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HYDRO-CHEMICAL CHARACTERISTICS OF THE UNDERGROUND WATER OF THE BAHLUI RIVER BASIN

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Rezumat: *Caracteristicile hidro-chimice ale apelor subterane din bazinul Bahlui.* Condițiile geologice (prezența în substrat a unor argile sarmațiene cu intercalații de marnă și nisipuri, puțin favorabile formării unor strate acvifere bogate), geomorfologice (râurile prezintă lunci largi, și numeroase terase, utilizate ca spații de rezidență, terenuri agricole sau în amplasarea unor obiective industriale ce implică o poluare accentuată a straturilor acvifere aferente), climatice (precipitații medii multianuale cuprinse între 500 și 550 mm, temperaturi medii multianuale de 9-9,4°C, caracteristice unui climat temperat continental cu nuanțe de excesivitate, cu perioade de secetă și uscăciune frecvente) și hidrologice (o scurgere de suprafață care prezintă variații mari ale debitelor râurilor) și hidrogeologice (coeficienți de infiltrație cu valori reduse, capacitate de acumulare a apei de asemenea redusă), la care se adaugă și o activitate umană susținută (în special în agricultură și în industrie), constituie premise esențiale în generarea unor caracteristici hidrochimice deosebite ale apelor subterane din bazinul hidrografic Bahlui. Parametrii analizați în pentru evaluarea caracteristicilor hidrochimice ale apelor subterane din acest bazin hidrografic au vizat variația concentrației ionilor de hidrogen (pH-ul), gradul de duritate (totală și temporară), conținutul de reziduu fix și substanțe organice și o serie de anioni (HCO_3^- -ionul hidrocarbonat, SO_4^{2-} -ionul sulfat, Cl^- ionul de clor), și cationi (Ca^{++} , Mg^{++} , $Na^+ + K^+$).

În funcție de parametrii chimici analizați, apele subterane din cadrul bazinului hidrografic Bahlui se încadrează în clasa apelor clorurat-sodice, sau parțial în clasa bicarbonat-sodice sau sulfat-sodice cu mineralizare ridicată, prezentând valori moderate ale cantității de substanțe organice și reziduu fix, valori ridicate ale pH-ului și durității totale și temporare, condiționate, în special, de caracteristicile hidrochimice ale depozitelor geologice, valori normale ale cantităților de Fe și amoniac, însă cu unele abateri față de limita maximă, în funcție de poziția forajelor hidrogeologice față de sursele de poluare

Key words: *hydro-chemical characteristics, underground water, drainage basin*

General considerations of the underground water of the Bahlui river basin

The Bahlui river basin, with a surface of 1950 km², is situated in the central-eastern part of Moldavian Plateau, at the contact of three great physical-geographical sub-units (Moldavian Plain to the north, Central Moldavian Plateau to the south, and Suceava Plateau to the west). This is a region poor in both surface and subterranean waters, and this has strong implications on the socio-economic development of the area.

The geological characteristics (the presence in the substratum of Sarmatian clays with intercalations of shale and sands, not too favourable for the formation of rich aquifer strata), the geomorphologic characteristics (slopes affected by intense erosion processes, the large floodplains and numerous terraces of the rivers, yet used as residential terrains, agricultural terrains or for the location of industrial objectives that lead to a severe pollution of the aquifer strata), the climatic features (average annual

precipitations of 500 and 550 mm, average annual temperatures of 9-9,4°C, characteristic to a temperate continental climate with excessive nuances, with frequent periods of drought and dryness), the hydrologic aspects (a surface runoff conditioned by the evolution of the climatic elements, and which presents high variations of the rivers discharge and low values of the specific runoff) and hydro-geologic conditions (low valued infiltration coefficients, low water accumulation capacity), to which is added a sustained human activity (mainly agricultural and industrial), constitute essential premises for the generation of special chemical characteristics of the subterranean waters from this basin.

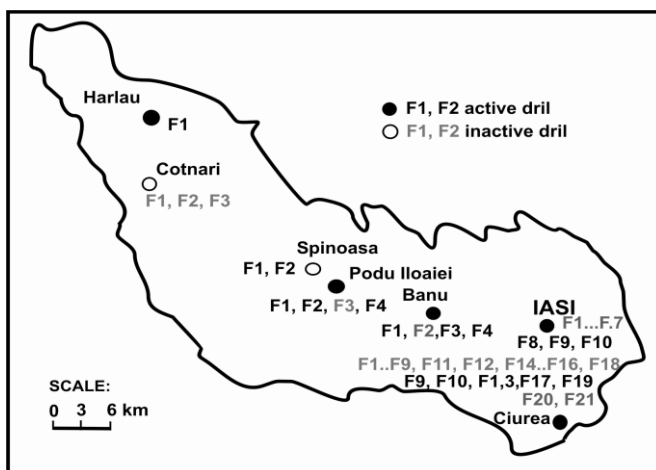


Fig.1. The position of the analysed hydro-geological drills in the Bahlui river basin

According to the lithologic characteristics of the geological deposits, several types of hydro-geological structures may be distinguished in the Bahlui river basin (Dragomir, 1998):

a) discharge hydro-structures of inter-stream type, whose aquifers are situated at the base of the loess-like deposits and in the Upper Basarabian deposits, with rainfall-snow and surface waters accumulation;

b) terrace bed load hydro-structures, mainly on the left bank of the Bahlui and Bahlueț, with alimentation from rainfall, snow melting and the surface waters, and which are drained by Bahlui river and its tributaries; their discharge is done through valley slope springs;

c) hydro-structures of proluvial fans and coluvio-deluvial glacies from the contact with the higher areas (Central Moldavian Plateau and Dealul Mare Hârlău), with alimentation mainly from surface waters;

d) discharge hydro-structures of the main river floodplains (alluvia hydro-structures), situated in the floodplains of the main river courses from Bahlui river basin, alimeted from surface waters or slope springs;

e) discharge hydro-structures of the oolitic sandstone type, developed over and more rarely under the base level, alimeted from rainfall, snow melting and surface waters;

f) profound hydro-structures, situated under the base level, alimanted from the surface waters through strata ends, with lifting and sometimes artesian character. Such structures have been identified in Bahlui basin through deep drills in the contact area with the Central Moldavian Plateau.

The deep aquifer strata are located in permeable deposits of Sarmatian (Badenian), Cretaceous, Silurian and Proterozoic (fissured crystalline rocks) age. These hydro-structures are alimanted only through the strata ends, and contain both potable oligo-mineral waters and highly mineralized waters, recommended for therapeutic purposes. The underground table maintains in general at depths over 5m, with the exception of the flow areas, where the depth of the superficial deposits is great, as well as in the cuesta fronts areas, where occur lots of springs of strata end, or along the rivers floodplains.

The analysis of the hydro-chemical characteristics of the subterraneous waters from Bahlui river basin has been conducted on the basis of the data from 7 hydro-geological stations (Hârlău, Cotnari, Spinoasa, Podu Iloaiei, Banu, Iași and Ciurea), each with at least one monitoring drill. Most of the hydro-chemical characteristics and water quality monitoring drills from Bahlui basin are at Ciurea experimental station (21 drills, part of them inactive).

Hydro-chemical characteristics of the underground water of the Bahlui drainage basin

The analysed parameters for the evaluation of the Bahlui basin subterraneous waters hydro-chemical characteristics have regarded the variation of the hydrogen ions concentration (pH), hardness degree (total and temporary), fix residuum, organic substances and a series of anions (HCO_3^- , SO_4^{2-} , Cl) and cations (Ca^{++} , Mg^{++} , $Na^+ + K^+$) content.

The period taken in consideration in the present study for the analysis of the hydro-chemical characteristics of the underground waters of the Bahlui basin is 1994-2004.

The values of the organic substances content oscillate between 6.15 g/l in F1-Hârlău drill and 9.8 g/l in F8-Iași drill or 12.3 g/l in F8-Iași drill. In general these values are kept in the maximum admitted limits for the 1st water quality category. Yet, during the analysed period maximum values of 19 g/l (on 23.9.2003 in F1-Hârlău drill) or 35g/l (on 19.5.2002 in F8-Iași drill) or 40g/l (on 21.9.2003 in F9-Iași drill) have been registered also.

The fix residuum oscillates between medium values of 859 mg/l in F1-Hârlău drill and 986 mg/l, values that include the underground waters from Bahlui basin in the 2nd water quality group according to this parameter (*Fig.2*). The maximum values of the fix residuum of 1388 mg/l (on 3.10.1997 in F1-Hârlău drill) or of 3583 mg/l (on 25.5.2001 in F8-Iași drill) reflect some influences on the evolution of this parameter according to certain climatic characteristics, mainly by atmospheric precipitations (*Fig.3*), that determine a decrease in underground water quality.

The concentration of hydrogen ions (pH) oscillates between quite restrained medium limits – 7.3 in F1-Hârlău drill and 7.5 in F8 and F9-Iași drills. These values of

alkaline domain are conditioned mainly by the hydro-chemical characteristics of the geological deposits.

The same hydro-chemical characteristics of the geological deposits determine very high values of the total and temporary hardness measured in all the hydro-geologic drills from the basin. The average hardness values exceed 30°G, much more than the maximum admitted limits for the use as potable water.

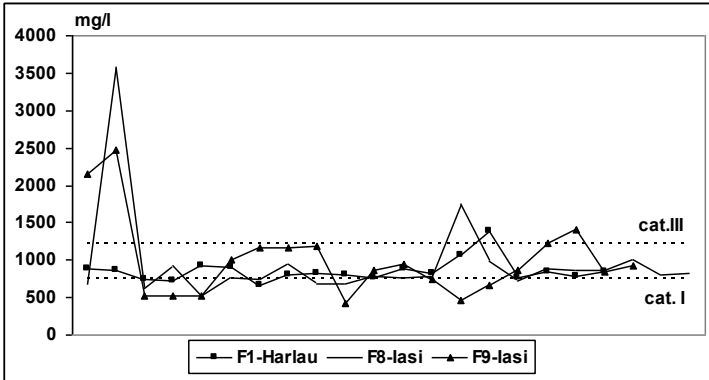


Fig. no. 2 : The variation of the fix residuum at some drills from Bahlui basin

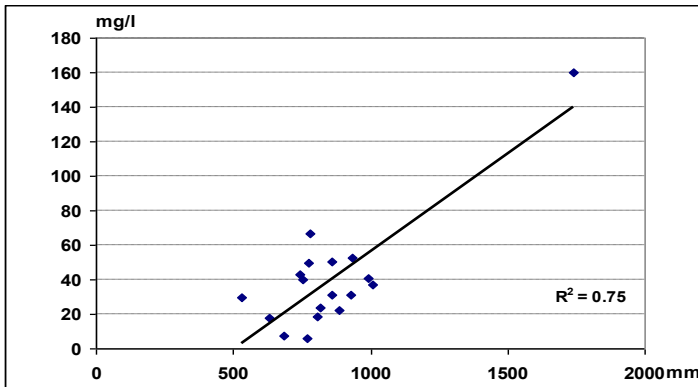


Fig. no. 3. : The variation of the fix residuum content in correlation with rainfall

A very important toxicity indicator, which exceeds in certain conditions the maximum admitted values for underground waters, is the ammonia content. This has, in general, average values between 0,270 mg/l in F1-Hârlău drill, but reaches over 500 (and even 600 mg/l in the drills from the lower Bahlui basin). This increase is caused by the influence of the Iași urban area on the hydro-chemical characteristics of the underground waters, because of the numerous pollution sources (slaughter houses, factories, domestic pollution etc.) (Fig.4).

If we analyse the dominant ions (HCO_3^- , SO_4^{2-} , Cl^- , Ca^{++} , Mg^{++} , $Na^+ + K^+$) from the water of the drills from Bahlui basin, we observe that their origin is inorganic,

mainly deriving from their dissolution from Sarmatian limestone, shale, clays and sands and from Quaternary deposits from the basin.

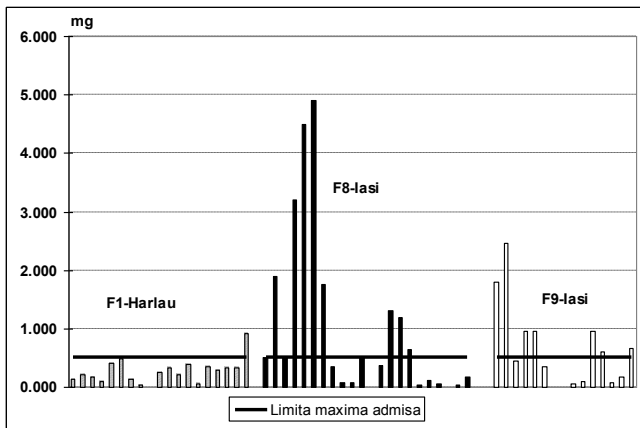


Fig.no. 4. : The variation of the ammonia content at some drills from Bahlui basin

The sodium ion, generally associated with the potassium one, derived from its dissolution from clayey Sarmatian rocks and from clayey Chernozems, varies between 2.9% in F17-Ciurea drill and 47% in F1-Banu drill, having a percentage almost equally to that of the calcium ion. From all the cations, magnesium has the highest percentage (20.6%), varying between 38% in F17-Ciurea drill and 1% in F3-Banu drill.

From the anions, at the level of the entire basin dominate the bicarbonates (28%), followed by sulphate (14%) and chloride (10%). Bicarbonates vary between 8% in F3-Banu drill and 39% in F9-Ciurea drill, and the sulphate ion between 8.3 in F9-Ciurea drill and 23% in F13-Ciurea drill.

In order to compare the chemical composition of the analysed water samples from all hydro-geological drills, and to identify the hydro-chemical type of the underground waters, we have used ternary diagrams, for the cations as well as for the anions (Fig.5).

The analysis of these diagrams points out that the majority of the drills enter the class of the chloride-sodic waters, or partially in the bicarbonated-sodic or sulphated-sodic waters.

Conclusions

According to the analysed chemical parameters, the hydro-chemical characteristics of the underground waters from the Bahlui basin are the following

- moderate values of the organic substances and fix residuum contents, highly correlated with the rainfall values;
- high values of the reaction and total or temporary hardness, mainly conditioned by the hydro-chemical features of the geological deposits;
- normal values of the iron and ammonia quantities, still with some diversions from the maximum admitted limit, probably induced by the anthropic activity;

- most of the drills enter the class of the chloride-sodic waters, or partially in the bicarbonated-sodic or sulphated-sodic waters, with high mineralization.

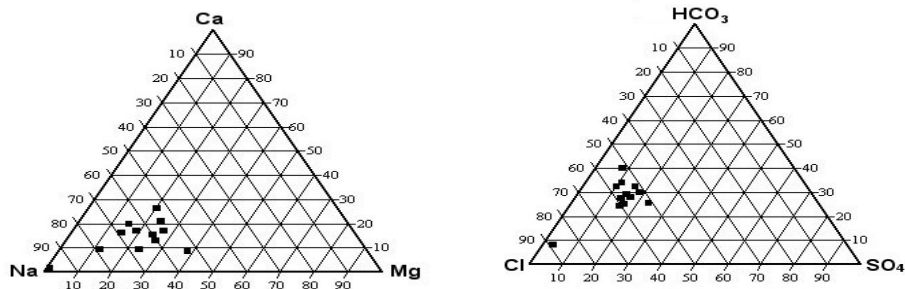


Fig.no.5 : Ternary diagrams used for evidencing the hydro-chemical type of the subterraneous waters of the main drills from Bahlui river basin

References:

- Apetrei, M., Bojoi, I., Lupașcu, Gh., Rusu, C.,** (1990) – *Considerații privind unele proprietăți ale depozitelor de suprafață din sudul Câmpiei Moldovei*, Lucrările Seminarului Geografic „Dimitrie Cantemir”, nr.9, 1988, Iași.
- Atanasiu, I., Cernătescu, R.,** (1935) – *Deux analyses chimiques des eaux du ruisseau Bahlui*, Anales scientifiques de l'Université de Iassy, tome XX, fasc.1-4, Iași.pag.407-414.
- Dragomir, S.,** (1993) – *Zonarea hidrogeologică and hidrogechimică a surselor acvifere subterane din județul Iași*, Anal.Șt. Univ.”Al.I.Cuza”, tom. XXXIX, s.II, Iași.
- Dragomir S.,** (1998) – *Geochimia apelor subterane de pe teritoriul Județului Iași*, teză de doctorat, Iași
- Dragomir, S., Saraiman A.,** (1995) – *Underground waters resources at the Botanic Garden of Iași*, Anal.Șt. Univ.”Al.I.Cuza”, tom XLI, s.II, Iași.
- Dragomir, S., Popa Gh.,** (1996) – *Les principales caracteristiques geochemiques du complexe hydromineral Strunga*, Anal.Șt. Univ.”Al.I.Cuza”, tom XLII s.II, Iași.
- Dragomir, S., Popa Gh.,** (1996) – *Consideration preliminaires sur les eaux minerals de Nicolina Iași*, , Anal.Șt. Univ.”Al.I.Cuza”, tom XLII s.II, Iași.
- Trufaș, V.,** (1980) – *Chimismul apei râurilor din bazinul hidrografic al Siretului*, Universitatea București.
- Ujvari, I.,** (1972) – *Geografia apelor României*, Edit. Șt., București.
- Varduca, A.,** (1999) – *Monitoringul integrat al calității apelor*, Edit. H.G.A., București.
- *** (1971) - *Râurile României- monografie hidrologică*, I.M.H., București.
- *** (1983) – *Geografia României, vol.I*, Ed. Academiei, București.