

ANALELE ȘTIINȚIFICE ALE UNIVERSITĂȚII „AL. I. CUZA” IAȘI
Tom L III, s. II – c , Geografie 2007

CONSIDERATIONS ON THE HYDRO-GEOLOGICAL CHARACTERISTICS OF THE SURFACE AQUIFERS FROM THE JIIA-PRUT CONFLUENCE AREA

Ionut Minea, Ionut Vasiliniuc

„A.I. Cuza” University Iași

Faculty of Geography and Geology

Rezumat : *Considerații asupra caracteristicilor hidro-geologice a acviferelor de suprafață din aria de confluență Jijia-Prut. La nivelul Podișului Moldovei, zonele de confluență suscită un interes deosebit prin dinamica morfologică a reliefului și caracteristicile hidrologice și hidrogeologice diferite față de zonele din amonte. Zona de confluență Jijia-Prut se integrează în acest peisaj geomorfologic prin caracterul mobil al condițiilor lito-geomorfologice și hidrogeologice, în funcție de factorii care au generat procesele hidrogeomorfologice locale. Fluxurile de substanță și energie, din cele două bazine hidrografice, al Jijiei și al Prutului, modulate într-o multitudine de secvențe, cu intensități diferite la scara timpului, au generat o mobilitate a zonei de confluență, în funcție de condițiile hidrologice conjuncturale. Plecând de la aceste premise ne-am propus o evaluare a caracteristicilor hidrogeologice ale acviferului din zona Cârniceni, aflată la 5km nord-vest de localitatea Sculeni (pe râul Prut).*

În urma analizei calitatea apelor subterane din este considerată nesatisfăcătoare datorită unor caracteristici fizico-chimice nefavorabile și a condițiilor și proceselor hidrogeochimice naturale, care se desfășoară în substrat, și care favorizează trecerea în soluție a diferiților anioni și cationi; poluării apelor de suprafață și schimbului hidrodinamic dintre acestea și apele subterane, reintroducerea în activitatea agricolă a îngrășămintelor pe bază de azot și de fosfor, precum și a pesticidelor; exploatarea necorespunzătoare a unor sisteme de irigații care au contribuit la mineralizarea materiei organice din sol și la migrarea substanțelor rezultate din aceste procese spre adâncime.

Keywords: underground water, hydro-geological characteristics, Jijia-Prut confluence

In the confluence areas, the oscillating fluxes of energy and substance and energy, reflected in the complex relations between forms, deposits and processes, integrate the totality of the morpho-hydrological processes that manifest in the upstream hydrographical basins. At the level of the Moldavian Plateau, the confluence areas imply a special interest through the morphological dynamics of the relief and the hydrologic and hydro-geologic characteristics, different from those of the upstream areas. Jijia-Prut confluence area enters this category of geomorphologic landscape through the mobile character of the

geologic, geomorphologic and hydro-geologic conditions, according to the factors that generated the local hydro-geomorphologic processes.

The fluxes of substance and energy from the two hydrographical basins of Jijia and Prut, modulated in a multitude of sequences, with different intensities at the time scale, have generated a mobility of the confluence area, according to the hydrologic conditions that manifest during a period of time. Referring to this area I. Rick (1931) signals an “intermittent confluence” between rivers Jijia and Prut, and an elevation of the riverbed due to the spatial extension of Jijia’s alluvial cone, as well as to the sedimentation processes of Prut during the floods and inundations. Developing this idea, V. Tufescu (1946) considers that this elevation of the riverbed, followed by a migration of the confluence area between the two rivers southwards, occurs due to the occurrence in the area of Jijia’s flowing into Prut of a transversal bar, that through a conjugated sedimentation during the floods gets higher, fact that leads that between the two rivers to take place a parallel flow, on a distance longer than 50km. Even if during the last 50 years a regularization of Jijia’s riverbed, mainly in its lower course, was realized, as well as a series of damming works of local character, or the construction of retention basins for avoiding major floods (as have occurred in 1932 or 1955), the Jijia-Prut confluence area still poses geomorphologic and hydrologic problems.

Presently a reconditioning and maintenance of the dams constructed during 1950-1970 is tried, as well as the realization of new ones for the complete regularization of Jijia’s course, mainly in the lower course. From 1998, Prut Water Direction in cooperation with the Nederland Institute for the Management of Interior Waters and Polluted Waters Treatment try to implement a series of monitoring and ecological reconstruction models in Prut basin. A first step was realized through the re-establishment of water flow on Jijia’s old course, downstream Chiperești and the realization of Costuleni wetland. In the riverbed of Jijia Veche was executed (but not yet finalized), the irrigation and draining system Sculeni – Tutora – Gorban. Also in this area have been realized two fishing areas that have presently been abandoned due to financial reasons. The terrain from the riverbed is intensely used for agriculture. Beginning with the political changes from 1989 the agricultural activity from this area was reduced and the terrain quality went wrong, occurring very many saline areas. The pastures were extended in the disadvantage of the arable terrains. The irrigation system is no longer used, and the drainage system functions only partially.

Departing from these premises we have proposed an evaluation of the hydro-geological characteristics of the surface aquifer from the Jijia-Prut confluence area - from Cârniceni area, 5km northwest from Sculeni (on Prut

River). Placed in the common riverbed of Prut and Jijia, the 1st degree hydro-geological station Cârniceni was realized in 1974 by Prut-Iași Water Direction, for the research and evaluation of the underground strata from a structural and lithologic viewpoint, the hydro-dynamic and hydro-chemical regime, as well as the interdependence between the meteorological phenomena and the regime of the free underground strata. The hydro-geologic wells are placed on two lines, being disposed such as the first profile in whose composure enter the F1, F2 and F3 wells has a transversal direction on Prut, and the second, made of the F4, F5 and F6 wells, is transversal on Jijia (*Fig.1*).

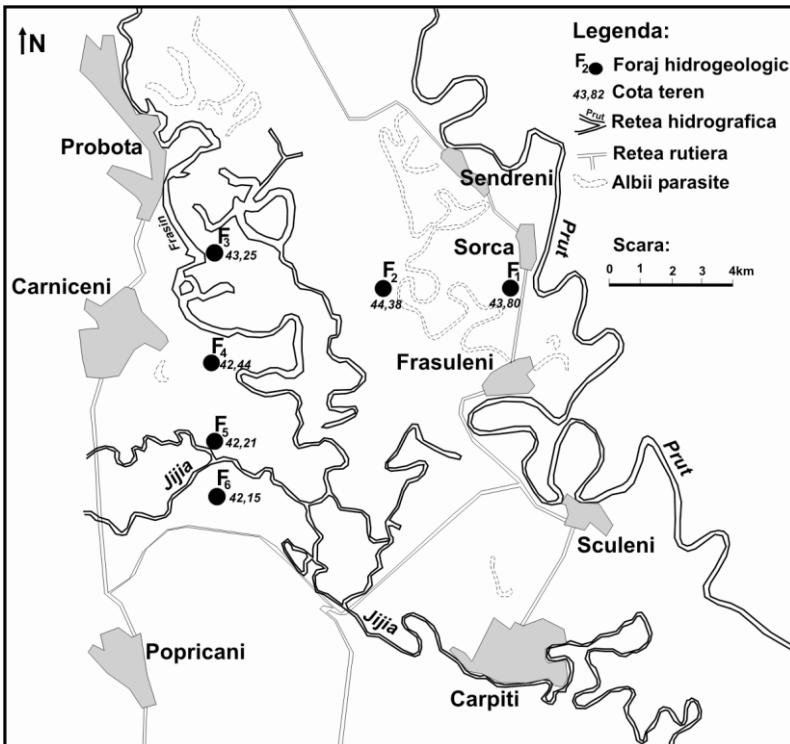
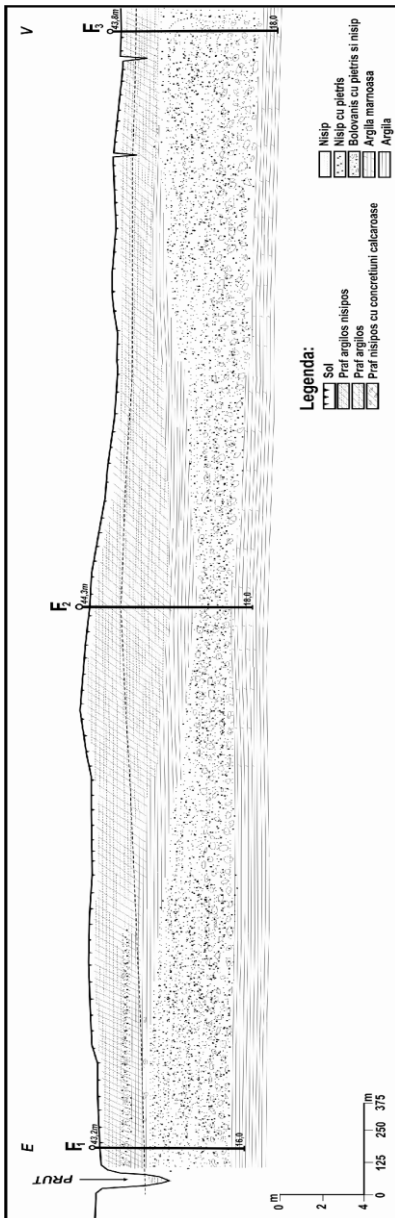


Figure no.1 : The position of the wells from Cârniceni hydro-geologic station

From a geological viewpoint, the studied area generally presents a variable structure, with inter-bedded stratification, characteristic to the riverbed Quaternary deposits. The origin of these deposits is mainly alluvial and deluvial. At the surface appears a soil horizon of almost one meter depth, followed by a group of clays, marls and sands that make up the roof of an aquifer stratum made



of boulders with gravels and sands. At the base of this aquifer were intercepted the violet-blue Sarmatian clays characteristic to the southern part of the Moldavian Plain (Fig.2). From a mineralogical and chemical point of view, these deposits are similar to the terrace ones, yet the limits of the components are different.

The grain size distribution of the aquifer stratum is characterized by a very high non-uniformity (the variation coefficient varying between 4 and 45.6), the grain class with the highest proportion in the composition of the strata being the gravel (between 34% and 68%). Taking into account the fact that the aquifer stratum is captive between two impermeable strata, the underground water contained has had during the preliminary pumping an easily ascendant character. Yet, in time, due to the local water exploitation, the water table has lowered. In the area of F3 and F4 wells, due to the presence at the surface of a permeable stratum made of clayey sands, the possibility of supplying the aquifer stratum through infiltrations during the rich pluvial phenomena, mainly from the old riverbeds of the Prut River, appears.

Figure no.2 : Geological profile in the area of Cârniceni hydro-geologic station

The geologic conditions from this area, although apparently inhomogeneous, have a complex influence on the hydro-chemical characteristics, both qualitative and quantitative, of the surface and underground water from the area and downstream. The rocks are weathered and altered and a part of

this material is carried in solution or mechanically in the water flow process. From

all the minerals that make up the rocks “attacked” by water and soluble in certain limits only a few constituents are present in appreciable quantities in the water. The analysis of the chemical composition of the underground waters presents a special practical interest, because it stands at the basis of determining the quality of these categories of waters for their usage in different socio-economical activities. The hydro-chemical characteristics of the underground waters from the area are generated mainly by the physico-chemical characteristics of the geologic substratum. In the evaluation of the chemical composition of the underground waters we have used the data obtained from the surveys for sampling and analysis of water samples from the six wells, conducted during 1974-2004 by D.A. Prut Iasi.

The analysis of the chemical composition of the underground waters regarded the evaluation of the fix residuum and organic substances content, of the reaction, total and temporal hardness, as well as of the ionic composition (main ionic constituents: Ca^{++} , Mg^{++} , $\text{Na}+\text{K}$, SO_4^- , Cl^- , HCO_3^- and secondary ionic constituents: nitrates- NO_3^- , nitrites- NO_2^- , ammonia – NH_4^+ and iron).

The average values obtained for the fix residuum oscillate between 1050mg/l for F1 well and 3600 mg/l for F5 well, allow the classification of the underground waters from this basin in the very high mineralization category and in the case of the surface waters from the area. The content in organic substances varies between 5.1 mg/l at F4 well and 12.6 mg/l at F6 well being conditioned by the closeness or dislodgment to the hydrographical network. The values of the pH insert the underground water in the category of the weakly alkaline waters (mean pH between 7.2 at F2 well and 8.1 at F6 well), while the total hardness frequently overcomes 30°G, fact that determines the insertion of these waters in the category of very hard waters, improper for the use in population alimentation or in other economic purposes.

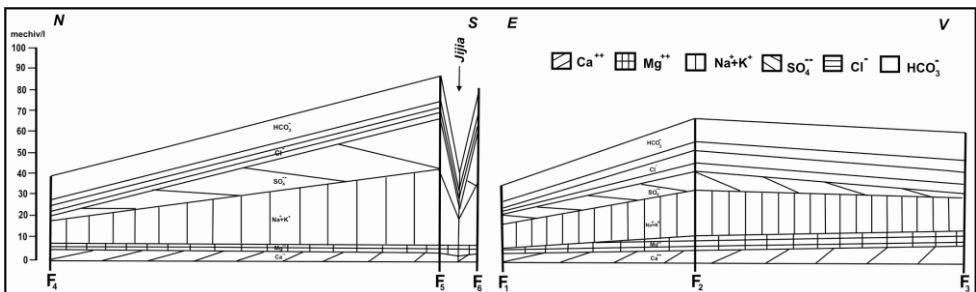


Figure no.3 : Hydro-chemical profile in the underground strata of the surface aquifer from Jijia-Prut confluence area

The determination of the chemical composition of the underground waters offers the possibility of establishing those factors on the basis of whom

may be identified the criteria according to which these water categories may be used in different domains of economy: to water alimentation where are followed four basic parameters (total mineralization, total hardness, drinkable degree and the type of water), to industrial water alimentation (where are analyzed different parameters: Fe, Mn, hardness, reaction, etc), or irrigations (where are analyzed the Priclonski irrigation parameter, electrical conductivity, the sodium absorption report – SAR and the sodium percentage -%Na).

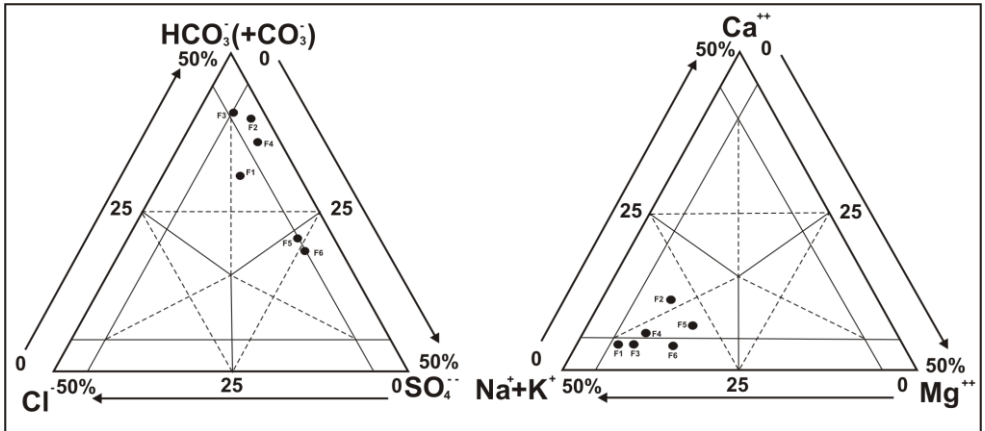


Figure no.4. Ternary diagram for graphical representation of the hydro-chemical characteristics of the surface aquifer from Jijia-Prut confluence area

The analysis of the ionic composition points out the dominance of the bicarbonate ion in all the wells (over 850 mg/l), followed by the sulphate ion (over 450mg/l) and sodium (over 250 mg/l) (Fig.3). In these conditions, according to the dominant anion, the underground waters from the surface aquifer from Jijia-Prut confluence area are part of the bicarbonate –sodium waters with very high mineralization (Fig.3).

In the case of population water alimentation or for industrial purposes, the analysis of the chemical components and of the total hardness has pointed out the fact that in this area the water from the surface aquifer cannot be used in this purpose. These waters are not drinkable, having a content higher than the maximum admitted limit through Schoeller-Berkaloff method, of the chloride, sodium and sulphate ions (Fig.5).

An analysis of the water quality from the viewpoint of the criteria for underground water usage for irrigations evidences at the level of this area that the values of Priclonski coefficient oscillate 4.93 at F1 well and 19.5 at F3 well, and of the SAR oscillate between 4.09 for well F1 and 25.0 at well F6. The

values of the specific electrical conductivity (C) oscillate between 268 mho at well F1 and 502 mho at Iași F4 well. On the basis of the analysis of the mean values of these parameters we may conclude that this water may be used in irrigations, but cautiously due to its high hardness.

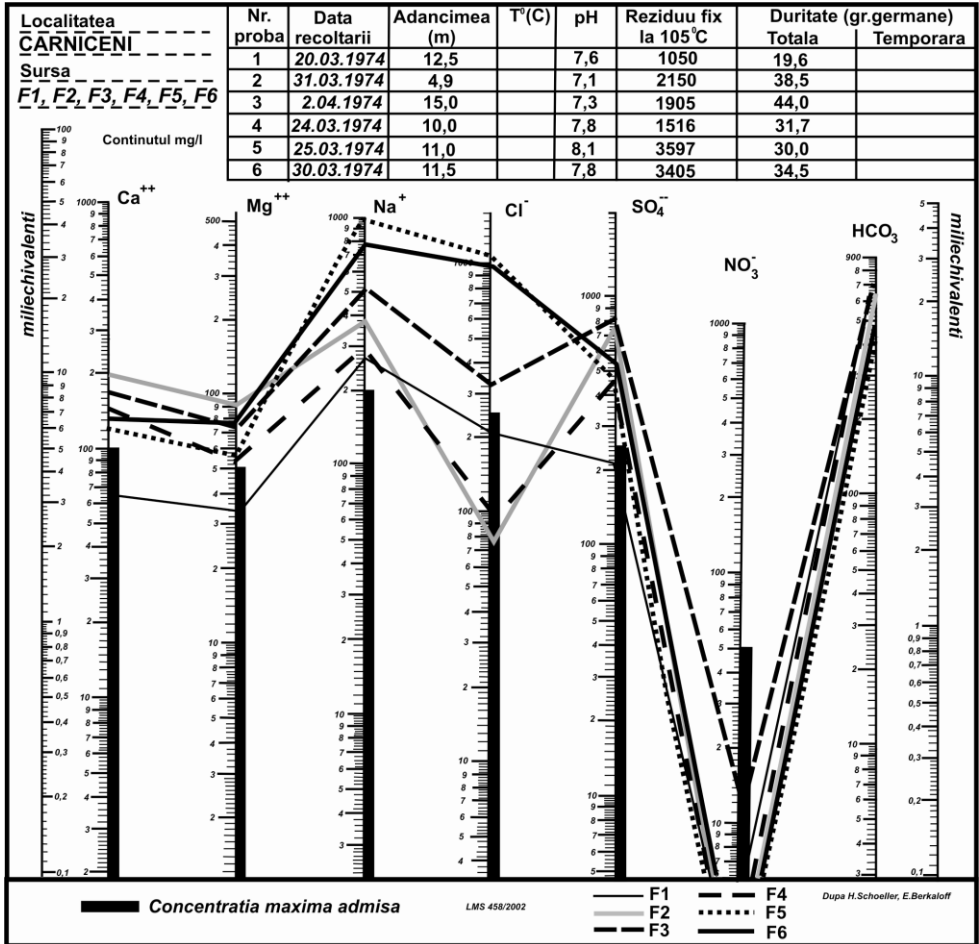


Figure no.5 : Scholler-Berkaloff diagram for the surface aquifer from Jijia-Prut confluence area

In conclusion, the quality of the underground waters from Jijia-Prut confluence area is considered unsatisfying due to some unfavourable physical and chemical characteristics and to the natural hydro-geochemical conditions and processes that take place in the substratum, and that favour the passing

into the solution of the different anions and cations, the pollution of the surface waters and the hydro-dynamic exchange between them and the underground waters, the re-introduction in the agricultural activity of the nitrogen or phosphorus based fertilizers, as well as of the pesticides and the inappropriate use of the irrigation systems that have contributed to the mineralization of the organic matter from soil and to the migration of the resulting substances from these processes in depth.

References:

- Băcăuanu, V.**, (1968) – *Câmpia Moldovei - studiu geomorfologic*, Edit. Academiei, R.S.R., București.
- Dragomir S.**, (1998) – *Geochimia apelor subterane de pe teritoriul Județului Iași*, teză de doctorat, Iași
- Pantazică, Maria** (1974) – *Hidrografia Câmpiei Moldovei*, Edit. Junimea, Iași.
- Pantazică, Maria, Schram, Maria**, (1983) – *Analiza unor indici de calitate a apei râurilor dintre Siret și Prut*, Lucrările Seminarului geografic „Dimitrie Cantemir”, nr.3, 1982, Iași.
- Rick I.**, (1931) – *Cercetări geografice și antropogeografice în depresiunea Jijiei*, Bul. S.R.R.G.L., L, București.
- Vaisman, I., Năstase, V., Popa, E.**, (1956) – *Caracterizarea calitativă a apelor din regiunea Iași în scopul utilizării lor pentru irigație*, Acad. Română (filiala Iași), Studii și Cercetări Științifice, Biologie și Șt. Agricole, anul VII, fasc.1, Iași.pag 201-207.
- Tufescu V.**, (1946) – *Confluențe și formarea luncilor Siretului și Prutului*, Rev. Geogr. I.C.G., III, nr.1, București.
- * * * (1982) – *Geografia României*, vol.I., Edit. Academiei R.S.R., București.
- * * * *Studii hidrogeologice pe bază de foraje definitive ale stațiunilor hidrogeologice situate pe teritoriul județului Iași*. Arhivele D.A.Prut – Iași and D.A. Siret – Bacău.