Water Quality Assesment of the Groundwater Body RODL01 from North Dobrogea

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RODL01 - Tulcea is a combined underground water body (phreatic and pressured) situated in Northern Dobrogea, in the county of Tulcea, characterized by an area of 1160 km², having a medium protection degree and being used for water supply of the population from this area. This paper presents the variations of some quality parameters (ammonium, nitrites, nitrates, phosphates, chlorine, sulphates, calcium, magnesium, sodium and potassium), based on recorded average annual value in 2011-2014 periods. For the physico-chemical evaluation of the groundwater body RODL01, 4 bore wells were monitored by Dobrogea-Litoral Basin Water Administration Constanta.

Keywords: groundwater body, water quality, physico-chemical parameters.

Groundwater, one of the most important natural resources, is in aquifers below the surface of the Earth. This water can be used for water supply and irrigation [1,2].

The groundwater from aquifers comes from precipitations which down through the soil by percolation phenomenon. Similarly, with this water can percolate in the ground other liquids which can contaminate the grounwater [2].

Even though it is hidden underground, groundwater pollution is possible due to our activities at the Earth's surface, and since groundwater interacts with surface water, contaminated groundwater can cause pollution of surface water. The important pollutant of the groundwater are the nitrates**,** coming from land fertilization [2].

A precise survey of the groundwater quality and network of Romania, and implicitly of the Dobrogea network, based on Based on the field measurements and the laboratory results obtained, was realised by the *Romanian Waters* National Administration [3-5].

Study area

In the hydrographical region Dobrogea-Litoral were identified and analysed 10 groundwater bodies. These differentiate through a unique code (e.g. RODL01 that forms by joining together *RO*- which represent the country's code, *DL*- which comes from the hydrographical region of Dobrogea-Litoral and 01- which represents the water body number from the hydrographical area mentioned above).

Inside the Dobrogea-Litoral Basin Water Administration, 10 underground water bodies were identified, four of them are aquifer water bodies with free level and six are pressured aquifer water bodies [4,5].

From a qualitative and quantitative perspective, annual observations and measurements are performed on 4 wells from the RODL01-Tulcea water body.

RODL01 - Tulcea is a combined underground water body (phreatic and pressured) situated in Northern Dobrogea (fig. 1). This water body is characterized by an area of 1160 km², used to water supply of the population and having a medium protection degree [4].

From the pressures perspective, in the Tulcea area and just south of it there are industrial units with environmental polluting potential.

The covering layer is made of loess deposits of variable height, often reduced and on large areas these are missing, leaving Triassic deposits to crop out of the soil. Active

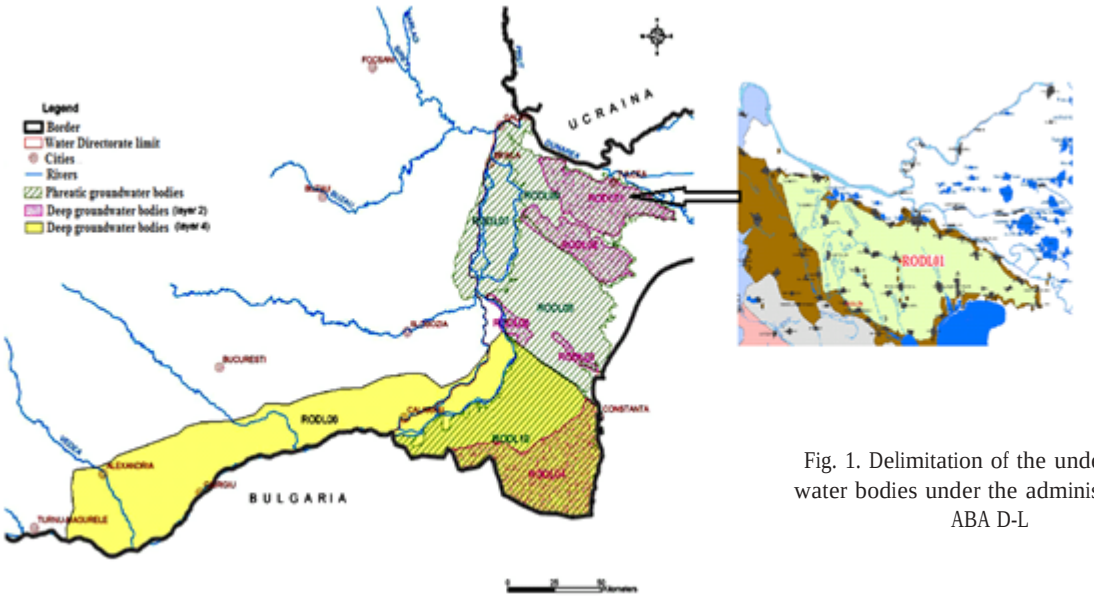

Fig. 1. Delimitation of the underground water bodies under the administration of ABA D-L

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infiltration in the region is estimated at around 15-30 mm water column per year, which falls into the medium global protection category.

This groundwater body is located in Triassic calcareous deposits (red nodular limestone, black limestone and grey dolomite, conglomerates and slates) situated south of Tulcea city, along the Danube (these deposits form a series of anticline and synclinal flexures oriented approximately NV-SE and are affected by fault lines which created local crack systems) and in the NV part of Lake Razelm [4].

The hydro-geological parameters provided by the boreholes, which are non-uniformly distributed are: the transmission constant K = 0.2 – 250 m/day and the transmissivity T= 2 - 6500 m^2/day, i.e. typical parameters for an inhomogeneous and isotropic environment such as the fissured sink from the area [4].

Experimental part

For the physico-chemical evaluation of the groundwater body RODL01, four bore wells were monitored by Dobrogea-Litoral Basin Water Administration Constanta, with a frequency of two measurements per year (table 1). The wells are placed in the S-E part of the water body and they are not distributed uniformly [4].

Table 1
NUMBER OF MONITORED WELLS ON THE GROUNDWATER BODY RODL01

No. of bore well	Name of bore well
Well 1	SATU NOU F source
Well 2	MURIGHIL
Well 3	MAHMUDIA
Well 4	VALEA NUCARILOR

In this study, the analysed parameters are: ammonium, nitrites, nitrates, phosphates, chlorine, sulphates, calcium, magnesium, sodium and potassium.

Results and discussions

The indicators which determined the physico-chemical state of the water body are according to [6]÷[15]:

-Ordinance 621/2014 – Regarding approbation of the limit values for Romanian groundwater, which has both unique national limit values, and limit values that are applicable to individual water bodies in Romania (provided in Appendix 2): NH_4, NO_2, PO_4, Cl, SO_4.

-HG53/2009 – Regarding approbation of the national plan for protection of the groundwater against pollution and degradation with nitrates and pesticides.

-Natural background level (NBL) for RODL01: Ca, Mg, K and Na.

In table 2 are presented the allowable maximum values.

In the following, the graphics represent the variation of the quality indicators for the groundwater body RODL01 analyzed between 2011 and 2014.

In figure 2 it can be observed that for the ammonium indicator, there were recorded increased levels for 2013 and 2014 at well 2, the other measured values are much lower compare to the allowable maximum value of 0.50 mg/L.

Concerning the resulted nitrites analysis, it can be observed that they are 90% below the considered limit value; therefore, there are no issues (fig. 3).

Regarding the nitrates (fig. 4), there were recorded excess levels in all years (up to about three times the allowable maximum value) at the Mahmudia well (Well 3). The other values are below the allowable maximum limit.

In the analysis of the phosphates there were not recorded excess levels, all the measured levels being with more than 60% below the limit value (fig. 5).

Parameter	NH_4	NO_2	NO_3	PO_4	Cl	SO_4	Ca	Mg	Na	K
Value (mg/l)	0.5	0.5	50	0.5	250	250	84.16	155.93	72.6	1.39

Table 2
ALLOWABLE MAXIMUM VALUE

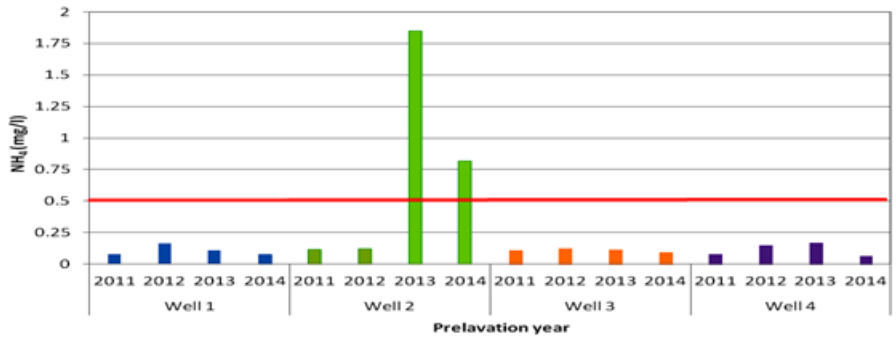

Fig. 2. The variation of the NH_4 indicator on the groundwater body RODL01

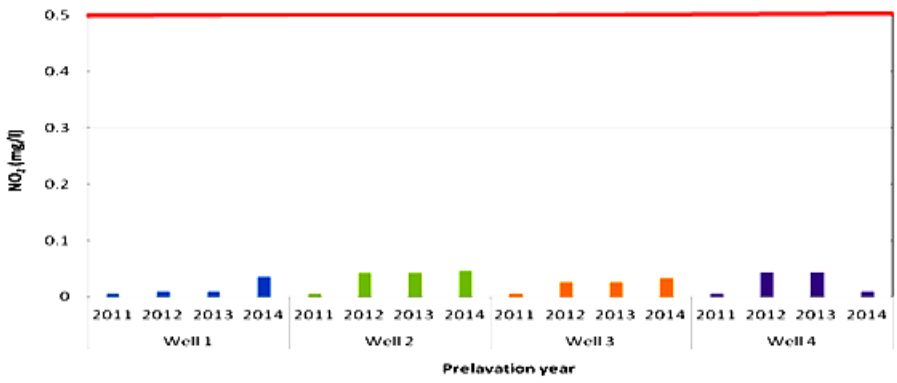

Fig. 3. The variation of the $N0_2$ indicator on the groundwater body RODL01

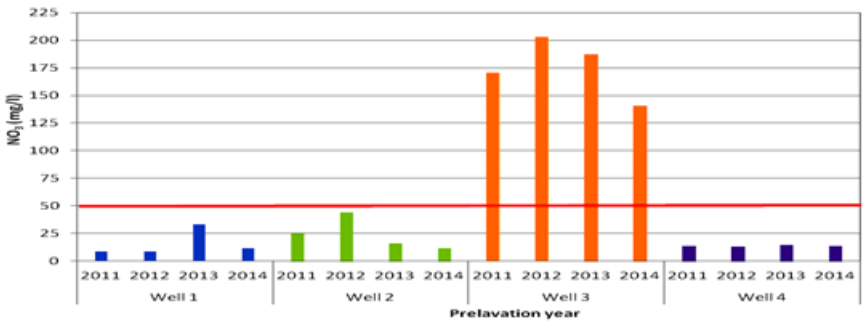

Fig. 4. The variation of the $N0_3$ indicator on the groundwater body RODL01

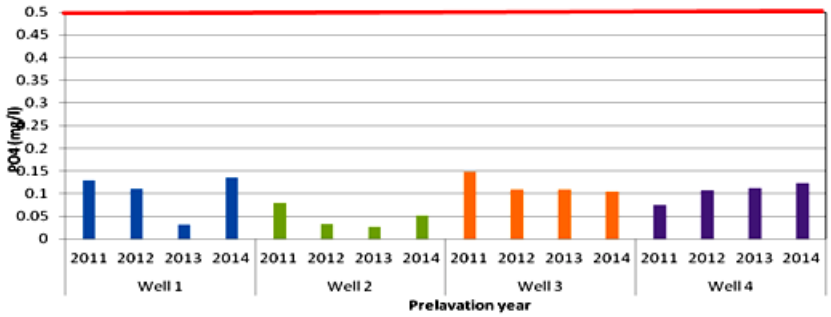

Fig. 5. The variation of the PO_4 indicator on the groundwater body RODL01

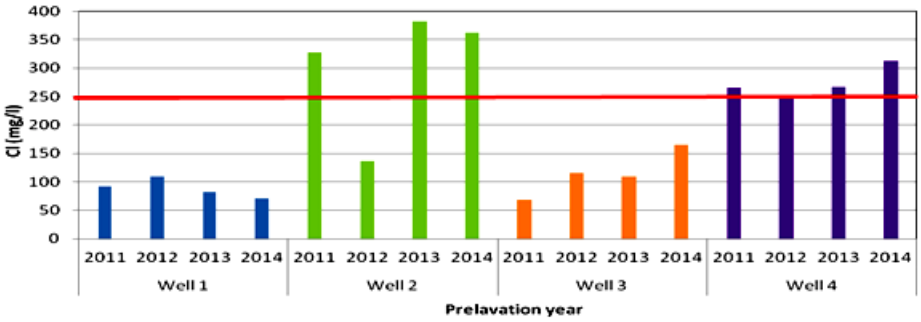

Fig. 6. The variation of the Cl indicator on the groundwater body RODL01

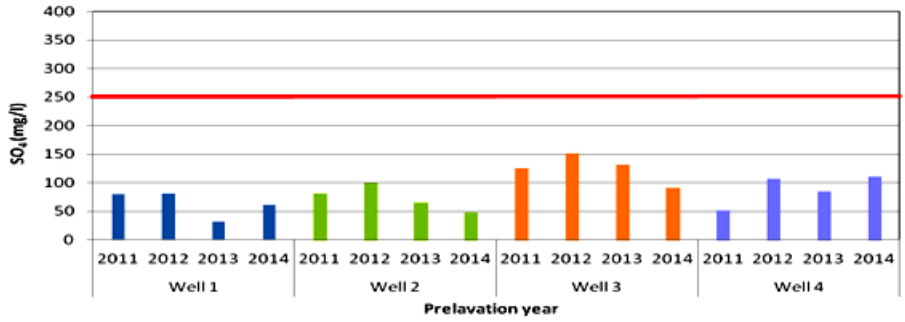

Fig. 7. The variation of the SO_4 indicator on the groundwater body RODL01

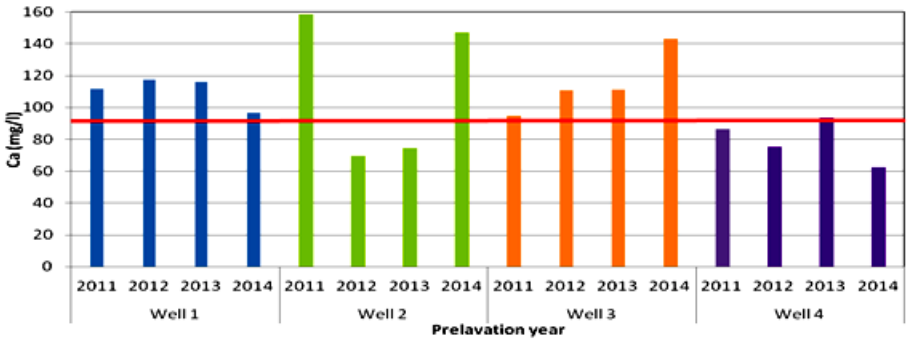

Fig. 8. The variation of the Ca indicator on the groundwater body RODL01

In figure 6 it can be observed that for the chlorine indicator, excess levels were recorded at well 2 – Murighiol in 2011 (of 31.3%), 2013 (of 52.7%) and 2014 (of 44,9%) and on well 4 – Nucarilor Valy in all years 2011 (of 6.3%) , 2012 (of 0.8%), 2013 (of 6.5%) and 2014 (of 25.3%).

In the studied period, the sulphates quantities don't exceed the limit value of 250 mg/L (fig. 7).

From the analysis of the Calcium indicator, excess levels can be observed for whole studied period at two monitored wells (Satu Nou and Mahmudia). At those wells we observe high values above the allowable maximum limit at well 2 in 2011 and 2014 and small values above the allowable maximum limit at well 4 in 2011 and 2013 (fig. 8).

For Magnesium there were not recorded any exceeds of the limit value of 155.95 mg/L, according to the Natural Background Level (NBL) (fig. 9).

For the Sodium, a rise of the measured quantity can be observed, as in 2011, excess values were registered for the wells 2 and 3, and for all the 4 wells in 2012 (fig. 10).

In figure 11, we observe that the measured quantity potassium is below the limit value, excepting the values from 2013 at well 1 and well 2 which are over the limit value.

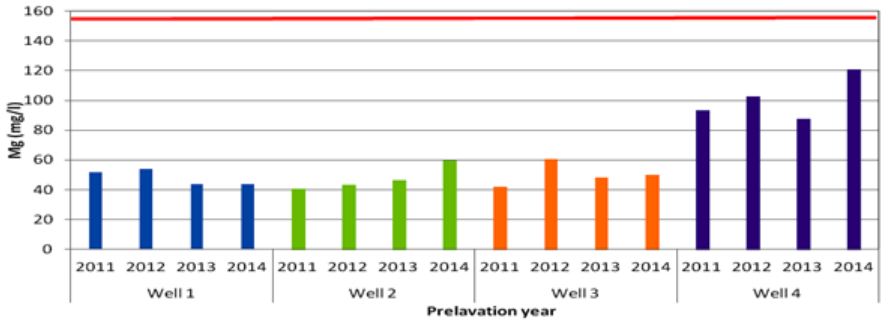

Fig. 9. The variation of the Mg indicator on the groundwater body RODL01

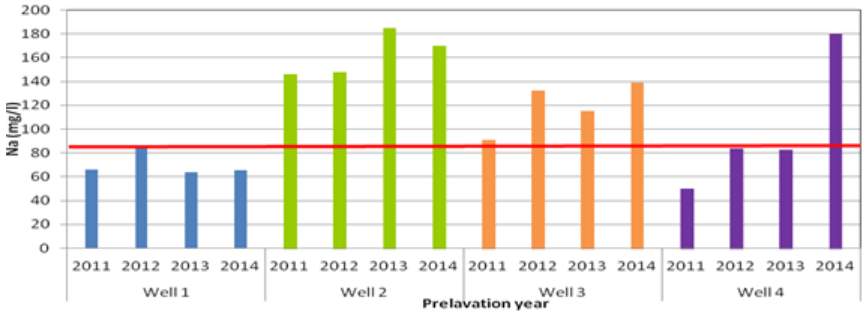

Fig. 10. The variation of the Na indicator on the groundwater body RODL01

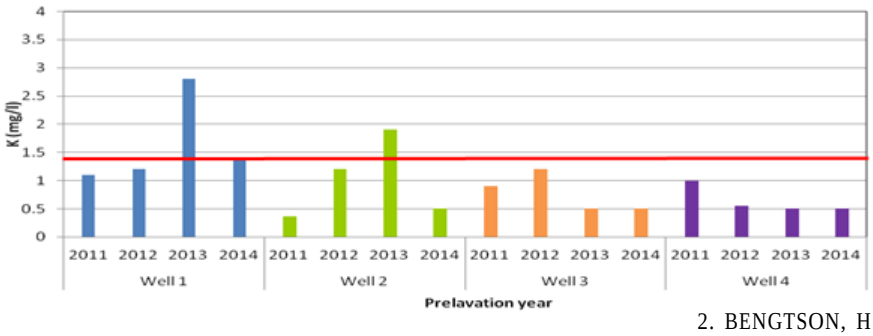

Fig. 11. The variation of the K indicator on the groundwater body RODL01

Conclusions

In the 2011-2014 period, the RODL01 waterbody displays a low chemical state, provided by the parameters of ammonium, nitrates and chlorides, for which were identified exced values over the allowable maximum value.

The causes of the groundwater pollution by nitrates are manifold and cumulative, its main sources of pollution with nitrogen are:

- permanent soil washing impregnated with nitrogen compounds by the application on certain categories of arable land of the chemical fertilizers, by water from precipitation and irrigation;
- lack of wastewater collection systems, especially in rural agglomerations.

For the four wells of RODL01, the following quality indicators were also monitored: water temperature, pH, alkalinity, concentration of dissolved oxygen, conductivity.

To improve the water quality, one of the following solutions can be adopted:

- renouncing to use the bore wells with deficiency in execution;
- chemical treatment of water, using systems to reduce the quantities of nitrates etc.;
- new water source in the neighbour areas, from deep aquifer.

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8.***Directiva 91/676/CEE - Privind protectia apelor impotriva poluarii cu nitrati proveniti din surse agricole

9.***Directiva 96/61/CEE - Privind prevenirea si controlul integrat al poluarii.

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