THE QUALITY OF THE NATURAL MINERAL WATERS FROM BUZĂU COUNTY

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ABSTRACT. – The quality of natural mineral waters from Buzău County. The main purposes of the present study were: to investigate the physico-chemical parameters of several mineral springs from Buzău County and to classify the investigated waters in mineral water classes, according to national legislation. The analyzed parameters were: pH, temperature, electrical conductivity (EC), total dissolved solids (TDS), salinity, dissolved oxygen (DO) and turbidity. The water samples were collected during October 2014. Generally, the water samples proved to be slightly acidic to neutral, with high levels of TDS (37 7 – 1,271 mg/l). Some of the analyzed dissolved ions (carbonates, bromine and phosphate) were not detected in the analyzed waters. The major dissolved ions distribution is dominated by the presence of sodium (3.8 – 589.2 mg/l), calcium (36.5 – 126.3 mg/l), sulphates (60.3 – 412.2 mg/l) and bicarbonates (213.2 – 915 mg/l). Magnesium ranged between 9.9 – 40.6 mg/l, potassium between 8.7 – 45.2 mg/l, fluoride between 1.0 and 2.9 mg/l., nitrates between 6.4 and 108.9 mg/l and chlorine was between 9.1 and 211.8 mg/l. Some of the investigated water can be commercialized as sodic water, chlorine water, sulphate water and bicarbonate water.

Keywords: mineral waters, brine water, mineral water classification, Geopark.

1. INTRODUCTION

Buzău Land covers an area of approximately 1035.9 km^2, located at the Carpathian Bend Area (Romania) in the proximity of the Vrancea seismic zone. Buzău Land is an isolated, mostly mountainous area inhabited by approximately 40,000 people. It's located at the bending of the Carpathians, in the proximity of the Vrancea seismic zone, in a geodynamical active context that gives rise to slop failures, mud volcanoes, natural gas seepage and mineralized water springs (Feru, 2012). Mineralized groundwater occurrences in Buzău Land include brine and sulphurous varieties that have been considered by just a few studies, most of them performed a long time ago (Pitulescu et al, 1953; Pricăjan, 1985; Saabner-Tuduri, 1906; Ştefănescu, 1967).

According to HG 1020/2005 "Approving the technical norms of exploitation and marketing of natural mineral waters" (transposing Directive no.

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777/80 / EEC of 15 July 1980) the natural mineral water is defined as being a water microbiologically pure, which originated from a shallow or deep aquifer and it comes from a source tapped at one or more natural or drilling this emergency. In Romania there are over 2,000 mineral springs, whose chemical diversity reflects the extremely complex geological conditions that have influenced their genesis. Most sources present carbonated mineral water. The most important mineral water aquifers from Romania, subject to bottling, are located in mountainous areas and in depressions, away from sources of pollution main characteristics of industrial areas, or where intensive agriculture is practiced (Feru, 2012). Romania has about 60% of mineral water reserves in Europe. Unfortunately, only 20% of these reserves are exploited.

The main purposes of the present study were: to investigate the physico-chemical parameters of 10 mineral springs from the surface of the future Geopark from Buzău County and to classify the investigated waters in mineral water classes, according to HG 1020/2005, in order to highlight the possibility of exploitation for economic benefits.

2. MATERIALS AND METHODS

The water samples were colected during October 2014. The geographycal distribution of the analysed mineral springs is shown in Fig. 1.

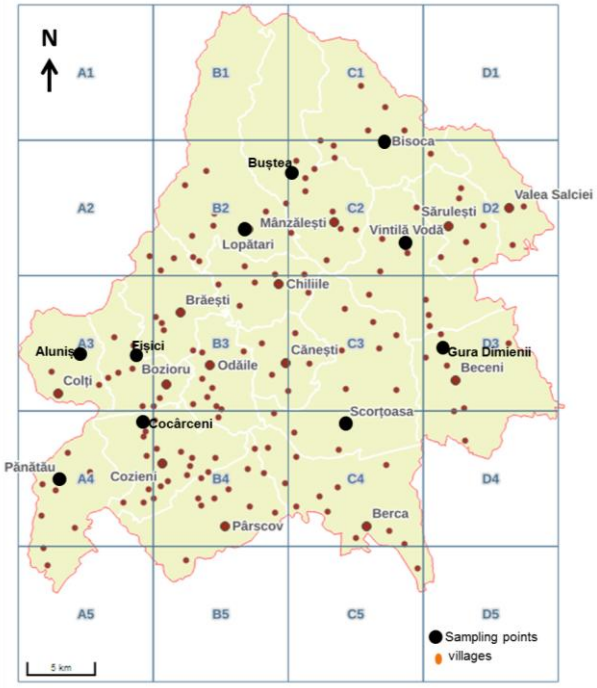

Fig. 1. ***The investigated area from Buzau County and the sampling points location.***

The analyzed physico-chemical parameters were: pH, temperature, electrical conductivity (EC), total dissolved solids (TDS), salinity, dissolved oxygen (DO) and turbidity, while the chemical parameters were major dissolved ions (Na^+, K^+, Mg^{2+}, Ca^{2+}, Cl^-, F^-, Br^-, HCO_3^-, CO_3^{2-}, SO_4^{2-} and PO_4^{3-}). The physico-chemical parameters were analysed *in situ* by using a portable multiparameter WTW 350i and a portable turbidimeter WTW pHotoFlex, while the major dissolved ions were analysed in laboratory, by ion chromatohraphy (IC system Dionex 1500). The water samples used for major dissolved ions analysis were collected in polyethylene bottles; the water samples were filtered in situ using 0.45 µm syringe filters. The samples were then shipped to the laboratory, stored at dark and 4º C, and analyzed within 48 hours from sampling.

3. RESULTS AND DISCUSSIONS

Generally, the analyzed waters were slightly acidic to neutral, having the pH between 6.3 and 7.3, with the exception of two samples which proved to be acidic water, having the pH 4.6 (Lopătari) and 3.9 (Fişici). 40% of the analyzed water have the pH lower than the permissible limit (6.5 – 9.5) imposed by the Romania legislation for drinking water (Law 458/2002).

The sampled springs have a relatively low electrical conductivity (EC), between 589 and 1,970 µS/cm, being lower than the maximum permissible limit (MPL) (2,500 µS/cm) imposed by the Romania legislation for drinking water (Law 458/2002). The total dissolved solids (TDS) ranged between 377 and 1,271 mg/l. This parameter is not restricted by the national law for drinking water, but in the international legislation the maximum permissible limit is 500 mg/l (US-EPA). For 70% of the analyzed waters, the TDS level exceeded the MPL imposed by international legislation, proving that the analyzed springs had a high level of dissolved inorganic and organic matter.

The water samples salinity ranged between 0.1 and 0.8 ‰, having a similar fluctuation as TDS. As in the case of EC and TDS, the highest salinity was registered in the spring from Scorţoasa. For 40% of the analyzed waters, the salinity level exceeded the MPL imposed by international legislation (0.2‰).

The dissolved oxygen (DO) level was relatively low, ranging between 3.9 and 6.6 mg/l. For 60% of the investigated springs, DO level did not comply with the limit imposed by national legislation for drinking water (>5 mg/l).

With the exception of two springs (Cocârceni and Lopătari) where the turbidity level was 2.02 NTU and 1.46 NTU, for all the other analyzed waters , the turbidity was lower than the permissible limit (1 NTU) imposed by Romanian legislation for drinking water. Higher turbidity levels are often associated with higher levels of disease-causing microorganisms such as viruses, parasites and some bacteria. These organisms can cause symptoms such as nausea, cramps, diarrhea, and associated headaches. The high levels of TDS and salinity can be correlated with the geological characteristics of the background in the area.

The analyzed springs proved to have a diverse composition for the major dissolved ions, the chemical diversity reflecting the extremely complex geological conditions that have influenced their genesis. As it is shown in the Piper Diagram (Fig.2.) the major dissolved ions distribution is dominated by the presence of sodium (3.8 – 589.2 mg/l), potassium (8.7 – 45.2 mg/l), calcium (36.5 – 126.3 mg/l), sulphates (60.3 – 412.2 mg/l) and bicarbonates (213.2 – 915 mg/l). Magnesium ranged between 9.9 – 40.6 mg/l and chlorine was between 9.1 and 211.8 mg/l. The carbonates, bromine and phosphate were not detected in the analyzed waters.

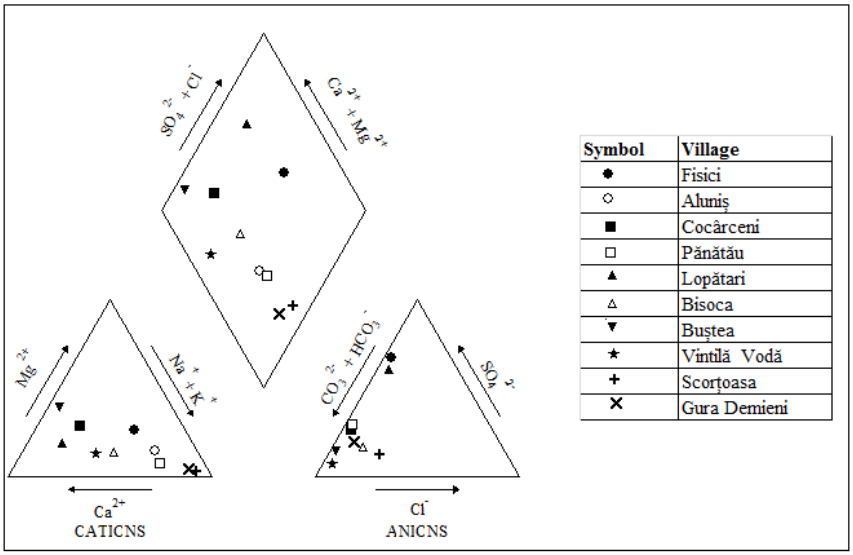

Fig. 2. ***Piper diagram for the investigated springs.***

Fluorine has relatively high levels in all the analyzed springs, ranging between 1.0 and 2.9 mg/l. 70% from the analyzed waters exceeded the MPL for fluorine (1.2 mg/l), imposed by Romanian legislation for drinking waters.

Nitrites were not present in any of the investigated springs, while the nitrates ranged between 6.4 and 16.8 mg/l being lower than the MPL (50 mg/l), set by Romanian legislation for drinking waters. Only one sample (Scorțoasa) had a significant level of nitrate (108.9 mg/l). The continuous consumption of water from this spring may lead in time to serious health risk for inhabitants.

The technical rules of exploitation and marketing of natural mineral waters in Romania is regulated by HG 1020/2005. In the legislation are mentioned the chemical composition requirements, which should be mentioned on the label for natural mineral water. According to these requirements, three of the investigated springs (Aluniș, Pănătău and Scorțoasa) can be commercialized as sodic water, having the sodium content higher than 200 mg/l (Fig. 3).

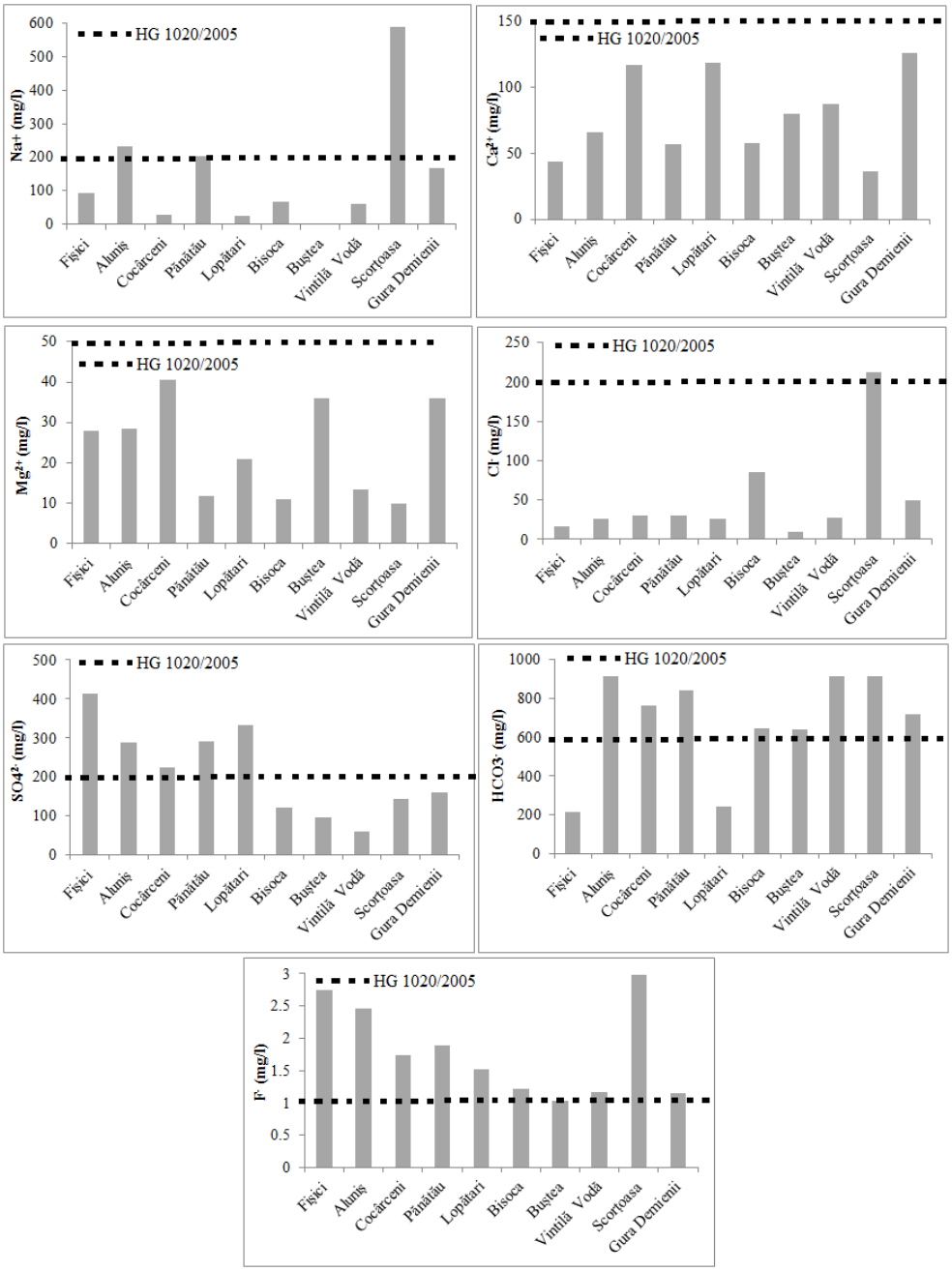

Fig. 3. ***Classification of the investigated minerals springs in mineral water classes.***

The water from Scorţoasa can be commercialized and as chlorine water, because it contains more than 200 mg/l of chlorine. 50% of the investigated springs can be commercialized as sulphate water, because in these waters the concentration

of sulphates is higher than 200 mg/l (Fig.3). All the analyzed waters had high levels of bicarbonates. With the exception of two springs (Fișici and Lopătari), the water from the other springs can be commercialized as bicarbonate water, having more than 600 mg/l of bicarbonates. All the investigated springs can be commercialized as fluorine water, having more than 1 mg/l of fluorine. The analyzed waters had a relatively low level of magnesium and calcium and these waters do not reach the requirements imposed by national legislation (HG 1020/2005) in order to be commercialized as calcium and magnesium waters (Fig.3). Because of the high level of nitrate, the water from Scorțoasa spring can not be comercialised only after a chemical treatment in order to reduce the nitrate concentration. The total cost of this process can be very high and it is possible that water marketing may no longer be profitable from the economic point of view.

5. CONCLUSIONS

Generally, the analyzed waters were slightly acidic to neutral, 40% of the analyzed water have the pH lower than the permissible limit (6.5 – 9.5) imposed by the Romania legislation for drinking water (Law 458/2002).

The sampled springs have a relatively high TDS. For 70% of the analyzed waters, the TDS level exceeded the MPL (500 mg/l) imposed by international legislation, proving that the analyzed springs had a high level of dissolved inorganic and organic matter.

The water samples salinity ranged between 0.1 and 0.8 ‰, having a similar fluctuation as TDS.

For 60% of the investigated springs, DO level did not comply with the limit imposed by national legislation for drinking water (>5 mg/l).

The analyzed springs proved to have a diverse composition for the major dissolved ions, the chemical diversity reflecting the extremely complex geological conditions that have influenced their genesis. The major dissolved ions distribution is dominated by the presence of sodium, calcium, sulphates and bicarbonates.

The water from some of the investigated springs can be commercialized as sodic water, chlorine water, sulphate water and bicarbonate water, in order to bring economic benefits for the local people.

Because of the high level of nitrate, the water from Scorțoasa spring can not be comercialised only after a chemical treatment in order to reduce the nitrate concentration.

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