

# ASSESSING THE HYDROGEOLOGICAL FUNCTIONING OF AN EVAPORITE KARST SYSTEM COUPLING TRITIUM AND PHYSICOCHEMICAL DATA

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## 1. INTRODUCTION

Using natural tracers in karst spring is very challenging due to most of them are highly volatile, thus groundwater techniques, such as the  $^3\text{H}/^3\text{He}$  method, can be hard to apply. However,  $^3\text{H}$  provides valuable information regarding the hydrogeological functioning of karst systems [1]. Anzur Bajo spring, located in evaporite karst plateau in Cordoba province (S Spain), drains brine groundwater ( $2 \cdot 10^7$  kg of NaCl per year [2]), reducing the chemical quality of runoff water downstream. This work aims to better understand the hydrogeological processes taking place in this evaporite karst system, intending to achieve well management of its impact downstream.

## 2. METHODS

From January 2014 to September 2017, discharge rate, electrical conductivity (EC) and temperature (T) of the water drained by the brine spring were hourly-recorded (WTW Cond 3310). 5 spring samples and 4 rain water samples for tritium determination were collected during different hydrodynamic conditions, and were later analysed in the mass spectrometric facility at the University of Bremen, following the procedure described by Sültenfuß et al [3].

## 3. RESULTS

The Anzur Bajo spring hydrograph shows steep rises, up of two order of magnitude (from 1 to 100 l/s) in few hours, after recharge episodes followed by rapid decreases, which evidences its markedly karst functioning. The hydrodynamic response was normally accompanied with falls of T and EC values. However, after the most intense rain events or coinciding with high water conditions into the system, rises of EC and T values were registered before they decreased. That is in agreement with a piston-flow effect [4], occurring as consequence of fast variations in the hydraulic pressure, which provokes the mobilization of warm and brine groundwater previously stored within the saturated zone towards the spring. The arrival of more recent surface water (cold and low mineralized), via swallow holes [2], would lead to the dilution and cooling of the groundwater drained through the spring.

All groundwater samples contained  $^3\text{H}$  (1.1 - 2.6 TU), although below the decay corrected  $^3\text{H}$  input function obtained for S Spain [2], which present values between 2 and 3.5 TU for the last 30 years. That suggests that samples may be admixture of tritium-free old groundwater and recently infiltrated water, particularly those with lower  $^3\text{H}$ , which could not be explain by winter tritium-low rain (1.8 TU). In general terms,  $^3\text{H}$  values increase with discharge rate and

they decrease with T (Fig. 1). The highest  $^3\text{H}$  content was found during chemical dilution and cooling of spring water, highlighting the influence and mixing of recently infiltrated water on the outflow. The second lowest  $^3\text{H}$  value was determined coinciding with piston-flow effect, suggesting that the groundwater mobilized from the saturated zone has less amount of  $^3\text{H}$  (or absence), which indicates longer residence times. The existence of said piston-flow effect reduces the correlation degree between discharge and  $^3\text{H}$  concentration, although the system depletion clearly is associated with a progressive fall of  $^3\text{H}$  and, therefore, to a greater contribution of older groundwater components.

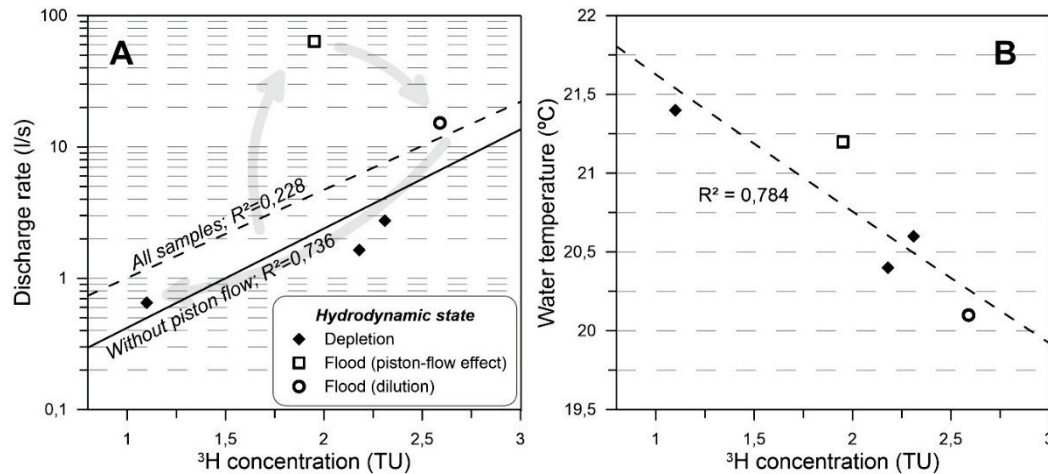


Figure 1.  $^3\text{H}$  concentration vs discharge (A) and temperature (B) of Anzur Bajo spring water.

#### 4. CONCLUSIONS

In this work, the joint use of  $^3\text{H}$  data and the information derived from the natural responses of a brine spring has helped to better understand the hydrogeological behavior of a highly karstified evaporite system, in which diverse groundwater flowpaths, with different residence time, converge. The information here obtained will be valuable in future strategic actions focused on brine caption, with a view to reducing water quality impacts downstream.

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