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## Extended Abstracts

**Editors:**  
Andrzej Zuber  
Jarosław Kania  
Ewa Kmieciak



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of Silesia  
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**General hydrogeological problems**

**6.2**  
**Hydrogeology of karst**

title: **Is the main karst reservoir situated above the regional water table level?**

author(s): **Helena Vysoka**  
Faculty of Science, Charles University in Prague, Czech Republic,  
[helenavysoka@hotmail.com](mailto:helenavysoka@hotmail.com)

**Jiri Kamas**  
Faculty of Science, Charles University in Prague, Czech Republic,  
[JiriKamas@email.cz](mailto:JiriKamas@email.cz)

**Jiri Bruthans**  
Faculty of Science, Charles University in Prague, Czech Republic,  
[bruthans@natur.cuni.cz](mailto:bruthans@natur.cuni.cz)

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Flow pattern and residence time in karst unsaturated zone was studied. Study area is situated in The Moravian Karst in The Ochoz, The Rudice and The Amaterska Cave (Czech Republic). Limestone is of Devonian age, high grade, folded and well lithified but not metamorphosed. There are numerous caves and sinkholes present in the area. Karst unsaturated zone is several tens to more than 100 m thick, saturated zone of karst aquifer is up to 500 m thick.

Main aim of the study was to find out: 1) the character of flow and 2) mean residence times of various flow components via unsaturated zone and 3) to compare the residence time in unsaturated zone with residence time of karst springs draining saturated zone.

Wide spectra of environmental tracers —  $^{18}\text{O}$ ,  $^3\text{H}$ , CFC 11, 12, 113 and  $\text{SF}_6$  were used, some of them repeatedly in period 2001 to 2008 in water draining from 70 m thick karst unsaturated zone of The Ochoz Cave to estimate mean residence time by means of modeling using FLOW code (Maloszewski and Zuber, 1996). Water was drained via sealed tubes to preclude the contact with cave air. To get information about fast flow components the tracer test using fluorescent dyes via unsaturated zone was launched and monitored by automatic sampler for 700 days. Conductivity and discharge were monitored on base of unsaturated zone for several years in 20 minutes intervals to record and quantify any direct recharge from soil zone. Five springs draining the karst aquifer were studied by environmental tracers mentioned above to estimate the residence time in whole karst aquifer. No-tension lysimeters were placed into soil zone to separate the residence in soil from residence in limestone body. Collection tank of lysimeter situated in 15 cm depth was equipped by pressure transducer to observe the inflow with high time-resolution and to study the hydraulic response propagation from soil zone to cave.

Mean residence time in 70 m thick unsaturated zone is 10–20 years, while hydraulic response after heavy rain or snowmelt propagates through it in few days. Based on monitoring the O isotopes, the direct fast flow via unsaturated zone did not exceed 15% in cave seepage even during largest recharge events. Residence time in several decimeters thick soil zone is few months only. Karst springs show similar mean residence times as seepage from unsaturated zone alone. Studied karst unsaturated zone thus probably presents dominant reservoir of mobile water in whole karst aquifer. In fact, based on water table levels in monitoring boreholes in close quarry, the “unsaturated zone” (part of the karst aquifer above the regional water table level) contains in many cases perched water table levels, which have small spatial extends. The results agree with study of Perrin et al. (2003) who found that epikarst host important part of whole water stored in the karst aquifer.

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#### REFERENCES

- Maloszewski P., Zuber A., 1996: *Lumped parameter models for interpretation of environmental tracer data*. In: Manual on mathematical models in isotope hydrology. IAEA-TECDOC-910:9-59. – International Atomic Energy Agency. Wien.
- Perrin J., Jeannin P.Y., Zwahlen F., 2003: *Epikarst storage in a karst aquifer: a conceptual model based on isotopic data, Milandre test site, Switzerland*. Journal of Hydrology 279, 106–124.



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