Brückl, E., Behm, M., Decker, K., Grad, M., Guterch, A., Keller, G.R. & Thybo, H. (2010): Crustal structure and active tectonics in the Eastern Alps. - Tectonics, **29**: TC2011. doi:10.1029/2009TC002491.

Bus, Z., Grenerczy, G., Toth, L. & Monus, P. (2009): Active crustal deformation in two seismogenic zones of the Pannonian region - GPS versus seismological observations. - Tectonophysics, **474**: 343-352.

Horvath, F. & Cloetingh, S. (1996): Stress-induced late-stage subsidence anomalies in the Pannonian basin. - Tectonophysics, **266**: 287-300.

## The Lurbach system (Central Styrian Karst - Semriach, Austria) - a complex (but) instructive karst aquifer to evaluate predictive modelling capabilities of rainfall - runoff approaches

Wagner, T.[1], Mayaud, C.[1], Benischke, R.[2] & Birk, S.[1]

[1] Institut für Erdwissenschaften, Karl-Franzens Universität Graz, Heinrichstraße 26, A-8010 Graz;
[2] Joanneum Research GmbH., Institut für WasserRessourcenManagment, Elisabethstr.16, A-8010 Graz

Predicting the hydrodynamic behavior of alpine spring catchments under changing environmental conditions is highly relevant in Austria and elsewhere, regarding drinking water supply, flood predictions and construction works (e.g., tunnels). Especially the effects of climatic changes are of growing concern. Appropriate hydrogeological tools able to capture the system responses outside calibration ranges are required. On the one hand, process-based distributive models might suffer from the lack of information about the spatial variability of hydraulic and geometric aquifer properties. Thus, the model calibration is expected to be ambiguous, suggesting high prediction uncertainty. On the other hand, global models use a group of parameters to reproduce from a given input function the observed system responses. These models are able to cope with the scarcity of input data but often do not adequately account for the physics of flow. Thus, process-oriented global (grey-box) approaches appear to be preferable, in particular, if conditions change beyond those considered by the model calibration.

Keeping these limitations in mind, the predictive capabilities of various global and distributive modeling approaches are tested using a well known and understood field site: The Lurbach system. Located in the Central Styrian Karst (Highland of Graz), the system serves as ideal test site for the evaluation of model performance and prediction uncertainties. Ample hydrogeological as well as speleological data are available (Behrens et al. 1992) and a profound understanding of the whole karst aquifer is established. The system behaves very differently as recharge conditions change. It is decoupled at low rates where the two springs (Hammerbach and Schmelzbach) act individually, but flow from one system to the other occurs at higher flow rates. Further, it seems that the proportion of flow in the conduit and matrix system changes with recharge as well. At extreme flood conditions a single conduit (the Lurgrotte cave) acts as the main flow path. Thus, this site provides an ideal framework to test models under strongly changing boundary conditions and aquifer characteristics. Limits in prediction-making capabilities and their uncertainties are addressed from synergies of the two model approaches (grey-box versus distributive) using differential split-sample tests of this complex aquifer system. The lessons learned will serve as a basis for other field sites where predictions outside the calibration ranges are needed.

Behrens, H., Benischke, R., Bricelj, M., Harum, T., Käss, W., Kosi, G., Leditzky, H., Leibundgut, C., Maloszewski, P., Maurin, V., Raijner, V., Rank, D., Reichert, B., Stadler, H., Stichler, W., Trimborn, P. & Zojer, H. (1992): Investigations with Natural and Artificial Tracers in the Karst Aquifer of the Lurbach System (Peggau-Tanneben-Semriach, Austria). - Steir. Beitr. z. Hydrogeologie, **43**: 9-158, Graz.

## Geophysical prospection of subsurface monuments in a highly noisy environment

Walach, G.K. & Scholger, R.

Department of Applied Geological Sciences and Geophysics, Chair of Geophysics, University of Leoben, Peter Tunner Str. 25, A-8700 Leoben

The investigated area in Semlach near Knappenberg (Carinthia) was a Roman iron production site between the 1st and the 4th century A.D. Due to the long period of industrial utilization, a considerable number of relics (walls, melting furnaces, slag heaps, etc.) have been preserved in the subsurface. The delimitation of such monuments by means of geophysical prospection is based on contrasts in their petrophysical parameters compared with the natural soil or under laying rock. In general, relics of iron production processes with a high magnetic susceptibility can be identified with relative ease in a magnetic survey, e.g., by high (dipole) anomalies. The variations of the total magnetic field exceed 2000 nT for huge slag heaps and reach up to 500 nT for smelting furnaces. Contrastingly, minor decreases of about 250 nT, may give evidence for buried walls.

Recent archaeological excavations on the site Semlach yielded remains of a large building, which is assumed to be a roman depository. For the prediction of the further extension of the external walls, a combination of different geophysical methods was applied. A magnetic survey with an extension of 34x45 m and a grid of 0.5x0.5 m was executed using GEM proton precession magnetometers. The apparent conductivity and the inphase response of the soil were measured with a Geonics EM38 electromagnetic instrument. Additionally, the resistivity method (geoelectric mapping and multielectrode geoelectrics) and the self potential method (SP) were applied on selected profiles crossing the excavation area.

The new results from the site Semlach yielded several zones of relative minima of the magnetic field over the suspected areas, which were indicative of walls. However, the interpretation was complicated by a highly noisy background, which was caused by deposits of slag from