

## ***Interactive comment on “Comment on “Origin of water in the Badain Jaran Desert, China: new insight from isotopes” by Wu et al. (2017)” by L. Zhan et al.***

### **Anonymous Referee #2**

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The manuscript ‘Comment on “Origin of water in the Badain Jaran Desert, China: new insight from isotopes” by Wu et al. (2017)’ contributes to the debate about origin of water discharging in a unique desert ecosystem. The authors refute the main result of the previous HESS paper, drawn from analysis of isotopic data, that local precipitation is the main source of groundwater feeding lakes of the area. The key argument against the observation of Wu et al. is that they incorrectly calculated the annual mean isotopic composition of local precipitation. A reliable quantification of these mean values is therefore a key factor in the evaluation of the manuscript. Unfortunately, neither the authors of the commenting paper, nor Wu et al. present details of their calculations. The GNIP record of isotopic composition of precipitation at Zhangye station covers only 18

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years with many gaps in data. Given that, as well as large seasonality of precipitation amount and its isotopic composition for that station, evaluation of the annual means is sensitive to the averaging method which is not described in the manuscript. Putting this issue aside, the reviewed manuscript tries to draw unambiguous conclusions concerning origin of groundwater for a huge system extending over hundreds of kilometers basing them on a limited amount of isotope data. Environmental tracers work best when supported by the understanding of the hydrogeological and hydrogeochemical characteristics of a system, none of which is available in this case. Conclusions based solely on the isotopic composition, especially for the large and diversified system, are subjected to large uncertainties which are completely not assessed here. These uncertainties are enhanced by the pronounced influence of evaporation on the isotopic signatures in such an arid environment. In its present form, the manuscript does not provide a convincing evidence against the results presented by Wu et al., especially that tritium data suggest a significant contribution from recent precipitation. I suggest major revision.

Suggestions for improving the manuscript.

1. Precisely describe methods used to calculate both the weighted and unweighted average isotopic compositions of precipitation.
2. The two disputed components of groundwater – recent infiltration and water recharging in distant mountain chain - should be easily distinguishable by the concentrations or concentration ratios of dissolved components. Are there any data that could be used to identify their chemical signatures?
3. Page 2/line 32. Distance between Qilian Mountains and the desert shown on the map (Fig. 3) seems to be smaller than 500 km.
3. Page 2/lines 35 - 38. The reasoning presented in the last two sentences of page 2 is logically flawed. Incorrect calculation of the averaged isotopic composition of precipitation does not invalidate the meaning and significance of tritium results.

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4. Page 5/lines 113 - 117. Are the surface water bodies mentioned here known to recharge groundwater or do hydrogeological conditions allow for infiltration from them?

5. Page 5-6/lines 122 - 127. Recharge in Qilian Mountains cannot be a source of detectable tritium in the desert or we have to assume that groundwater flows over hundreds of kilometers in tens of years. As with point 3, tritium data are not well integrated in the discussion.

Fig. 1. What are standard deviations (due to averaging) of the monthly and annual averages presented here? They should be shown on the plots if significant.

Fig. 2. There is a considerable spread in groundwater isotopic data used to derive EL2 evaporation line, which might lead to a biased identification of the line itself and of its interception with GMWL. These data are pooled results of several studies, do all of them represent locations on the presumed groundwater flow lines between the recharge area and BJD lakes? Perhaps not all of them are representative for derivation of the evaporation line.

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