INVESTIGATION OF THE ENVIRONMENTAL CHANGES PRODUCED BY HUMAN ACTIVITY ON EXAMPLE OF A KARST LAKE WITH THERMAL SPRING-WATER

Tünde NYILAS [1] – Gábor NAGY [2] – András KIRÁLY [2] – Lóránt BÍRÓ [1] – Márton PAPP [1]

[1] Department of Mineralogy Geochemistry and Petrology, Faculty of Science, University of Szeged, H-6701 Szeged, PO Box: 651., e-mail: nyilas@gmail.com
[2] SoilChem Agricultural and Environmental Laboratory, H-6782 Mórahalom, Vállalkozók útja 1/b.

Abstract: Nowadays natural habitats are imperilled because of human landscape-transformer processes and negative effects of climate change. Watery habitats belong to the most vulnerable lands because low rate of anthropogenic effects can lead to significant and fast changes in these places. Although we can characterize Carpatian Basin with high mosaicity, it is need to be managed in its entirety without borders. The international realization of this is supported by the Hungary-Romania Cross-Border Co-operation Programme of the European Union. Conditions of Püspökfürdő (karst lake with thermal spring-water, Pârâul Peţea reserve, Oradea, NW Romania) and anthropogenic effects in dynamics of environmental processes are examined in this project. Paleoecological analysis, soil- and wather-chemical measurements and geological examinations are carried out in the area. Based on laboratory measurements and field studies we are able to do comparative analysis, prepare parameter-maps and examine the evolution of the area. Aims of our work are to classify ecological potential, to define the rate of degradation and to determine ecological function of the natural habitat. Results give possibility to sustainable development of tourism investments and operation in case of Püspökfürdő, what assists the improvement of ecological status of the lake, because Pârâul Peţea reserve is touched by anthropogenic effects in higher degree. In this paper we present a part of examinations of water chemistry.

Keywords: Pârâul Peţea reserve, thermal spring, water chemistry, anthropogenic effect

Introduction

Research focusing on the recent processes of karst areas is still current and of particular importance. Such research is justified by the changes in the state of karst environment and its sensitivity; the latter is due to special karst features such as the special wildlife, hydrological system, morphological elements and their sensitivity. In karst areas, water quality is a cardinal issue, as it is a link between the elements of the karst system. Nowadays, however, preserving the quality of our waters has become an increasing challenging task. With the contamination of waters usage possibilities are also reduced. However, the growing population and limited supplies require the preservation of the available resources in their original state (Samu, 2011).

Materials and methods

The Pârâul Peţea reserve is located in Băile 1 Mai spa (Püspökfürdő), 9 km southeast from Oradea, Romania, and was declared in 1932 around the hypothermal lake formed by some extensions of the brook (total length 1.5 km, Fig.1, a)). It is situated within the borders of Băile 1 Mai spa, with a hospital, a hotel, a public pool and drainage facilities as nearby potential pollution sources on the left bank, and agricultural activities (possibly implying the use of pesticides) on the right bank (Gagiu and Venczel, 2008).
The reserve has roughly two zones: first (A), a pond with thermal, underwater springs, having a depth of 0,1 – 3 m and an average temperature between 35 °C by the springs

and 25 °C near the shore (Paina, 1978). The second zone (B) is an elongated pond formed by another diverticulum of the rivulet (in 2002 it was excavated and cleaned of excessive mud and organic debris threatening to overload the biotope). Aquatic vegetation is abundant, consisting of species of *Potamogeton*, *Typha*, *Phragmites*, *Lemna*, *Butomus*, *Alisma*, *Spirodela*, *Cabomba*, *Elodea*, and the local endemic morph *Nymphaea lotus* L. var. *thermalis* (Tuzson, 1908).

Water samples were collected from 20 cm under the water surface (glass and PET bottle, 2 x 0,5 litre). Every sampling point was appointed by EOV coordinates (153 points). Electrical conductivity (EC) and pH were measured on the scene. Conserving was carried out by a high purity nitric acid (pH 3) and samples were stored in 4^{o}C. Chemical data were measured by Hungarian standard on studied water samples. Magnesium, natrium, potassium, calcium contents were determined by atomic absorption spectrophotometry (MSZ 1484-3:2006. (6.)). Nitrate (MSZ 1484-13:2009. (5.2.)) and phosphate (MSZ 448-18:1977.(6.1.)) contents were measured by UV-VIS spectrophotometry. pH and EC measurements were carried out strength of MSZ 1484-22:2009 and MSZ EN 27888:1998. Carbonate content was determined by volumetrical analysis (MSZ 448-11:1986).

Results and discussion

Parameters show that the eastern arm of the studied area (right side in the picture) is differed from other parts absolutely. Causes of differences are (1) another spring water feed the rivulet – water with other dissolved compositions; (2) intensive agricultural activity on areas next the rivulet; and (3) rivulet-water moves slowly because the water of main thermal spring backs up the water of eastern arm. The pH is lower (~ pH 7) in the main spring and in the flow out water of public pool but pH is higher at the fields are grown thickly by vegetation (pH (Fig. 1, b)). EC, Ca^{2+}-, Mg^{2+}-, K^{+}-, Na^{+}- and carbonate-concentrations are highest in the water of main spring, in the flow out water of public pool and in some spots on the middle of the studied area (Fig. 1, c)). We suppose that there are "runaway springs" in the latter case. The presumable springs are located on Mg-concentration map best of all (Fig.1, d)). There is minimum of the K-concentration where vegetation is the thickest because K is macro-nutrient element. Phosphate-concentration is zero in the water on the all field but area of intensive agricultural activities (eastern arm of the studied area) and forest covered area (left side in the picture) where we could experienced some flow. We established that anthropogenic pollutants come to the water from cultivated fields but ones (come from herbicides, pesticides, muck-heaps and digged toilets) can accumulate in the sediments. Nitrate-concentration is the highest next the hospital.

The main aquifer systems in the area are located in holocene, pleistonce, pliocene (cold), lower cretaceous and triassic deposits (thermal – 35 ^{o}C -120 ^{o}C). The pH level of water is in the range of 6,3-8,15. The EC of geothermal waters in the aqiufer is relatively low in Oradea perimeters. The high water hardness of Oradea aquifer is a consequence of the presence of limestone and dolomite in the triassic aquifer. Major dissolved cations are calcium (134-275 mg/l) and magnesium (32-71 mg/l). The waters from thermal aquifer of Oradea can be classified as sulfate-bicarbonate-calcium-magnesium type. (Roba, 2010). Flow paths of spring water are short, so the contact time with carbonate rocks is short too and the dissolvable substance concentrations are less on the area of Püspökfürdő.

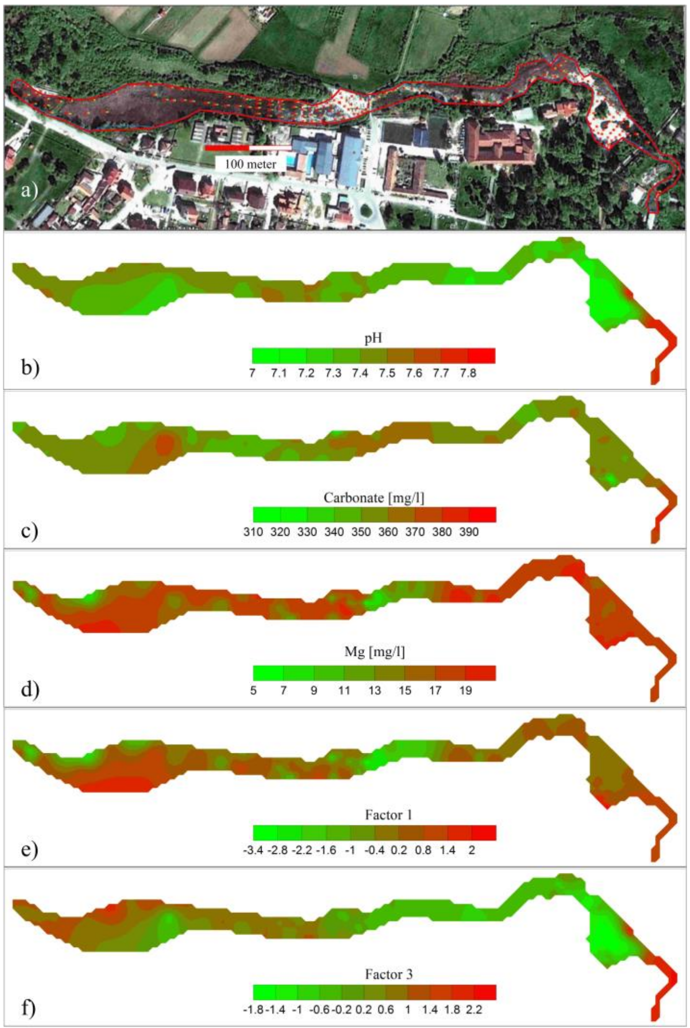

Figure 1. Picture of studied area (a) and distribution maps of pH (b), carbonate (c), phosphate (d), Factor 1 (e) and Factor 3 (f)

Kaiser-Meyer-Olkin examination was the first step of statistical analysis. We established that there are not strong relations between the pair of variables (0.594) so variables are suitable to factor analysis, but Bartlett examination show that there is latent structure among parameters. K, Mg and Ca are correlated to a certain extent. Results of communalities show r>=0.5 between factor and original variation with the except of nitrate. Na has very strong communalitie (0.970) so we removed it from variables. The first three factors wrote down variables in 65.953%. System was interpreted by first factor in 27.142%, second factor in 20.835%, third factor in 17.976%. Factors transformed variables well on the basis of the khi-square (value <20, level of significance ~ 0.5). We were considering those parameters which were more than |0.250| to factors (Extraction Method: Maximum Likelihood, Rotation Method: Varimax with Kaiser Normalization, Rotation converged in 4 iterations.). Factor 1 contained Ca (0.712), Mg (0.851) and K (0.936). This group characterized compounds of carbonate rocks and flow up thermal spring water (Fig 1, e)). Factor 2 contained EC (0.893), phosphate (0.795) and carbonate (0.510). Anthropogenic effects are reflected by phosphate (vegetation, eutrophication, muck-heaps, agricultural activities etc.). Influence of carbonate is minimal on the factor. Factor 3 contained Ca (-0,255), EC (-0,268), phosphate (0,352), pH (0.857) and nitrate (-0,522). pH was grown by this factor best. Consequently there was an effect what influenced pH only, so pH was independent of carbonate rock and factor which influenced EC. This effect was not anthopogenic, because Factor 3 opposited to nitrate, although nitrate belong to Factor 3 in slighter degree (Fig 1, f)).

Conclusions

Collective analysis of parameters back up the previous results and different effects are outlined by its: main spring, "runaway springs", intensive agricultural activity, vegetation influences, waters come from another places (springs with other compounds and pool water).

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