# STUDIES CONCERNING THE POLLUTION DEGREE OF GROUNDWATER, IN CARNECEA, CARAS SEVERIN COUNTY

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***Abstract***:
*Groundwater represented all the time is of vital importance .Groundwater is an important source of drinking water. Most of the population uses groundwater supply and agricultural purposes. The first wells for drinking water were excavated in Egypt and ancient China. Marcus Vitruvius is the first who observed that a source of groundwater is infiltrating rainwater or melted snow; He is basically the precursor infiltration theory. The first hydrogeological work in Romania is that of Pop V, which refers to the Transilvanian mineral waters. Unfortunately, many of the Romanian wells are already polluted with nitrates and other industrial and agricultural chemicals. Later, Drăghiceanu and Cucu-Starolescu have addressed the issue of groundwater in the area of Bucharest. In this paper we present the results of groundwater chemical analysis, from Carnecea, Caras Severin in order to establish the pollution degree. The main source of pollution in this area, is represented by agricultural and human activities. Analyses of parameters of water quality were made according to standardized methods. The parameters analyzed were pH, concentration of nitrates* ($NO_3^-$)*, ammonia* ($NH_4^+$)*, nitrites* ($NO_2^-$)*, phosphates* ($PO_4^{3-}$) *and chemical oxygen demand (COD. The analyses were performed in the laboratory of Environmental Chemistry of the Faculty of Agriculture, BUASVM King Michael I, Timisoara. pH was determinate by conductometric method; The content of nitrates, nitrites, ammonia and phosphates, was determined by UV-VIS spectrophotometric method, at* $\lambda$ *= 520 nm, 410nm, 425 nm, respectively, 715nm.; chemical oxygen demand was determined by volumetric method. The result of the tests led to the conclusions that high concentrations of pollutants where determinate, in particular during months with low temperatures. Thus, groundwater analyzed exceeds the maximum permissible levels for drinking water.*

***Key words***: *groundwater, pollution, nitrates, nitrites, ammonium, phosphates, oxidable substances.*

## INTRODUCTION

Water is present as a key and essential for human existence. We can not conceive human activity, the existence of life forms or the current balance of the planet, without water.

Water is a renewable natural resource, vulnerable and limited, indispensable element for life and for society, for productive activities, energy source and method of transport, the key factor in maintaining the ecological balance.

\"Groundwater\" means all water which is below the surface of the ground in the saturation zone and in direct contact with the ground or subsoil. (EU Directive 2000/60) \"Groundwater Status\" is the general expression of the status of a body of groundwater, determined on the basis of the most unfavourable values of its chemical and quantitative. (EU Directive 2000\/60). \"Good chemical Status of groundwater is the chemical status of a body of groundwater, which meets all the conditions laid down in the quality standards. (EU Directive 2000\/60, annex V).

Groundwater pollution is difficult to determine and to correct. Very often groundwater pollution is detected only when the pollutant reaches into a well, at some distance from the source of pollution

Groundwater pollution is caused by the infiltration of solid and liquid pollutants. The main types of pollution which threatens the groundwater quality is due to the diversity of inorganic and organic compounds coming from household activities, industrial, mining, agricultural; levigation of nitrate, nitrite and pesticides, acidification. (Oncia S. and Smuleac L., 2010).

Due to the accumulation of pollutants in groundwater, may be affected both human health and the ecosystem.

Unfortunately, groundwater from rural areas in Romania, such as Carnecea, Caras Severin County is already polluted with nitrates, nitrites, phosphates, ammonia, even heavy metals, due to inappropriate use of mineral and organic fertilizers or/and inappropriate storage of manure.

The amount of nitrate in groundwater is typically related to the land use activities in the upstream watershed or on the land over the aquifer. Septic systems may also be a source of nitrate in ground water while deforestation and land clearing also provide significant nitrate addition to groundwater.

Both nitrates and nitrites are products of oxidation of nitrogen by microorganisms in plants, soil and water. Although nitrates are more stable, under anaerobic conditions, can be transform into nitrites. The most vulnerable wells are those in farm communities or areas with large number of aging septic tanks.

Mineral dissolution was identified as the dominant source of phosphorus in the groundwater and stream base flow draining crystalline or siliciclastic bedrock in the study area. Low concentrations of dissolved phosphorus in groundwater from carbonate bedrock result from the precipitation of minerals and (or) from sorption to mineral surfaces along groundwater flow paths. Phosphorus concentrations are commonly elevated in stream base flow in areas underlain by carbonate bedrock, however, presumably derived from in-stream sources or from upland anthropogenic sources and transported along short, shallow groundwater flow paths (Denver J., 2010) .

The most common N compound found in groundwater is $NO_3^-$ but in strongly reducing environments, $NH_4^+$ can be the dominant form. $NH_4^+$ is formed in groundwater naturally as a result of anaerobic decomposition of organic material, following the chemical reaction (Bohlke et all., 2006)

$NO_3^- + 4H_2 + 2H^+ \rightarrow NH_4^+ + 3H_2O$ (dissimilatory nitrate reduction to ammonium)

Recently studies have shown that it may be the dominant process in some environments (Rutting et all., 2011).

## MATERIALS AND METHODS

The samples were taken in three replicates, from 6 – 8 meters wells, Carnecea, Caras Severin County, during January – October 2013. Samples were collected in 2 L plastic bottles previously and scrupulously cleaned with non-ionic detergent, rinsed with tap water and finally with distilled, de-ionized water. The samples were transferred into a cooler box containing ice-chips, transported to the laboratory and stored in the refrigerator at about 4 °C prior to analysis. These steps assure retardation of possible chemical or biological reactions in the sample. Refrigerated samples were usually allowed warm up to the room temperature, filtered and analyzed within 48 h after sampling (Akiwumi et all., 2012).

Nitrates, nitrites, ammonia and phosphates content were determined by spectrophotometric method, using a CINTRA 101 spectrophotometer, at the following wavelenghts: 410 nm ($NO_3^-$), 425 nm ($NO_2^-$), 520 nm ($NH_4^+$) and 715 nm ($PO_4^{3-}$). Chemical oxygen demand was determined by volumetric method, using $KMnO_4$.(Berbecea and Radulov, 2010).

## RESULTS AND DISCUSSION

The nitrates content is ranged between 11,6 and 58,5 mg $NO_3^- \cdot l^{-1}$, exceeding the maximum admitance level of 50 mg $NO_3^- \cdot l^{-1}$ in water samples taken from well no.3.

The lowest values of nitrates content were determinated in samples taken from well no.2 and 4 in May and the highest values (58.5 and 55.4 mg $NO_3^{-}\cdot l^{-1}$) were determinated in water samples taken from well no.3 in February and March. (Figure 1).

Nitrites content from water samples taken from Carnecea wells is high, exceeding the maximum admittance level in the most of cases. The highest values of 0.7 mg $NO_2^{-}\cdot l^{-1}$ were determinated in samples taken from well no.3 and 4 in May and June. The lowest content was observed in winter and spring months (January, February and March). (Figure 2).

The presences of nitrites in water samples indicate an advanced decomposition of organic substances with nitrogen, so their presence highlights an old pollution.

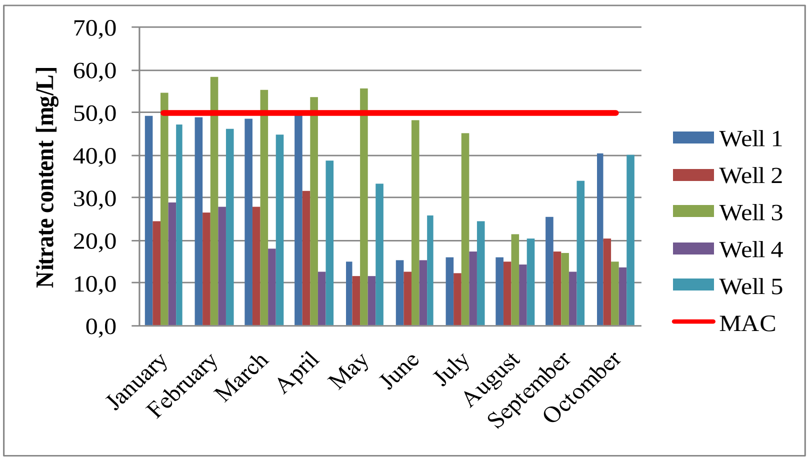


Figure.1 Nitrates content in water samples taken from Carnecea, Caras Severin County

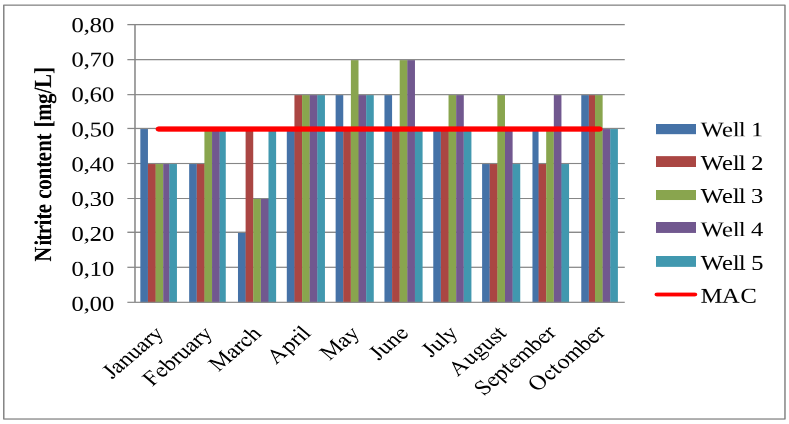


Figure 2. Nitrites content in groundwater samples taken from Carnecea, Caras Severin County

Ammonia content determinated in groundwater samples is ranged between 0.9 and 2.3 mg $NH_4^{+}\cdot l^{-1}$, exceeding in all samples the maximum admittance concentration of 0.5 mg $NH_4^{+}\cdot l^{-1}$. The highest value (2.30 mg $NH_4^{+}\cdot l^{-1}$ was determinated in samples taken from well no.4 in May. (Figure 3).

In groundwater, the presence of $NH_4^+$ ions is the result of incomplete degradation of organic substances with nitrogen. This is the first stage of decomposition and indicates a recent pollution.

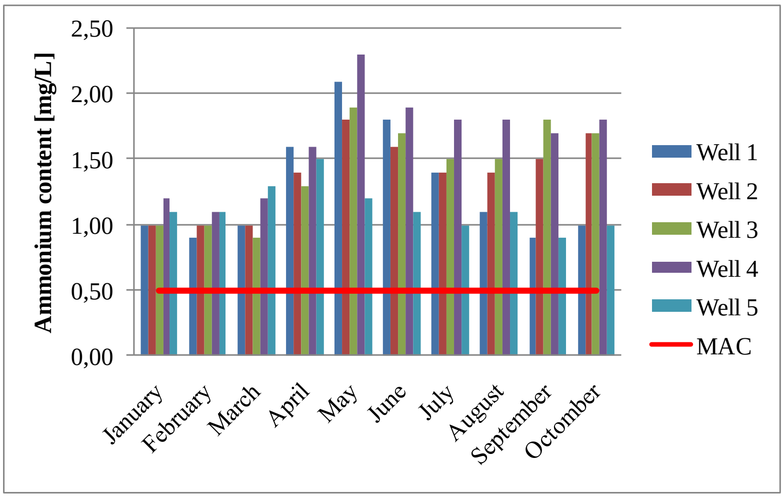


Figure 3. Ammonia content in groundwater samples taken from Carnecea, Caras Severin County

During the natural process of weathering, the rocks gradually release the phosphorus as phosphate ions which are soluble in waters (Rao and Prasad, 1997).

Phosphate ions content, determinated in groundwater samples taken from Carnecea area is high, exceeding the maximum admittance concentration in 39 samples (from 50 samples taken). Values which exceed 7 mg $PO_4^{3-}\cdot l^{-1}$ where determinated in samples taken from well no.2 (7.9 mg $PO_4^{3-}\cdot l^{-1}$ in April, and 7.45 mg $PO_4^{3-}\cdot l^{-1}$ in September), well no.3 (7.85 mg $PO_4^{3-}\cdot l^{-1}$ in September, 7.5 mg $PO_4^{3-}\cdot l^{-1}$ in Aprilie and 7.31 mg $PO_4^{3-}\cdot l^{-1}$in May) and well no.4 (7.8 mg $PO_4^{3-}\cdot l^{-1}$ in April, 7.45 mg $PO_4^{3-}\cdot l^{-1}$ in October and 7.34 mg $PO_4^{3-}\cdot l^{-1}$ in May).(Figure 4).

The lowest values, above 4 mg $PO_4^{3-}\cdot l^{-1}$ were determinate in samples taken from well no.1 in August (3.90 mg $PO_4^{3-}\cdot l^{-1}$) and well no.3 in January (3.36 mg $PO_4^{3-}\cdot l^{-1}$).

Also, a cause of these high levels of phosphates in groundwater could be partially treated or untreated sewage.

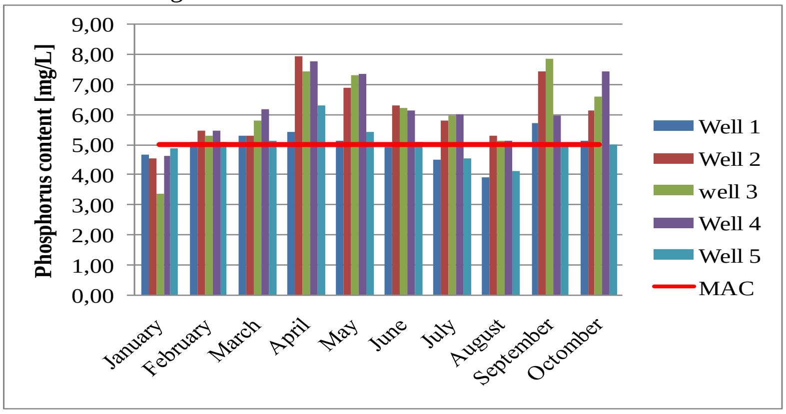


Figure 4. Phosphates content in groundwater samples taken from Carnecea, Caras Severin County

In environmental chemistry, the chemical oxygen demand (COD) test is commonly used to indirectly measure the amount of organic compounds in water. Most applications of COD determine the amount of organic pollutants found in surface water (e.g. lakes and rivers) groundwater or wastewater, making COD a useful measure of water quality.

The values of COD determinated on groundwater samples taken from Carnecea area are high, exceeding the maximum admitance level of 5 $mgO_2 \cdot l^{-1}$ in the most of samples. The highest values were determinated in samples from well no.3, in the whole period monitoring (from January till October) and in samples from well no.4 in March, Aprilie, May, June and July. (Figure 5).

These high values of COD are usually related to high contents of oxidable substances (organic or inorganic).

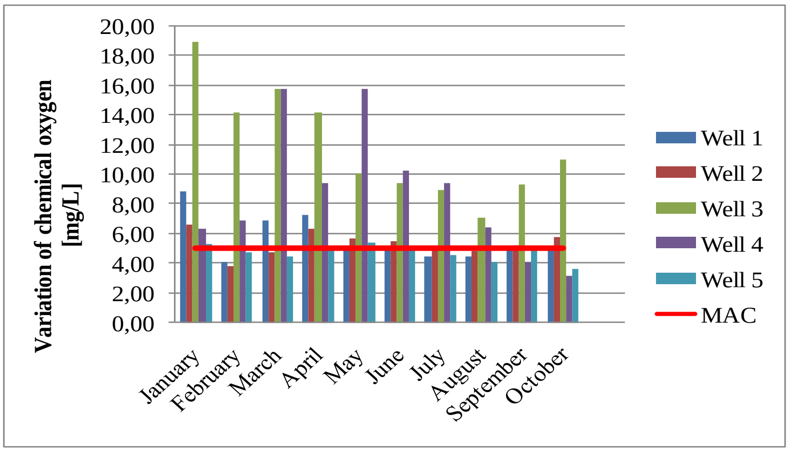


Figure 5. COD in groundwater samples taken from Carnecea, Caras Severin County

## CONCLUSIONS

The aim of this research was to watch some quality parameters of potable groundwater in order to determine the pollution degree. Analyses of theese parameters were made according to standardized methods. The parameters analyzed were pH, concentration of nitrates ($NO_3^-$), ammonia ($NH_4^+$), nitrites ($NO_2^-$), phosphates ($PO_4^{3-}$) and chemical oxygen demand (COD).

We studied the pollution degree of groundwater from a rural area in the soth-west part of Romania, Caras Severin County, by analyzing water samples taken from 6-8 m depth wells. These wells are used as sources of drinking water.

Based on results of chemical analysis, we observed that water samples taken from wells no.3 and 4 exceed the maximum admittance concentration for all parameters. So these wells are not appropriate as a source of drinking water.

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