Geophysical Research Abstracts
Vol. 14, EGU2012-8229, 2012
EGU General Assembly 2012

Investigation of groundwater dependent ecosystems in a complex hydraulic situation

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Protection and management of groundwater dependent ecosystems (GDE) is a crucial issue all over the world. The understanding of their groundwater dependence constitutes the basis of the implementation of the Groundwater and Biodiversity Conservation in the US (Brown et al. 2007) and the EU Water Framework Directive (WFD), too. Hungary is reach in wetland areas and in the coupled GDEs. In a large part of the Great Hungarian Plain these wetland areas are plagued by salinization as well. The key of their management is the understanding of their natural functioning. Through an example it was attempted to set up a generalized conceptual model regarding the salinization and the connection of the flow systems to the GDEs in this hydrogeological environment. The aim was to understand the qualitatively and quantitatively influence of the flow systems on these habitats.

A saline lake, Lake Kelemenszék was chosen as a study area which is located in the N-S oriented saline wetland zone of the Danube Valley. The saline wetland tract sits in the regional discharge area of the two main flow systems of the basin: a gravity-driven water flow system acting in the upper 250 m depth and an overpressured flow regime originating in the Pre-Neogene basement (Mádl-Szőnyi and Tóth, 2009). Detailed hydraulic investigation pointed out that this regional discharge is superimposed by a local, 20 m deep flow system below the lake, formed between a local height and a surrounding canal. Hereby, the lake is in a through-flow situation, and its water budget is only influenced by the local flow system. Nevertheless, the saline chemical pattern around the lake is determined by the regional flow systems. The source of the salt is the overpressured, NaCl type groundwater of the basement which ascends in a small amount into shallower depths along tectonic lineaments and it mixes to the $NaHCO_3$ type water of the basin sediments (Mádl-Szőnyi and Tóth, 2009). These saline groundwaters ascend together close to the surface, contact the local flow system by diffusion from below. The local flow system distributes the salt in the upper 20 m. Thus the ascending deep saline groundwater provides salt for the salinization. The saline regional discharge did not influence the lake water budget quantitatively, but it is responsible for the production of the chemical pattern around the lake (Simon, 2010; Simon et al., 2011).

This example highlights the importance of application of the flow system concept in the investigation of groundwater dependent ecosystems, as well as the significance of scale effect on the understanding of the interaction between lakes and groundwater. The study also draws the attention to the consideration of the human activities, which can change critically the natural flow conditions.