STUDY ON GROUNDWATER QUALITY IN BANAT PLAIN

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Abstract. *Groundwater is the largest reservoir of freshwater in the world, representing more than 97% of all available freshwater reserves of the globe (excluding glaciers and ice caps). As groundwater flows slowly through the basement, the impact of human activities may affect a long time. This means the pollution that occurred decades ago - whether in agriculture, industry and other human activities - may still threaten water quality today and in some cases will continue to do so for several generations.Monitoring of groundwater quality in the Banat Plain was done by collecting water samples from four wells located in certain areas of importance: Timisoara, Moravia, and Fibiş stolen in June of 2016 and May 2017. The main indicators are determined as: reacting water and nitrogen content, calcium content and magnesium content of iron, manganese, water conductivity, the content of phosphates, chlorides, sulfates, calcium, potassium and sodium salts.After the analysis has shown that the quality of groundwater in the Banat Plain is good quality with a slightly basic pH; water conductivity remains below the maximum permissible ammonium exceeds the maximum permissible concentration in all wells, except in Timisoara; nitrogen content remains below the maximum permissible exceedances are recorded only Fibiş drilling in both years under study; manganese content exceeds the maximum allowed in all wells studied, except Fibiş drilling in 2017, the remaining indicators maintained at values below the maximum permissible concentration.*

Keywords*: groundwater, quality, drills, pH, nutrient regime, salinity*

INTRODUCTION

In present, water sources are relatively well known, both quantitatively and qualitatively, while groundwater resources, although locally were studied and researched in detail, have not been evaluated as a water balance based on hydrogeological potential determination of the basin (ȘMULEAC ET AL, 2012, 2014, 2016).

Compared to other European countries it is estimated that Romania currently has water resources of about 2,000 m^3/inhabitants/year, compared to 20,000 m^3/inhabitants/year in Nordic countries.

The limited volume of groundwater resources, the progressive increase of water requirements, the emergence of very stable pollutant products impose a radical improvement of the management of all water categories in order to ensure a balance between the availability and the requirements of the consumers(ADAMOV ET AL, 2016,). There have been many cases where designers and owners of investment have failed to take into account the need to ensure such a balance, plus the criterion of water resources existence necessary to promote new objectives have sometimes been considered of minor importance, or simply ignored. In this case, to resolve water supply, have been used technical solutions more costly, with large transport distances and increased energy consumption for exploitation.

We cannot conceive a human activity, the existence of a life form or the current balance of the planet on which we live without water. In this direction, there has been until no long time ago the conviction that mankind will have infinite water resources, that nature has made available to us this element (HORABLAGA ET AL, 2014; NEACȘU ET AL, 2011). But the reality of the last decades, and especially of recent years, has proved in time alarmingly that freshwater resources from the world are not at all inexhaustible.

Environmental pollution processes have become more and more frequent, intense,

complex and lasting, and they affect all of its components (RADULOV ET AL, 2016; NIȚĂ, , LATO ET AL, 2013). In the case of groundwater, their pollution is even worse, for at least two reasons: they are the main source of drinking water supply and for the food industry and the long duration of the phenomenon once installed. Under these circumstances, it is necessary to monitor the quality of underground water, especially when it is used for domestic consumption of the inhabitants.

MATERIAL AND METHODS

The monitoring of the underground water quality from Banat Plain was done through sampling water samples from four drillings (Figure 1) located in certain areas of importance: Timisoara, Moravita, Sustra and Fibis.

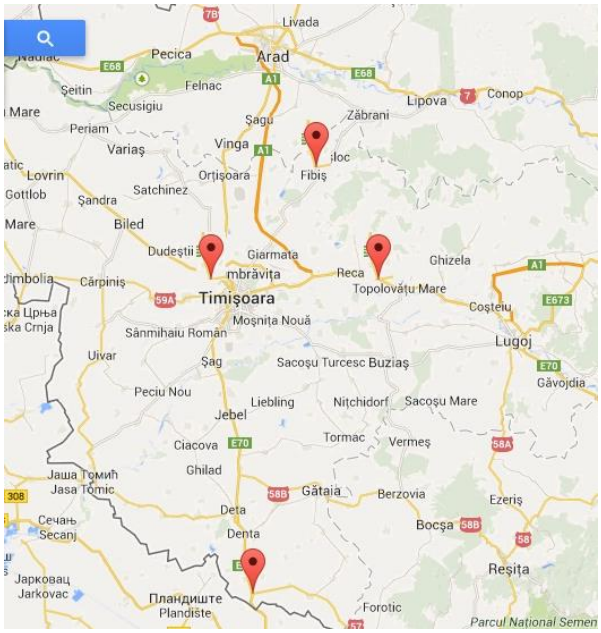

Figure 1. The locations of drillings

Water sampling was carried out in June in Timisoara, Moravita, Sustrei and Fibis areas for the year 2016 and in the year 2017 samples were taken in May.

The main quality indicators were: water reaction, nitrate and nitrogen content, calcium and magnesium content, iron, manganese content, water content, phosphate, chlorine, sulfate, calcium, potassium and sodium content. The results were interpreted and compared with the main physico-chemical quality parameters from Annex 1 to the Law no. 311 of 28/06/2004 amending and supplementing Law 458 of 2002 regarding the quality of drinking water.

RESULTS AND DISCUSSIONS

TIMISOARA DRILLING

The pH of the water is maintained basically (figure 2), decreasing from the value of 8 in June 2016 to 7.5 in May 2017, very good values according to Law 311/2004. The water conductivity is maintained below CMA limit (figure 3), decreasing from 1113 (June 2016) to 1082 µS/cm (May 2017).

Regarding the nutrient regime, ammonium is kept well below the maximum allowed value, with values ranging from 0.038 to 0.027 mg/l (figure 4). The amount of nitrites decreases from 0.11 mg/l in 2016 to 0.081 mg/l in 2017 (figure 5). The nitrogen content increases from 9.42 mg/l to 10.85 mg/l, the value below the maximum limit allowed (figure 6).

The sulphate content is maintained in both years at constant values (60, respectively 66 mg/l), values that do not exceed CMA, as phosphates content (figure 7). Hardness of the water ranges around the value of 33-335^{0}G (figure 8).

If the iron content (figure 9) is maintained at a low level (48-63 μg/l), manganese exceeds CMA. In the year 2016 is recorded the value of 0.342 mg/l and decreases to 0.177 mg/l, both values being above the maximum allowed limit.

The content of calcium and magnesium is maintained at high levels (132-122 mg/l in the case of Ca and 62-77 mg/l Mg), fact which increases the quality of the water. The sodium content is reduced by only 42 mg/l in 2016 and decreases to 24 mg/l in 2017. Potassium has a constant boom of only 1 mg/l and the chloride content is slightly increased from 71 to 74 mg/l in 20177 values under CMA.

MORAVIŢA DRILLING

Water samples taken from the Moraviţa drilling have a slightly basic character, which is maintained constantly in both years, of 7.2 pH units. Conductivity drops from 854 in 2016 to 545 μS/cm in 2017.

If in the year 2016 the ammonia value was below the CMA, in 2017 a value of 0.814 mg/l is reported that exceeds the maximum allowed limit for drinking. The nitrate content is low and drops from 0.04 mg/l to 0.01 in May 2017. Also, the nitrate concentration in water is reduced, slightly increasing from 0.55 to 0.8 mg/l.

Phosphates have a low value in June 2016 of 0.06 mg/l and increase up to 0.73 mg/l in May 2017. The hardness is 20-22.60G. The iron content is maintained at low values (0.054-0.073 mg/l), while the manganese concentration exceeds CMA from 0.3-0.12 mg/l.

The sodium content (51 - 41 mg/l) and potassium (3 - 1) is low and the chlorine content (16 - 8 mg/l) does not pose problems in water drinking.

SUSTRA DRILLING

In the case of this drilling, the water is slightly acidic with a pH that drops from 6.9 to 6 pH units. Conductivity is reduced, being 377 μS/cm in June 2016 and slightly increased up to 420 μS/cm.

The ammonium content slightly exceeds CMA in June 2016, being 0.68 mg/l and is maintained at the maximum permitted level in 2017 (0.50 mg/l). The content of nitrates is low (0.038 - 0.015 mg/l), as in case of nitrates.

The phosphate concentration registered an increase from 0.065 in June 2016 to 2.13 mg/l in May 2017. Sulfates are below CMA, with only 70 mg/l in 2016, then halving at 45 mg/l in May 2017. Hardness has the smallest value of the four drillings taken, of only 8,960G in 2016 and increases to 18,8^{0}G in 2017.

Iron content is maintained at low levels in both years, but manganese has values that far exceed the maximum admissible limit (1.72 - 2.14 mg/l). Calcium and magnesium have lower values in this drilling, the sodium content increases slightly from 19 to 24 mg/l (much below CMA limit), potassium is maintained at low concentrations (2 and 3 mg/l), and chlorides are only 10.78 mg/l in 2016 and drops to 8 mg/l in 2017.

THE FIBIS DRILLING

The water from Fibis drilling is slightly basic with values ranging from 7.5 to 7.9 in May 2017. Conductivity is increased in this drilling (1777 in 2016 and 1112 in 2017) but with values below the CMA.

Ammonium content records exceedances of CMA in both years taken under study, 1.2 mg/l in 2016 and 0.75 mg/l in May 2017. Exceedances of the maximum limit also occur in the case of nitrate content, 0.75 mg/l in 2016 and rising to 0.82 mg/l in 2017. Nitrates have values falling from 6.96 mg/l in 2016 to 4.58 mg/l in 2017.

Phosphates have low values of 0.042 and slightly increase to 0.074 mg/l in 2017 (figure 7). Sulfates are maintained at constant level (67-74 mg/l) under CMA. Hardness drops from 53 to 32^0G.

The iron content (figure 9) does not exceed the maximum admissible limit (0.14 - 0.19 mg/l), unlike manganese, where in 2016 the value is 0.07 mg/l and drops below the CMA in 2017 to 0.04 mg/it.

The calcium content is high (230-195 mg/l), sodium is kept below CMA values (84-123 mg/l), potassium is constant (1 mg/l), and chlorine content is half of the maximum limit allowed (96-87 mg/l).

Following laboratory analyzes, the pH (Figure 2) in the four drillings shows that the water has a basic character, except for the Sustra drilling, where in the year 2017 it drops below the maximum limit allowed.

The water conductivity depends on the amount of minerals from the water content and it is noted that the largest quantities of minerals are at the Fibis drilling in June 2016 (Figure 3).

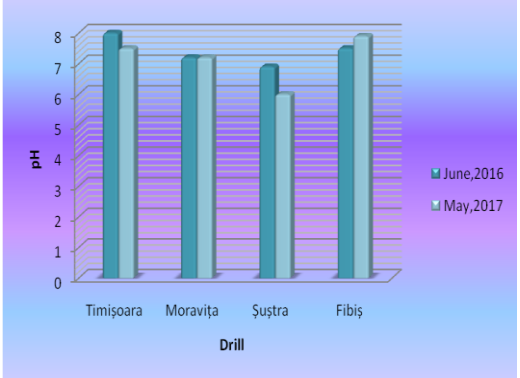

Figure 2. Evolution of pH

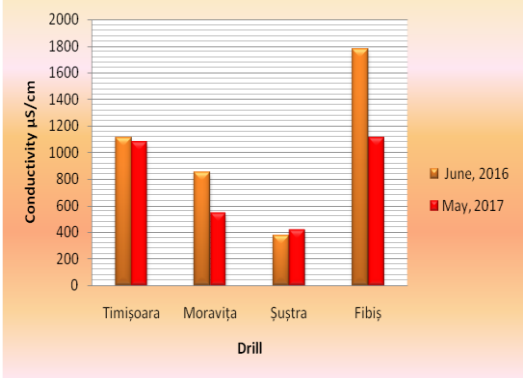

Figure 3. The water conductivity

At the ammonium indicator are highlighted exceedances of the maximum allowed concentration in all drillings, except for the one from Timisoara (Figure 4).

The content of nitrites (Figure 5) is kept below the maximum allowed limit, exceedances are recorded only at the Fibis drilling in both years of study. From Figure 6 it is observed that there are no exceedances of the nitrate content, the highest values being recorded at the Timisoara drilling.

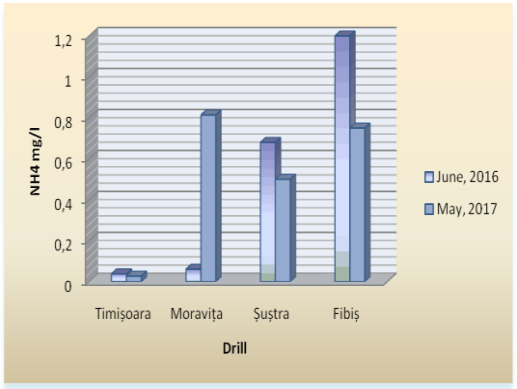

Figure 4. Ammonium content

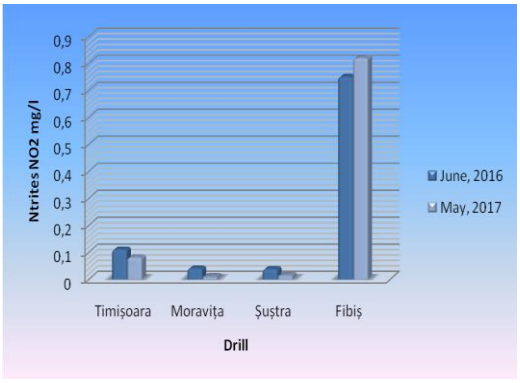

Figure 5. The evolution of nitrites content

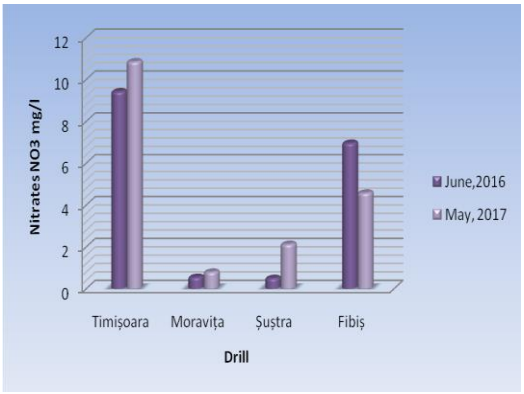

Fig. 6. Nitrates content

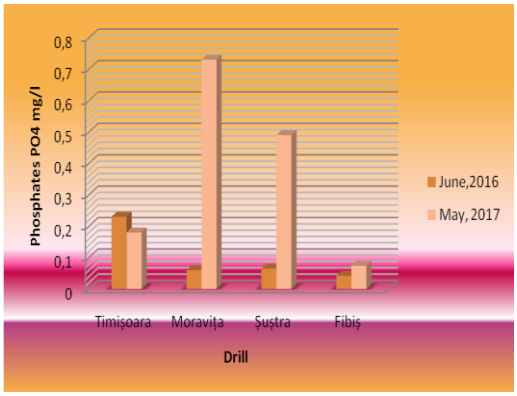

Figure 7. Phosphates content

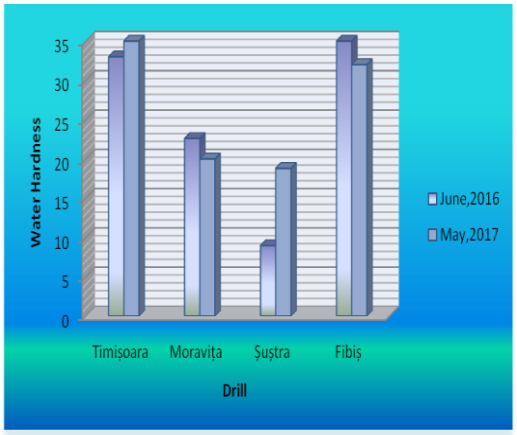

Figure 8. Water hardness

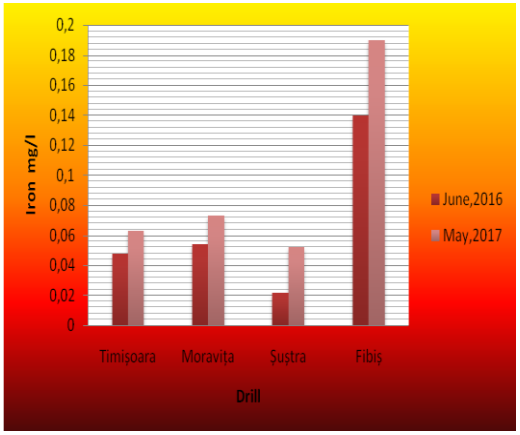

Figure 9. Iron content

Manganese content exceeds the maximum allowed limit in all the studied drillings (Figure 10), except for the Fibis drilling in 2017.

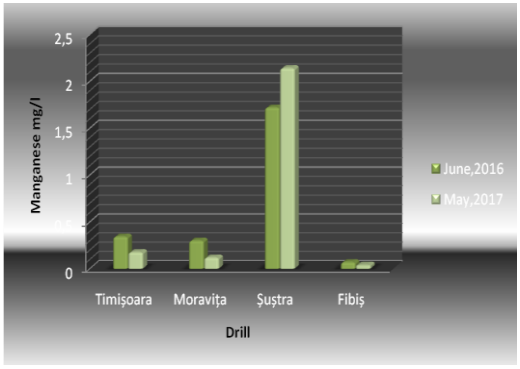

Figure 10. Manganese content

CONCLUSIONS

1. The water samples from the Timisoara drilling revealed the slightly basic character; the nutrient status is kept below the maximum permitted level; the iron content is maintained at a low level, but in the case of manganese there are exceedances of CMA in both years taken under study; the calcium and magnesium content is maintained at high level, fact which increases the quality of the water.
2. The water samples taken from Moravita drilling have a slightly basic character; the ammonia value in 2016 was below the CMA, in 2017 there is a sign that exceeds the maximum allowed limit for drinking, the content of nitrates is reduced; the iron content is maintained at low values, instead the manganese concentration exceeds the CMA; the sodium and potassium content is low and the chlorine content does not pose problems regarding making the water drinking.
3. Water samples taken from the Moravita drilling have a slightly basic character; the ammonia value in 2016 was below the CMA, in 2017 there is a sign that exceeds the maximum allowed limit for drinking, the content of nitrates and nitrates is reduced; the iron content is maintained at low values, instead the manganese concentration exceeds the CMA; the sodium and potassium content is low and the chlorine content does not pose problems in water drinking.
4. In the case of Sustra drilling, the water is slightly acidic; the ammonium content slightly exceeds CMA in June 2016 and remains at the maximum permitted level in 2017, the nitrate content is low; the iron content is kept at low levels in both years, but manganese has values exceeding far the maximum allowed limit; calcium and magnesium have lower values in this drilling, the sodium and potassium content is maintained at low concentrations.
5. Water from Fibis drilling is slightly basic; the ammonium content records exceedances of CMA in both years taken under study, exceedances of the maximum permitted limit occur also in the case of nitrogen content; the iron content does not exceed the maximum allowed limit, unlike manganese where we have high values in 2016 and falls below the CMA in 2017; the calcium content is high, the sodium is kept below CMA, the potassium is constant, and the chloride content is at half of the maximum allowed limit.

6. On the whole, the quality of the underground water from Banat Plain is of good quality, with a slightly basic pH except for the Sustra drilling, where in 2017 it drops below the maximum allowed limit; the water conductivity is kept below the maximum allowed limit; ammonia exceeds the maximum allowed concentration in all drilling, except for one from Timisoara; the content of nitrates is kept below the maximum allowed limit, exceedances are recorded only at Fibis drilling, in both years taken under study; the manganese content exceeds the maximum allowed limit in all the studied drillings, except for the Fibis drilling in 2017, the rest of the indicators remaining at values below the maximum allowable concentration.

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