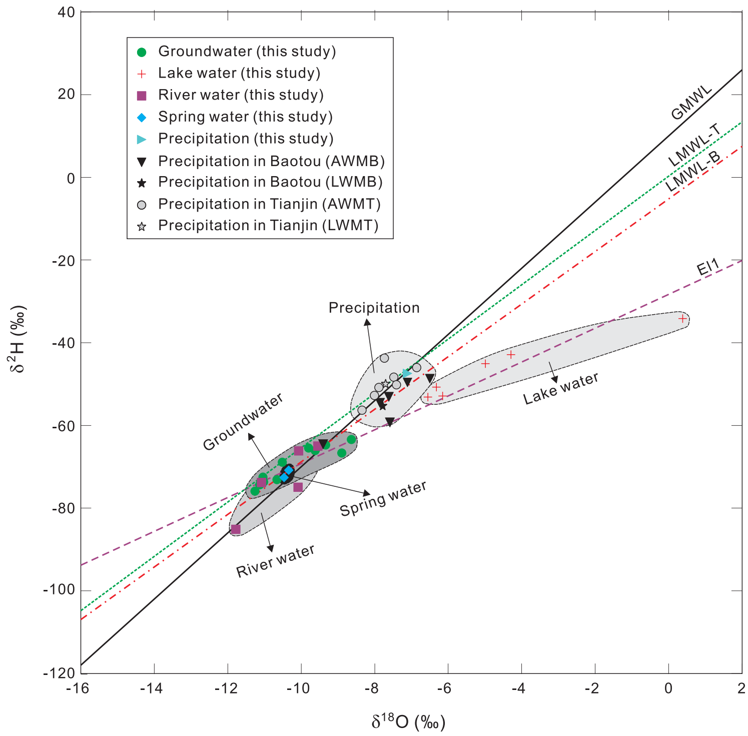

Fig. 7. Fig. 7. The bivariate diagram of δD and δ18O, i.e. the Craig diagram, for the natural water samples in this study. Different relationships between the groundwaters, lake waters, river waters, spring w

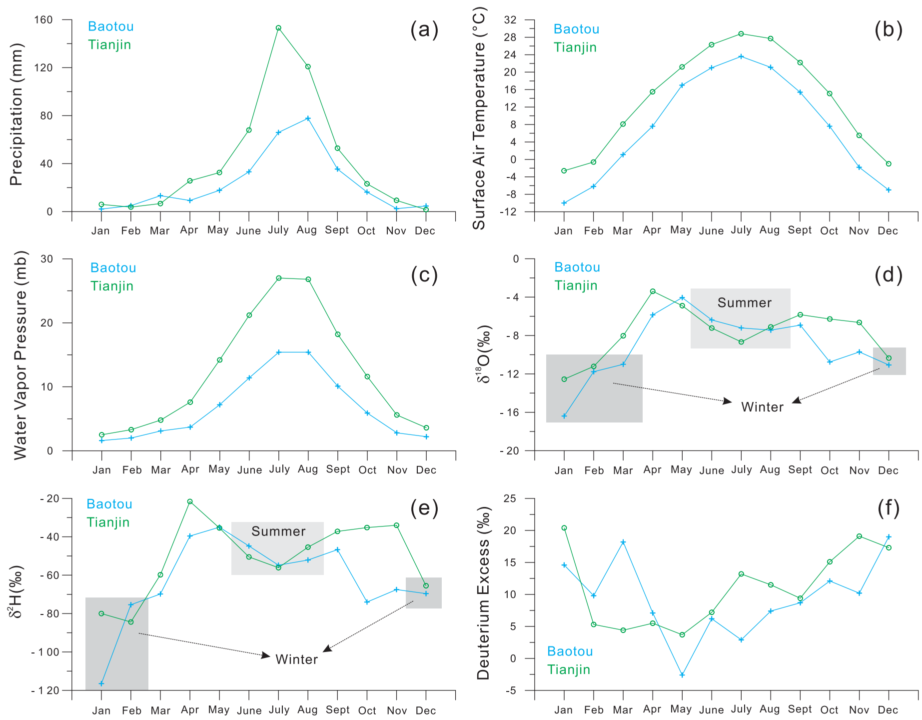

Fig. 8. Fig. 8. The seasonal mean distributions of (a) precipitation, (b) surface air temperature and (c) water vapor pressure from the Baotou and Tianjin weather stations (station sites seen in Fig. 1a) in t

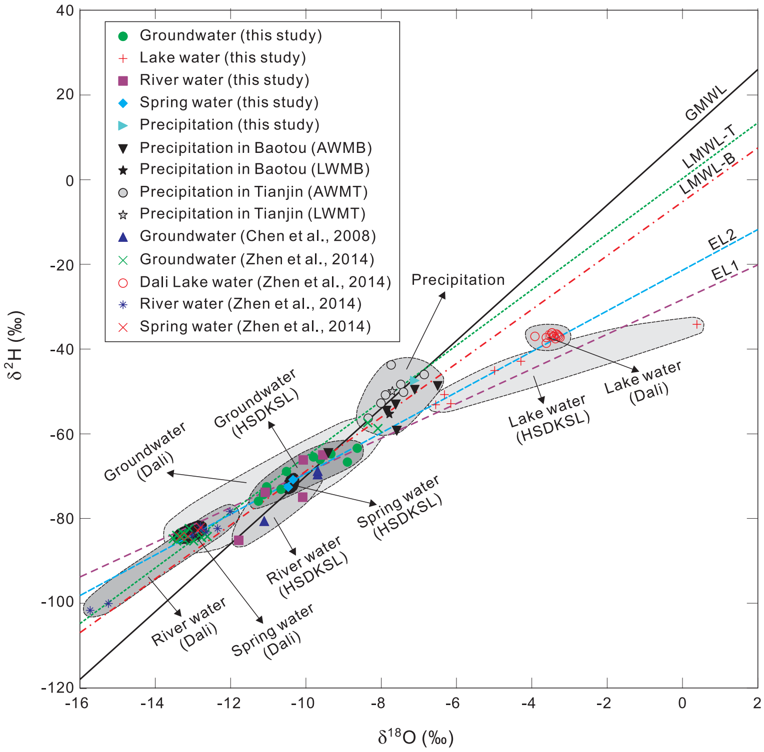

Fig. 9. Fig. 9. The bivariate diagram of δD and δ18O, i.e. the Craig diagram, for the natural water samples collected in the Otindag (this study) and the Dali Basin. Different relationships between the ground

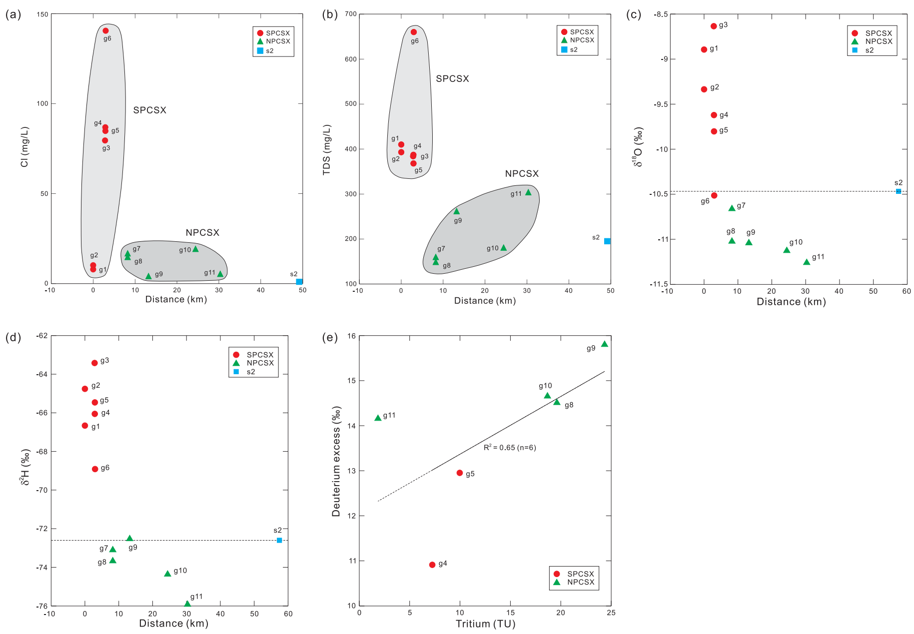

Fig. 10. Fig. 10. (a) Sketch map showing the relationship between the groundwaters in the NPCSX and SPCSX areas, based on variations of (a) the chloride concentrations, (b) the TDS concentrations, (c) the δ18O

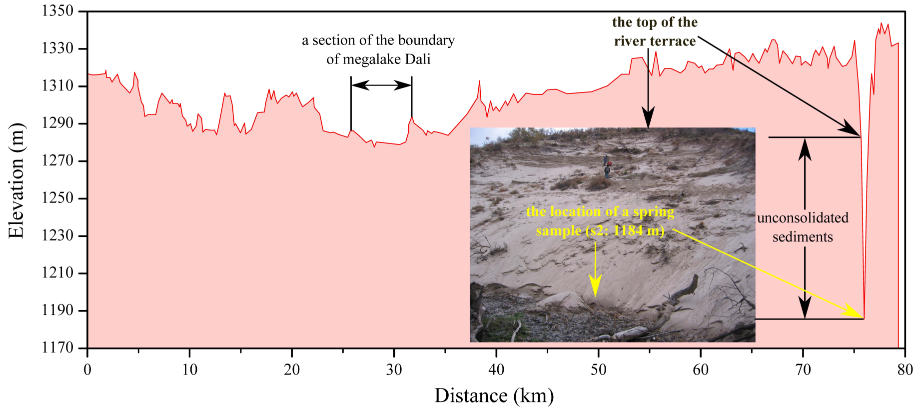

Fig. 11. Fig. 11. Variation of the topographical elevation along the section S1 (see Fig. 1b) from the upstream of the Dali Lake to the location site of the spring water sample (s2) in the riverhead of the Xil