

**IMPACT OF THE PROPERTIES AND COMPOSITION
OF INUNDATING NATURALLY CARBONATED MINERAL WATER
ON THE SOIL IN THE AREA OF OLT VALLEY**

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Abstract

In this present study we analyzed the impact of three naturally carbonated mineral water springs to the soil pH value of the surrounding farmlands in the Olt Valley, selected by us. The field and forest areas are inundated by the mineral water making the soil wet, and we assume that by its mineral salt content it affects the pH value of the soil, thus altering fertility. By our measurements we tried to prove these assumptions. Moreover, we would like to support our research by the observation of the changes in vegetation around the springs.

Introduction

The Neogene volcanic mountain range lies on the Western edge of the Eastern Carpathians. A large amount of post-volcanic gas is still emitted from the volcanoes which slowly simmer down in the deep layers. These gases rise to the surface along the cracks of volcanic rock layers building up the volcanic range and the surrounding areas while mixing with the low depth subsurface waters and partially dissolving in them. Thus, the carbonated mineral water springs came into being in this area [1].

A lot of carbonated mineral water springs gush out in the Olt valley. The analyzed springs belong to a post-volcanic zone which is farther from the volcanic ranges, characterized by frequent carbonated mineral water springs with varied composition [1].

We marked out three carbonated mineral water springs in this present study, which can be found in the Olt valley in Covasna County [2]. These springs partly inundate the agricultural farmlands, meadows. We studied the impact of the properties and composition of these mineral waters on the pH value of the flooded soils.

The experiment

The water springs selected for our research goals (Annex 1,2-Fig 1,2) were marked as the first step of the experiment, in the Olt River floodplain, all of them can be characterized differently, bearing a so-called “personality” each.

1. The first spring is the old carbonated Central Spring at Malnaș-Băi on the right side of Olt River with 1140 mg/l high sodium, 3080 mg/l bicarbonate and 2000 mg/l free carbon content [11].
2. The second spring is the Somos Spring, 2 kilometers from Malnaș-Băi in the valley of Somos stream which flows down the Eastern slopes of the Baraolt mountain range. It is characterized by clean sodium-bicarbonate nature, 273.2 mg/l sodium, 2495.3 mg/l bicarbonate and 672.8 mg/l free carbon dioxide content [12].
3. The third spring is the Bedő Spring at Micfalău, on the North from Sfântu Gheorghe. It can be approached from the National Road No. 12 turning towards Baraolt, passing on a suspension bridge over Olt River next to the road. It is a sodium bicarbonate, calcium chloride type spring, slightly acidic, with a 2684 mg/l free carbon content and with high 428.2 mg/l sodium, 151.4 mg/l calcium, 1342 mg/l bicarbonate, 322.5 mg/l salt content [4].

The next step was to take soil samples at each site as described in the current studies [5]. In all three cases, the mineral springs were considered point-source emissions and sampling was carried out accordingly. First we toured the sampled areas, considering the springs as centers of a 5, 10 and 15 meter radius arcs, drawing them according to the cardinal and intercardinal directions, and we marked the sampling sites in the intersection points of the rays as in Figure 2.

During the preparation of the sampling net, taking into account the local facilities, the sampling points were marked in the following way:

1. 3-3 sampling points were marked along 5, 10 and 15 meter radius arcs from the Central Spring at Malnaș-Băi, to EW, NW and SW directions.
2. 3-3 sampling points were marked along 5, 10 and 15 meter radius arcs from the Somos Spring at Malnaș-Băi, to EW, NW and SW directions.
3. 3-3 sampling points were marked along 5, 10 and 15 meter radius arcs from the Bedő Spring at Micfalău to EW, NS and SW directions.

Each of the sampling points were coded with the ordinal number of the arcs and with the respective cardinal/intercardinal direction. It should be noted that the regional endowment around the Central Spring at Malnaș-Băi made it impossible to apply the 15-meter radius sampling unlike the other two springs.

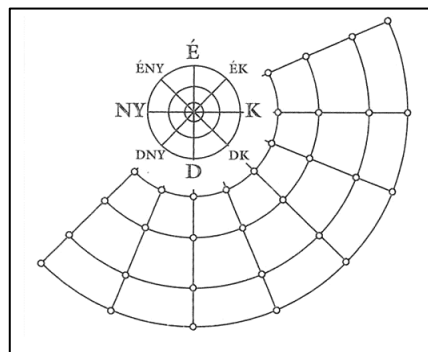


Fig. 2. Sampling of point source emission area [5]

Soil sampling was carried out manually with a shovel after removing the surface litter and organic soil topcoat. All soil samples weighed 250g and were picked up from a 20x20 cm² and 30 cm deep site. The samples were placed in sealed nylon bags which were labeled by the code and the time of sampling. After each sampling, the unused soil was replaced into the ground. Together with the sampling we performed water pH measurement for each spring. An AD12 type universal portable pH probe was used for our measurements, which provides built-in automatic temperature compensation. A two-point calibration gauge (pH = 6.86 and pH = 4.01) was calibrated prior to measurement.

It can be noted that with 9-10 days prior to the sampling no substantial change in weather went on, no rain or temperature fluctuations which could have significantly affected the composition of the soil.

After the sampling had been carried out all the samples were transported to the laboratory where they were prepared for analysis. Plant roots, debris were removed and the plants were dried for 24 hours in the laboratory. Then they were pulverized in a mortar, sieved through a steel sieve (1 mm). There were 10 grams taken for analysis of each sample, then deionized water was added in 1:2 proportion, stirred and allowed to stand for 30-40 minutes in order to release the salts from the soil into the water [6]. The gained soil suspension was filtered and the pH value of the obtained solutions was measured in a portable pH meter. After each tenth measurement the pH meter was checked and re-calibrated if necessary.

Results and discussions

1. The pH data referring to the water and the surrounding soil of the Central Spring at Malnaş Băi are presented in Table 1.:

Table 1.

The pH value of the Central Spring at Malnaş Băi is 6,26				
The ordinal number of the arc	The distance measured from the emission source	The pH values of the soil in different cardinal and intercardinal directions		
		N-W	E-W	S-W
1.	5m	8,63	8,51	8,71
2.	10m	8,48	8.91	8,41

According to our analysis we can state that the pH value of the Central Spring is slightly acidic, however, by 5-10 meters distance from the spring in the marked directions the soil is characterised by alkaline and slightly alkaline pH values [7]. Moving away from the spring the alkaline nature of the soil reduces except of EW direction, where an increase of the pH value was experienced. This is probably due to a 10 cm deep ditch which drains the flooded spring water into another ditch next to a nearby concrete court, and therefore the pH value of the soil increases.

2. The pH data referring to the water and soil surrounding the Somos Spring at Malnaş Băi are presented in Table 2.:

Table 2.

The pH value of the Somos Spring at Malnaş Băi 6,84				
The ordinal number of the arc	The distance measured from the emission source	The pH values of the soil in different cardinal and intercardinal directions		
		N-W	E-W	S-W
1.	5m	8.04	8,25	8,72
2.	15m	6,98	6,33	7,71

According to our analysis the pH value of the water of the Somos Spring is neutral, however, by 5 meters from the spring in the marked cardinal and intercardinal directions the soil is characterised by alkaline and slightly alkaline pH values [7]. Departing from the spring the alkaline pH value of the soil is reduced by 1-2 orders of magnitude. The almost 2 orders of magnitude decrease in EW direction can be attributed to the extreme proximity of the groundwater which was experienced during the sampling as well.

3. The pH data referring to the water and soil surrounding the Bedő Spring at Micfalău are presented in Table 3.:

Table 3.

The pH value of the Bedő Spring at Micfalău 5,95				
The ordinal number of the arc	The distance measured from the emission source	The pH values of the soil in different cardinal and intercardinal directions		
		N-S	E-W	S-W
1.	5m	8,52	8,38	8,23
2.	10m	8,03	8,09	8,09

Due to the results we can state that the pH value of the Bedő Spring is slightly acidic, however, by 5 meters from the spring in EW and SW direction the soil is characterized by slightly alkaline pH value and in NS direction by alkaline pH value [7]. By 10 meters from the spring along the second arc the pH value of the soil reduces, but still belongs to the slightly alkaline category.

In order to explain the increase of the pH value of the soil around the three springs we needed to analyze the pH value of the soils in the studied

geographical region. According to the studies [13,14], 5,5-5,8 pH value brown soils (Annex 3-Fig.3) can be found in the analyzed areas.

We can therefore state that the increase of the pH value of the soil around the springs cannot be triggered by the slightly acidic or neutral nature of the mineral waters. The phenomenon cannot be caused by the acidity of the brown soils of the given geographical region. This phenomenon is probably due to the high sodium, magnesium and calcium bicarbonates presence in the content of the spring waters inundating the lands. These mineral salts ensure the alkaline nature of the selected springs [8].

We can mention that the sampling took place in the second half of August, in 2013 and the preceding period (9-10 days) were no substantial changes in weather, rainfall or temperature, which could have significantly influenced the composition of the soil.

Simultaneously with out analysis we studied the vegetation of the inundated area (Annex 4). Around the Central Spring at Malnaş Băi we found vegetation that thrive in calcareous soils, rich in bases [14], such as: *Carex davallian*, *Salvia pratensis* L. known as a herb for medicine, *Plantago major* L., *Potentilla anserine* L.

The *Mentha longifolia* occurring around Somos Spring at Malnaş Băi that live in waterlogged soils [14], also used as a herb for medicine, as well as the *Carex helleriana* which thrives in wet woodland habitats.

The Bedő Spring is surrounded by a homogeneous thick common reed (*Phragmites*) stock, which mixes with the *Calystegiasepium* present in nutrient-rich areas of high groundwater level.()

Conclusions

Based on our results we can state that the acidic forest and agricultural fields are alkalized around the studied mineral springs, which are slightly acidic and neutral in 5-10-15 meters from the springs, due to their high sodium, magnesium or calcium bicarbonate content, increasing their pH values with 1-2 orders of magnitude. According to these results the alkaline pH value of the mentioned soils decreases with distance from the springs. The changed – alkaline and slightly alkaline - pH value of the soil is indicated by the surrounding vegetation as well.

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Annex 1.

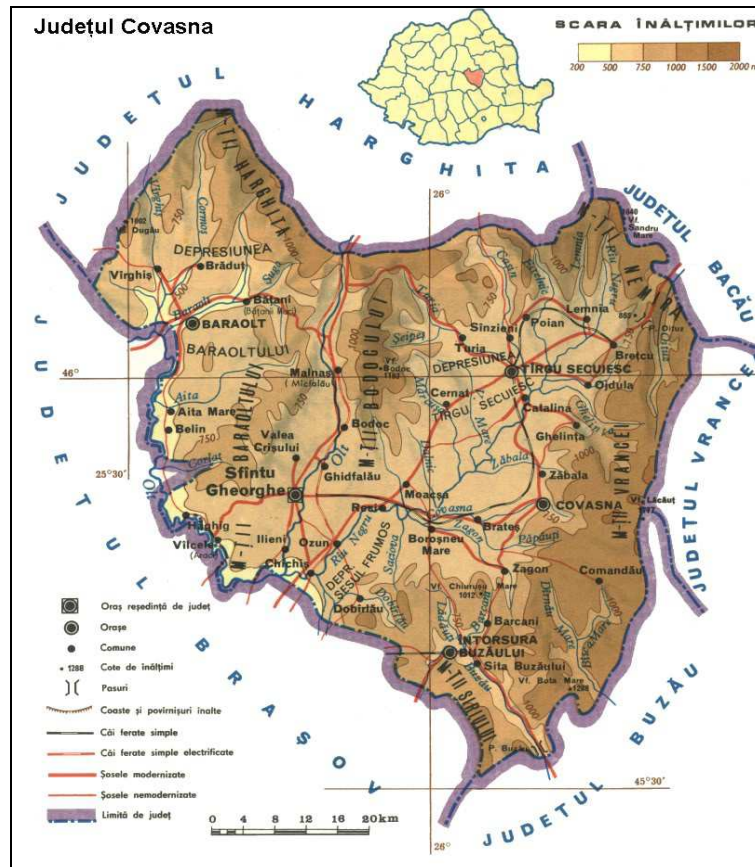


Fig.1. The geographical situation of the selected springs Covasna county [14]

Annex 2.

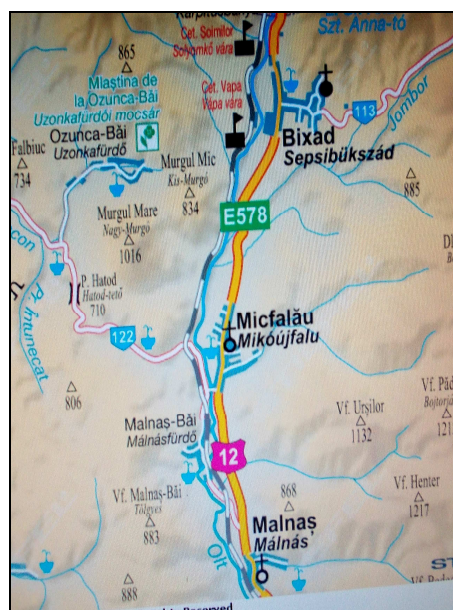


Fig.2. The geographical situation of the selected springs [14]

Annex 3.

Malnaș Băi-Central Spring Malnaș Băi– Somos Spring Micfalău- Bedő Spring

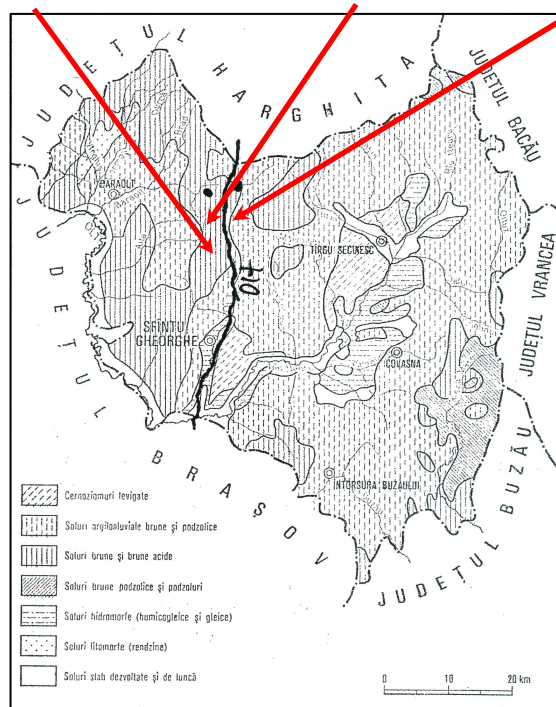


Fig. 3.: Soil maps of Covasna County [12]

Annex 4



Carex davallian s.m. [15]



Salvia pratensis L.



Plantago major L. [15]



Potentilla anserine L. [15]



Mentha longifolia [15]



Carex halleriana [15]



Phragmites australis [15]



Calystegiasepium [15]