Geophysical Research Abstracts, Vol. 8, 02156, 2006
SRef-ID: 1607-7962/gra/EGU06-A-02156

Estimation of transport and system parameters in a karst aquifer using artificial and environmental tracer data

Piotr Maloszewski

GSF - Institute of Groundwater Ecology, D-85764 Neuherberg, Germany, Email: Maloszewski@gsf.de; Fax: +49 89 3187-3361

Knowledge about water storage and flow in karst groundwater systems plays very important role. The volume of water as well as transport and rock parameters gives significant information for delimiting contamination protection zones and for estimation of water resources. Karst studies include the use of a wide variety of artificial and environmental tracers as a tool to determine those parameters. Generally, karst aquifer can be approximated by two interconnected parallel flow systems of (1) a fissured-porous aquifer (karst massif), and (2) karst channels. The fissured-porous massif has high storage capacity and contains mobile water in the fissures and stagnant water in the porous matrix. The water enters this system at the catchment surface and flows through it to drainage channels, which are regarded as a separate flow system, finally drained by karst spring(s). The drainage channels are also connected with sinkholes, which introduce additional water directly from the surface. To find the parameters of the system the environmental isotope data of both ^{18}O and tritium (if available) measured in precipitation and in discharging water combined with precipitation amounts and discharge rates can be used. Modelling using lumped-parameter approach may yield in such a case the information on the mean values of the hydraulic parameters: the volume of water in the whole catchment area, in channels and in fissured-porous aquifer; as well the portion of direct flow from sinkholes to springs (Maloszewski et al. 2002). However, the application of environmental tracer data yields information about water flow and mass transport through the drainage channel averaged for the whole catchment, while the detailed information on mass transport between sinkholes or dolines and karst spring(s) is often requested due to drinking water protection against point source pollution. To find more exact values of transport parameters in that part

of the karst system the artificial tracer experiments are required.

Several well-described artificial tracer experiments performed in karst of different types can be found in literature. In most cases the artificial tracer concentration curves observed as result of injection performed into sinkholes or dolines are characterised by a strong tailing effect. Their quantitative interpretation is often performed inadequately using the method of moments (Stoiber, 1988). After finding transport parameters in such a way, in most cases the dispersion model cannot fit the tracer curve observed. To describe tailing effect observed by experiments with an "ideal" tracer two model approaches can be applied. The first model assumes that the system consists of several individual, parallel subsystems (flow-paths) having different water velocities and dispersivities. This approach was developed for karst systems by Maloszewski et al. (1992). The second model assumes that the tracer flows through a "double-porosity" system which is approximated by parallel, identical channels (or fissures) equally distributed in the micro-porous matrix. The channels include mobile water, whereas stagnant (immobile) water exists in the micro-porous matrix. The tracer diffuses between these water phases. This approach was introduced for artificial tracer experiments in fissured aquifers by Maloszewski & Zuber (1985) and applied in karstic aquifers by Seiler et al. (1989).

Examples of practical application of environmental and artificial tracer experiments to find system and transport parameters in the karst aquifer and the description of models used will be presented.

Maloszewski, P., Harum. T. & Benischke, R. 1992. Mathematical modelling of tracer experiments in the karst of Lurbach system. *Steirische Beiträge zur Hydrogeologie*, 43; 116-136.

Maloszewski P., Stichler W., Zuber A. & Rank D. 2002. Identyfing the flow systems in a karstic-fissured-porous aquifer, the Schneealpe (Austria) by modelling of environmental ^{18}O and ^{3}H isotopes. *Journal of Hydrology*, 256 (1-2), 48-59

Maloszewski, P. & Zuber, A. 1985. On the theory of tracer experiments in fissured rocks with a porous matrix. *Journal of Hydrology*, 79; 333-358.

Seiler, K.-P., Maloszewski, P. & Behrens, H. 1989. Hydrodynamic dispersion in karstified limenstone and dolomites in Upper Jura of Franconian Alb, FRG. *Journal of Hydrology*, 108; 235-247.

Stoiber, I. 1988. Dispersion als Hinweis auf den Karsttypus. *Deut. Gewässerkundliche Mitt.*, 4, 107-110.