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Scale continuous characterisation of karst aquifers

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In this work results of different field experiments for the characterization of karst aquifers are compared and attributed to the structural properties of these systems. The results are important for parameterizing numerical models dealing with karst hydraulics.

A karst aquifer represents a dual flow system consisting of a low permeability fissured matrix and a highly permeable conduit system. Over a large volume the fissured matrix can be considered as a continuum and a representative elementary volume (REV) can be defined. However this REV is only valid on a local scale. On a regional scale the drainage of the karst aquifer is controlled by the conduit system which might display a highly anisotropic geometry. In current modeling approaches for simulation of karst hydraulics the conduit system is therefore implemented as a second continuum or as a discrete pipe network hydraulically coupled to a fissured matrix continuum (Sauter et al. 2006).

Classical methods to characterize karst conduit systems are artificial tracer tests. These tests are usually applied to identify point-to-point connections (e.g. between a sinkhole and a karst spring), to determine flow and transport parameters in the aquifer and to estimate geometric and hydraulic parameters of a conduit system. A disadvantage of the method is, however, that only limited information about the geometry of the conduit system and the interaction between conduit system and fissured matrix is achieved.

Conventional methods for characterization of aquifer properties on local scale are hydraulic borehole tests. Slug-tests, for example, can be applied in deep small-diameter boreholes as it is often the case in karst systems with thick unsaturated zones. However, test results strongly depend on the location of the investigated borehole and the applied displacement depth. The spectrum of responses may range from strongly oscillating water levels in high conductivity parts of the aquifer to slowly responding water levels in low permeability parts. Because of the small volume of integration the representative elementary volume of the fissured matrix is difficult to estimate with slug-tests. Larger aquifer volumes surrounding a borehole can be characterized applying pumping tests.

In the present study we consider pumping tests with pumping rates of several 100 l/s, which allow a regional drawdown of the water level in a karst aquifer (Maréchal et al., 2008). The high pumping rates require the pumping well to be directly connected to the conduit system. Thus, the drawdown of the water level at early times reflects the response of the conduit system and therefore allows the determination of its hydraulic and geometric properties. Late time drawdowns are controlled by the hydraulic characteristics of the whole system, i.e. conduit and matrix, while intermediate times show the drainage of the matrix system alone. Large-scale pumping tests have therefore the potential to characterize karst aquifers in a scale-continuous manner by applying a single method, essential for the parameterization of numerical models.

Literature

Maréchal, J.-C., Ladouche, B., Dörfliger, N. (2008): Interpretation of pumping tests in a mixed flow karst system. – Water Resources Research 44, doi: 10.1029/2007WR006288.

Sauter, M., Kovács, A., Geyer, T., Teutsch, G. (2006): Modellierung der Hydrodynamik von Karstgrundwasserleitern - Eine Übersicht. – Grundwasser 11: 143-156.