EGU21-10629
https://doi.org/10.5194/egusphere-egu21-10629
EGU General Assembly 2021

Cave monitoring at Drenska Peštera (N. Macedonia) – preliminary results

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Southeast Europe (i.e. Balkan Peninsula) is a climatologically interesting and complex area, located in a transient zone affected by both Mediterranean and continental atmospheric influences. Speleothem paleoclimate records are limited in this region, with only a few such records from the central parts. Furthermore, in the central parts, there are almost no existing data on cave monitoring, as well as on isotopic composition of precipitation.

For that purpose, a cave monitoring campaign was initiated in October 2018 at Drenska Peštera (southern parts of N. Macedonia) that followed a precipitation monitoring program initiated in the area in April 2018. The study site, located at 1150 m a.s.l., is an old fossil cave with a relatively simple morphology, and a total depth of ~40 m. The area has a mountain climate characterized as Dfb (cold with warm summer and no dry season) according to the Köppen-Geiger climate classification. Vadose speleothems are found throughout the cave, and few broken stalagmites were collected for paleoclimate study purposes. The cave monitoring initially included only monitoring of cave air temperatures, and was expanded in 2019 to include also monitoring of dripwater hydrology and geochemistry. Air temperatures were recorded at an hourly rate at three vertically distributed locations in the cave and at one location outside. Monthly collection of dripwater was initiated at two and later expanded to three dripping sites in the cave.

Preliminary results show that the local annual precipitation is generally in low amount (~400 mm), with maximum in Summer and Spring, and lowest in Winter. $\delta^{18}O$ values of the precipitation show strong seasonality, with two distinct periods of higher (May-October) and lower (November-April) $\delta^{18}O$ values, when average monthly temperatures are, respectively, above or below the local mean annual temperature. The local meteoric water line has slope that is close to the global meteoric water line with somewhat higher intercept indicating mixture of North Atlantic and Mediterranean atmospheric influences. Monthly variation of deuterium-excess indicates higher contribution of Mediterranean-sourced moisture in the cold period, likely related to Mediterranean cyclogenesis.

Cave air temperatures are stable (10.8±0.1 °C), reflecting the mean annual air temperature of the outside station (10.7 °C). Cave dripping is active mostly between December and July, and decreases (or completely stops) between August and November. Mean dripwater $\delta^{18}O$ values (-11.1 ‰) are lower than the weighted-mean value of precipitation (-8.6 ‰), indicating bias

towards cooler period infiltration. Dripwater $\delta^{18}O$ values have smaller variation but still reflect the seasonal pattern of the precipitation, albeit with a seasonal shift, as the highest $\delta^{18}O$ values are found in the winter period. The smallest variation in $\delta^{18}O$, dripping rate and temperature is found at the deepest station, reflecting better mixed aquifer, and most stable environment.

This research was funded by the GINOP-2.3.2-15-2016-00009 'ICER' project. We would like to thank Dragan Temovski, Biljana Temovska, Stojan Mitreski, as well as Zlatko Angeleski and Darko Nedanoski from SK Zlatovrv, for their assistance with the cave and precipitation monitoring.