

Interactive comment on “Storage and transport in cave seepage- and groundwater in a South German karst system” by K. Schwarz et al.

K. Schwarz et al.

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We thank the referee for an overall positive evaluation of the manuscript. ANSWER:s to comments are listed below marked with “ ANSWER:”

COMMENT Section 3.2 contains the statement “.. our findings show that the local precipitation is indeed responsible for the recharge of the spring without any alteration of the isotope signal”. However, while I agree with the conclusion that evaporation does not enrich the water isotopically, evapotranspiration does nevertheless have an effect by reducing the amount of the more positive summer precipitation that infiltrates the ground relative to the amount of the winter precipitation that infiltrates. This seasonal effect is due to the seasonal variation of evapotranspiration. The isotopic data given in the paper appears to support this effect, in spite of the authors claiming that the average values of the seepage and spring waters matched the long

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term average of the precipitation (in the Abstract and Conclusions (ii), and elsewhere). Their 11-month precipitation weighted mean of -9.4 permille is more positive than the ranges of the various seepages and Blautopf Spring they gave (around -9.5 to -10.6 per mille) and that determined by Nordhoff (2005) of -10.5 to -11.2 per mille. Consideration of evapotranspiration is important to the understanding of the processes in the upper layers of the vadose zone, which is the focus of the paper. The isotope value of the spring is claimed to be homogeneous throughout the year (Conclusions (i)). Average or weighted average values as well as the standard deviations of the variations should be given for the seepages and spring where sufficient data is available, to substantiate this. Fig. 3b appears to show slight variations in both the spring and seepage waters.

ANSWER: We agree with the referee that seasonal effects can be observed to a minor extent in the cave water. We could observe a minor seasonality in the cave drip waters with the most positive values around February / March. Then, with the most positive precipitation values around July, this could indicate the infiltration time to the caves of about half a year. However, this seasonality is masked and lies within the errors of detection of the method (2 sigma of d18O measurements = 0.4), so that only a very careful interpretation can be made.

ANSWER: To clarify the effect of evapotranspiration: Transpiration does not enrich the stable isotope signal of water while evaporation does. Therefore if we find enrichment in seepage water or discharge the mechanism could be evaporation that influenced soil waters that remained close enough to the surface of enough time after infiltration. With fast infiltration and the groundwater table being away far enough from the surface this effect can be assumed as minor. On the other, hand with evapotranspiration being more active during the warmer season, less water infiltrates thus shifting the annual average seepage water and Blautopf spring water towards slightly more negative values. This is because these averages were influence to a somewhat larger extent by winter infiltration when evapotranspiration was less active. Nonetheless the differences are too small to establish a proper mass balance to weigh summer versus winter pre-

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precipitation. An addition like this can be made to the current manuscript. Note however, that weighted average numbers of cave seepage and discharge cannot be given as the discharge rates were not recorded at time of sampling. In order to do this properly one would need to install continuous flow meters and measure the isotopes at much higher frequency than has been done in this study.

Detail comments COMMENT: P1268, L12 I suggest you use the words 'a representative'; instead of 'an integral'. ANSWER: Will be arranged

COMMENT: P1270, L6 The meaning of the words 'to this zone that lies at the receiving end of the flow path'; is not clear. ANSWER: Suggestion for a new sentence: Furthermore with caves being present, we were able to investigate to which degree mixing of the water takes place in the unsaturated zone.

COMMENT: P1272, L20 Use the word 'reduction'; not 'combustion'. ANSWER: Will be arranged

COMMENT: P1272, L24 Spelling: 'Standard'; not 'sandard'. ANSWER: Will be arranged

COMMENT: P1274, L1 'relatively'; not 'relative'. ANSWER: Will be arranged

COMMENT: P1274, L15 'water only varied'; not 'water did only vary'. ANSWER: Will be arranged

COMMENT: P1275, L7 'almost not noticeable'; not 'hardly found'. ANSWER: Will be arranged

COMMENT: P1275, L22 'processes occur'; not 'processes to occur'. ANSWER: Will be arranged

COMMENT: P1276, L18 'gravimetric'; not 'gravimetri-

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cal” ANSWER: Will be arranged

COMMENT: P1276, L18 “events smaller fissures also become” not “events also smaller fissures become”. ANSWER: Will be arranged

COMMENT: P1276, L26 “determined to be only” not “determined with only”. ANSWER: Will be arranged

COMMENT: P1277, L12 “was not found” not “could not be found”. ANSWER: Will be arranged

COMMENT: P1278, L2 “focus on” not “focus at”. ANSWER: Will be arranged

COMMENT: P1278, L4 “travel” not “travelling”. ANSWER: Will be arranged

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 5, 1267, 2008.

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5, S640–S643, 2008

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