Geophysical Research Abstracts,
Vol. 11, EGU2009-7760, 2009
EGU General Assembly 2009

Karstification of an aquifer along the Birs River, Switzerland – from natural to anthropogenic dominated boundary conditions

D. Romanov (1), J. Epting (2), P. Huggenberger (3), and G. Kaufmann (4)

(1) Freie Universitaet Berlin, Institute of Geological Sciences, Berlin, Germany (dromanov@zedat.fu-berlin.de, +49 30 838 70 729), (2) Department of Environmental Sciences, Applied and Environmental Geology, University of Basel, Bernoullistr. 32, 4056 Basel, Switzerland (jannis.epting@unibas.ch, +41 61/267 2998), (3) Department of Environmental Sciences, Applied and Environmental Geology, University of Basel, Bernoullistr. 32, 4056 Basel, Switzerland , (4) Freie Universitaet Berlin, Institute of Geological Sciences, Berlin, Germany (georg.kaufmann@fu-berlin.de, +49 30 838 70 729_

Karst aquifers are very sensitive to environmental changes. Small variations of boundary conditions can trigger significant and fast changes of the basic properties of these geological formations. Furthermore, a large number of hydraulic structures have been built in Karst terrains and close to urban areas. Within such settings it is of primary importance to understand the basic processes governing the system and to predict the evolution of Karst aquifers in order to mitigate hazards.

There has been great progress in numerical modeling of the evolution of Karst during the last decades. We are now able to model early karstification of locations with complicated geological and geochemical settings and our knowledge about basic processes governing Karst evolution has increased significantly. However, there are still not many modeling attempts with data from real Karst aquifers.

A model describing the evolution of a gypsum Karst aquifer along the Birs River in Switzerland is presented in this study. The initial and boundary conditions for the simulations are taken from results of geophysical and geological field studies and a detailed 3D hydrogeological model of the area. Three time intervals of the aquiferś development are discussed in details. The first covers the natural karstification for a period between several hundreds up to a few thousands years. The results from this evolution period are used as initial conditions for the second interval, which covers the time between 1890 and 2007 AD. This period is characterized by anthropogenic alterations of the system through a man-made river dam, which considerably changes the evolution of the aquifer. In 2006 and 2007 AD - after serious subsidence of a nearby highway has been observed – technical measures have been conducted and thus the boundary conditions have changed once again. This is the beginning for the third modeled interval. A forecast for the following 100 years is developed. Our results correlate very well with the findings of the field studies of the area. Furthermore, predicted evolution timescales are reasonable from what is known about the past of the aquifer.

The Karst evolution models allowed simulating the development of aquifer properties, which subsequently could be transferred to the 3D hydrogeological model, allowing a more realistic representation of subsurface heterogeneities.

It could be demonstrated that the various investigative methods for Karst aquifer characterization are complementing each other and allow the interpretation of short-term impacts and long-term development on system-dynamics. The obtained results show that our models can be applied not only for theoretical research of simplified and idealized Karst aquifers, but also to places with complex geological and hydrological properties. Investigative methods for similar subsidence problems can be optimized, leading from general measurements and monitoring technologies to tools with predictive character.