Evaluation of temporal variation of the discharge and physico-chemical parameters of Boltív Spring (Budapest, Hungary)

Petra Bodor, Vencel Lovrity, Anita Erőss
Eötvös Loránd University, Budapest, Hungary (petra.bodor28@gmail.com)

Europe's largest thermal karst system is the Buda Thermal Karst, which is situated in Budapest, in the capital of Hungary. The Buda Thermal Karst is a recently active hypogenic karst system (Erőss *et al.*, 2012a). Its discharge area is tectonically controlled and can be found in a narrow zone near the Danube (Fig. 1).

Rózsadomb is one of the three main discharge areas of the Buda Thermal Karst (Fig. 1). In the past, when natural conditions were prevalent in this region, hot (50-65°C) springs with high TDS (800-1350 mg/L) arose close to the Danube and lukewarm (20-29°C) springs with lower TDS (770-980 mg/L) discharged close to the hills. It is supposed that a N-S trending fault zone separate their discharge zones (Erőss *et al.*, 2008). This area is nowadays a fully urbanized environment. The natural springs have been mostly substituted by wells in the last eighty years, only few natural springs are known today, which are drained mostly unused into the Danube.

The lukewarm springs are the results of mixing of two components (Erőss *et al.*, 2012b): a hot one which comes from the deep, regional carbonate aquifer of the Transdanubian Range and and a cold one which has a local recharge area in the Buda Hills.

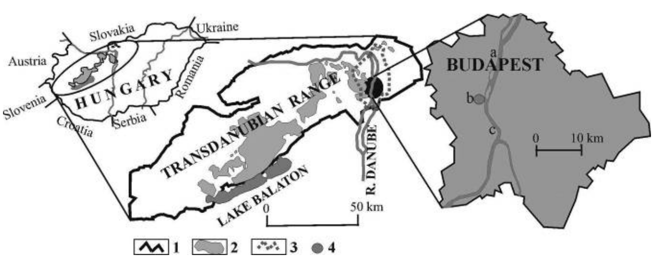

Fig. 1.: Location of the Buda Thermal Karst System in the Transdanubian Range. 1: Subsurface boundary of Mesozoic carbonates, 2: Uncovered Mesozoic carbonates, 3: Buda Thermal Karst System, 4: Boltív Spring, a: Northern discharge area, b: Central discharge area (Rózsadomb), c: Southern discharge area

We studied one of these lukewarm springs of Rózsadomb, the Boltív Spring and Malom Lake which is an artificial lake, fed by this spring (Fig. 2). We studied the changes in the spring discharge and physico-chemical parameters, which may represent the changes of the mixing ratio between the hot and cold components.

We measured discharge, temperature, pH and electric conductivity every four days (from October 2012 to June 2013) in a canal under the Lukács Spa (Fig. 2) where the effluent water of Boltív Spring can be reached. Beside we put a continuous measuring device (Dataqua) into the Malom Lake where the Boltív Spring reaches the lake through an enlarged fracture. Dataqua measured every hour (from October 2012 to July 2013) the level of the lake, the temperature and the electric conductivity. Furthermore we also used archive discharge and temperature data from the 1950-60's in our study.

For every period we compared the variation of parameters to the amount of daily precipitation and water level of the Danube, which represents the base level of erosion and hence influences the discharge of the natural springs. We made graphs to study the connection between the parameters and for quantitative results we used geomathematical methods. First of all we made descriptive statistics to determine the parameters' variability. In order to analyse the contemporary effect of the precipitation and changes of the water level of the Danube, we used correlation, to determine their delayed effect we used cross correlation.

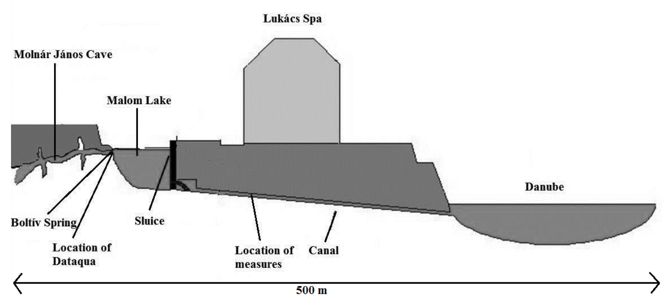

Fig. 2.: Schematic cross section of the study site

As a result from these methods we get that between the parameters and the precipitation the correlation coefficient is low (<0.1), which means that there's no linear connection between them. Probably it's due to the large storage capacity of the karst system. Contrary, the correlation coefficient is higher (0.4-0.9) between the parameters and the water level of the Danube. Beside this, the river has a transient effect on the discharge and physico-chemical parameters, which is confirmed by the varying value and sign of the correlation coefficient from time to time. We don't know yet the exact reason for that, and the detailed investigation of this problem is subject of an ongoing research.

With our measures we also strengthen that this nowadays unused spring could be used for geothermal purposes e.g. by heat pump systems. The spring's temperature is stable (20-21.8°C) and the discharge is large enough all year, so it is economical and sustainable resource for geothermal usage.

Erőss A, Mádl-Szőnyi J, Csoma A (2008): Central Euro Geol 51/3: 267-281.

Erőss A., Mádl-Szőnyi J., Csoma A.É. (2012a): Hypogenic karst development in a hydrogeological context, Buda Thermal Karst, Budapest, Hungary. In: Maloszewski P., Witczak S. & Malina G. (*Eds*.), Groundwater Quality Sustainability: IAH Selected Papers on Hydrogeology 17. London: CRC Press - Taylor and Frances Group: 119-133.

Erőss A., Mádl-Szőnyi J., Surbeck H., Horváth Á., Goldscheider N., Csoma A. É., (2012b): J Hydrol 426-427: 124-137.

The Hungarian Scientific Research Fund (OTKA) has provided financial support to the project under the grant agreement no. NK 101356.