

GEOGEN POLLUTION WITH HEAVY METALS IN BISTRA AREA, CARAŞ - SEVERIN COUNTY

POLUAREA GEOGENĂ CU METALE GRELE ÎN ZONA BISTRA, JUDEŢUL CARAŞ-SEVERIN

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Abstract: The researches regarding the heavy metals contents in Bistra Hydrographic Basin, from Caraş-severin County, demonstrated that, generally, here the values exceed the normal values. Because these values were founded along the Couloir we considered that geogene hypothesis pollution exists. It is known that Ruşchiţa area is a mineralogical area. The pollutant activity of S.C. GAVAZII STEEL S.A. Oţelu Roşu is considered insignificant. If this pollutant activity would exist, the maximum values would be founded about the locality with a reduced tendency towards the valley extremity, fact that does not exist.

Rezumat: Cercetările în ceea ce priveşte conţinutul de metale grele în solurile bazinului hidrografic Bistra din judeţul Caraş-Severin au evidenţiat faptul că aici valorile determinate depăşesc, sau sunt foarte aproape de valoarea limită normală. Deoarece aceste valori limită au fost determinate de-a lungul întregului culoar s-a emis ipoteza unei încărcări geogene a solurilor cu metale grele. Se ştie că arealul Ruşchiţa reprezintă o veche şi binecunoscută arie metalogenetică. Activitatea poluantă a întreprinderii S.C. GAVAZII STEEL S.A. Oţelu Roşu se apreciază ca nesemnificativă în acest caz. Dacă aceasta ar fi existat, valorile maxime ar fi fost identificate în jurul localităţii cu tendinţă de reducere a concentraţiilor înspre extremităţile depresiunii, fapt ce nu a fost sesizat.

Key words: geogene pollution, heavy metals, normal value, mineralogic area

Cuvinte cheie: poluare geogenă, metale grele, valoare limită normală, arie mineralogică

INTRODUCTION

The heavy metals that arrive at the soil surface suffer a levigation processes, by that these percolate the soil profile. Their transport through the soil profile are made through liquid phase because all of the heavy metals come into the soil in dissolved forms, or in a suspension forms, and all the interaction that take place between the heavy metals and the solid constituent are to the solid-liquid interface.

Most of the heavy metals cations are quickly hydrolysed in aqueous soils. The heavy metals can be adsorbed by the adsorptive soils complexes in the forms of cations or anions (Mateescu F, 1959). In the heavy metals circuit a different biologic barrier functionate, by which a selective bioaccumulation takes place, with the defence of living organism at their excess. The manifestation depth of the heavy metals high accumulation degree, in the rocks and the soils of Bistra area, differ from a place to another, function of the denudation degree and the sedimentary intensity of the bottom land or the erosion valley.

The left part of the valley, bordered by Ţarcu Mountain, present a low contents of heavy metals. That's because the mountain not present an increasingly loading with heavy metals, but also because the piedmont forms diminished the floods and conduct the maximum leakage, that influence the heavy metals content (Lăzărescu Gh. 1970).

The right part of the valley, which is near the Poiana Ruscă Mountain, has an important charging of heavy metals because here the river has a big slope and, at the floods, can bring on a lot of materials that contains a lot of chemical compounds.

The heavy metals charges are different, function of the downstream confluences. At the confluence of Rusca River with Bistra River take place the first substantial charging. Here the river water that come to the Rușchița area arrive at the valley and it reduced their rate of flow and it abandon, in upstream and downstream the Voislova locality, the grosser materials that has heavy metals content (Lăzărescu Gh. 1972).

Towards downstream the heavy metals concentration decrease, but take place another charging, at the confluence of Bistra with Bistra Mărului River. Downstream of Oțelu Roșu city, the heavy metals contents gradually decrease until the confluence of Bistr with Timiș River.

The role of clay is to retain the heavy metals and reduce it. In the debris cone area the most soils have a loamy texture, and in the meadow the texture is sandy clay. The very low clay's percent is a factor that attenuates the heavy metals accumulation (Lăzărescu Gh. 1970).

In a condition of coarse granulometric composition, the only factor that is responsible for the heavy metals accumulation is the sedimentary materials that come in. So, the most part of the area's heavy metals are in the rocks that have a high resistance to the alteration processes (especially, quartz fragments). In time, these types of rock are gradually altered and the acid solutions extract the heavy metals that are given to the plants (Gh. Ianoș, 1992).

The organic matters content of the soils from inferior section of Bistra Couloirs is low because of the pedogenetic processes (from piemountain area) and the periodic coverage of the meadow at the floods. These facts, according with the coarse texture, conduce to the reduced metals accumulation. The coarse textured soils and the soils with low organic matters contents have a reduced cationic change capacity, fact that decreases the heavy metals accumulation.

The soil reaction has an essential role in the alteration and occurrence of metallic elements into the rocks and secondary minerals. For a high mobility of these metals the value of pH moderate or strong acid is necessary. If the granulometric composition and the organic matters content are unfavorable for the heavy metals accumulation, the soil reaction is very favorable to the chemical elements bounded forms (chemical or physical bounded forms) to pass into the soluble form, accessible to the plants. With a small exception, the soils that are recovered into the researches area have a low ph value (4 to 6), a domain of pH in that the heavy metals have a maximum mobility. In this case, any deposit of heavy metals, in ionic forms, will be quickly translocated into solution and forward in plants

MATERIAL AND METHOD

The heavy metals analysis was determinated through spectrophotometer of atomic absorption. Atomic absorption with flame was applied in common analyses for potassium, sodium, calcium, cupper and iron detection.

RESULTS AND DISCUSSIONS

The heavy metals contents are presented in figure 1.

Cupper

Naturally, cupper comes from basics rocks alteration. So, the exceed values of cupper that are founded to the right side of Bistra River can rise from geogene sources, idle from the calcareous rocks from Rușchița area. This metal was determinates in small spot quantities into the sterile dump perimeter of S.C. GAVAZZI STEEL S.A. Oțelu Roșu that are situated into the north-west part of the locality (135 ppm).

Downstream the Glimboca locality, the cupper accumulation, in total forms, is insignificant (under 20 ppm). Some more cupper, but in tolerable limits (21 to 30 ppm) are founded in the soils that are

localised updown the Oțelu Roșu city, but these quantities can't be considered pollutant. The only perimeter that presents a high content of copper is the north part of the Oțelu Roșu city. For the soils of this perimeter, near the factory, we preconize a physical disequilibrium, now hard to observed, but with grave implication on time (Gh. Ianoș, 1994).

Zinc

This element presents a medium normal concentration in soils close to 50 ppm. On a generally acid pH, all the zinc unbounded through the alteration processes are mobilized from the natural area and it is dispensed along the couloir. So, the Bistra Couloir starts with high contents of zinc (50 to 60 ppm), the remainder zinc being anthropic induced.

The dump materials, comes to the technological processes presents very high zinc contents (735 ppm), from here the zinc go to the downstream through the flow waters. So, all the area has a very high content of zinc, over 130 ppm, these values being observed between Voislova and Obreja locality.

The zinc migration in soils and plants are more intensive in the sandy soils than the clay soils (C. Răuță, 1992). In these sense, any zinc quantities existed in these soils are quickly take up from the plants and human and animal organisms. The areas with maximum content of zinc are being identified in all the soils. This fact put the bases of the hypothesis that exist an exclusive geogene charging with zinc, especially because the value founded on the dump (735 ppm) is approximate equal with the value determinate in soils (Gh. Ianoș, 1994).

A high content of zinc was also determinated on the right side of Bistra River, downstream the Oțelu Roșu city, until the confluence of Bistra with Bistra Mărului River.

A medium concentration of zinc (50 to 70 ppm) was founded on the terraces that has a podzolic soils between Obreja and Var locality, and the most reduced values (under 50 ppm) were founded on the high terraces in the south part of Glimboca and Oțelu Roșu on the very evaluated soils.

Lead

The lead has a major risk on the vegetables and animals organism because it doesn't have a metabolic utility. In total forms, in soils and waters, the lead has 16 or 15 ppm concentration.

A high value of lead contents was founded not only in Bistra Couloir, but also in Timiș Couloir, Almăj and Oravița Depression. This fact show that the lead abundance is an anthropic origin, by alteration, transport and sedimentary processes from the area were this element has a native occurrence. The lead concentration on Bistra area is favoured by the anthropic activity.

The lead is transported downstream by the flood water and running water. The slow oxidation of this element, especially in the sulphur presence that comes from S.C. GAVAZZI STEEL S.A. Oțelu Roșu, very hard soluble compounds generate. This fact keeps a high accumulation potential of lead; even the activity of the factory does not emanate lead compounds.

The right part of the Bistra River, downstream of Voislova locality, has an excessive content of lead could be declared polluted area. The source is geogene, the lead immobilization being aid by the sulphur emission from S.C. GAVAZZI STEEL S.A. Oțelu Roșu. The geogene hypothesis is reflected by the lead concentration.

The right part of the valley has medium lead concentrations (more than 30 ppm, in total forms), with 50 ppm values downstream the valley, where the sources of lead is near the valley (the alluvial valley that come to the Rușchița metalogenetic area).

Cobalt

The cobalt soil's normal values vary between 8 to 11 ppm. In the inferior part of Bistra Couloir the medium values are overstepped. The bigger values are founded in the alluvial and districambosols soils from Bistra valley and in the right part of the couloir (15 to 20 ppm).

Like lead, the cobalt has a great affinity for sulphur and for this reason the cobalt was accumulated in the area where the sulphur are predominant. The only area where the cobalt contents are lower is the left part of Bistra River, where the pedological processes favoured the depth percolating processes. The most reduced cobalt's concentration was founded in the evaluated and podzolic soils, where the mobile forms of cobalt go into the depth as a result of the illuvial-elluvial processes.

Nickel

The nickel native occurrence is in the basic rocks. In the Poiana Ruscăi Mountains, Ruşchiţa area, these types of rocks are predominant.

After the alteration processes the nickel stay in the residuals, like $(NiMg)_3[(CH)_2Si_4O_{10}]_nK_2O$ hydrosilicates, than it is transported into solution being deposit in the Bistra muds. The high affinity of nickel to the sulphur determinate their accumulation forming chelate compounds. So, the area between Voislova and Obreja has a high nickel charges (25 to 30 ppm). It is known that the toxic value of nickel is about 50 ppm. In the inferior part of Bistra Couloir does not exist this value, only in the dump hence the nickel can be scattered from the pluvial waters (Gh. Ianoş, 1994).

Manganese

The manganese mobility is maintained into superior level in acid conditions of soils and into predominant reduced conditions (cold climate, abundant rainfalls).

In these conditions, all the area has relative low manganese contents, the higher values (more than 400 ppm) being in the alluvial soils, upstream the Oţelu Roşu locality. Downstream these city the values becomes small and small (200 to 400 ppm). The most reduced values (lower than 200 ppm) was founded in the very podzolic soils from the piemountain area. Into the acid and oxido-reduced conditions, the manganese mobility is favoured.

Although in these conditions the manganese can be toxic, the iron oxides those are in the soils determinate a blocking into the plants manganese uptake. In these conditions, the uses of nitric fertilisers go to the manganese total forms transformation into the forms that are accessible to plants (Gh. Ianoş, 1994).

Chrome

The chrome pollution is rarely because these elements becomes toxic only when it is in oxidized anions form (Cr^{6+}), form that can appear only in acid pH range. The only place where the chrome was founded in a big level was the dump from north –west part of Oţelu Roşu city (1050 ppm). So, we recommend that the water from the dump gone to Bistra River without being loose to the agricultural lands (Gh. Ianoş, 1994). The chrome concentration into the left part of the Bistra River is due to the low ionic ray of this element being able to substitute the iron or the aluminium from the silicate's crystalline lattices. So, in the Bistra Couloir's soils not exist an immediate danger regarding the chrome concentration.

Cadmium

In the Bistra Couloir the cadmium is in very low concentration (1 to 8 ppm). The uniform distribution of this element on the entire surface shows that the provenience source is geogene or, the natural conditions are an anthropic amplification. The cadmium ions arrive here along with the crop out materials from Nordic mountain area. From the chemical alteration processes, the cadmium gets out quickly, and then it is draw out from the rocks and it is transported into the depression area.

Even the literatures indicate that the toxic values of cadmium is over 3 ppm, it is considerate that the entire valley have a high polluted risk, because the values of 1.5 o 3 ppm was founded all over. The analyses show a uniform distribution of cadmium on the entire profile.

Iron

The major causes of the iron accumulating are the oxidation processes, and the essential factors that influence their migration processes are the oxygen and carbon dioxide presence or their absence.

Because of the fact that in the Bistra area the depositions comes through an altered rocks, rocks that generate a value of pH bigger than 8, the iron remained blocked into the residues deposits and the materials that are transported into the couloir area are a very low contents of this element.

The heavy metals contents are presented in figure 1.

CONCLUSIONS

Experimental research showed the following

A solution for the copper content amelioration we impose the water flow interception measures, downstream the dump, and conduce it in Bistra River to avoid their dispersion onto the agricultural lands by overflowing. Also we recommend carbonates or colloidal substances administration that can block the copper adsorption or can block the reaction between copper and other elements with chelate compounds formation.

For the zinc contents we recommend high attention to this area from the north part of Oțelu Roșu, where the zinc concentration is above the normal medium concentration about tenfold. Also we recommend making phreatic water analyze because the zinc can be uptake by the plants. The control measures now are inefficiently.

To stop the lead accumulation we recommend intercepting of flood waters that come from Poiana Ruscăi Mountain and maintaining these waters in the accumulator tank to settle out the coarse sandy material.

To stop the next soil's loading with cadmium; we recommend capturing all the waters that come from the Nordic mountain area, their maintenance a period of time in an accumulator tank, to coarse material sedimentation, and their controlate conduction into the Bistra River. Another ameliorative measure is the massive organic fertilisers applying on all the soils. These fertilisers will determinate the formation of a humic horizon, situated in the superior part of the soil profile, that will fix, through an absorption process, the cadmium into the colloidal complexes. We accentuate that the major hazard is the dump from S.C. GAVAZZI STEEL S.A. Oțelu Roșu, which contained a very toxic of cadmium concentration (11 ppm).

In these areas the iron not presents a real hazard for the soils. Even if in the valley the iron concentration is about 20 000 to 25 000 ppm, in the absence of calcium carbonate we don't anticipate the apparition of ferric green stickiness.

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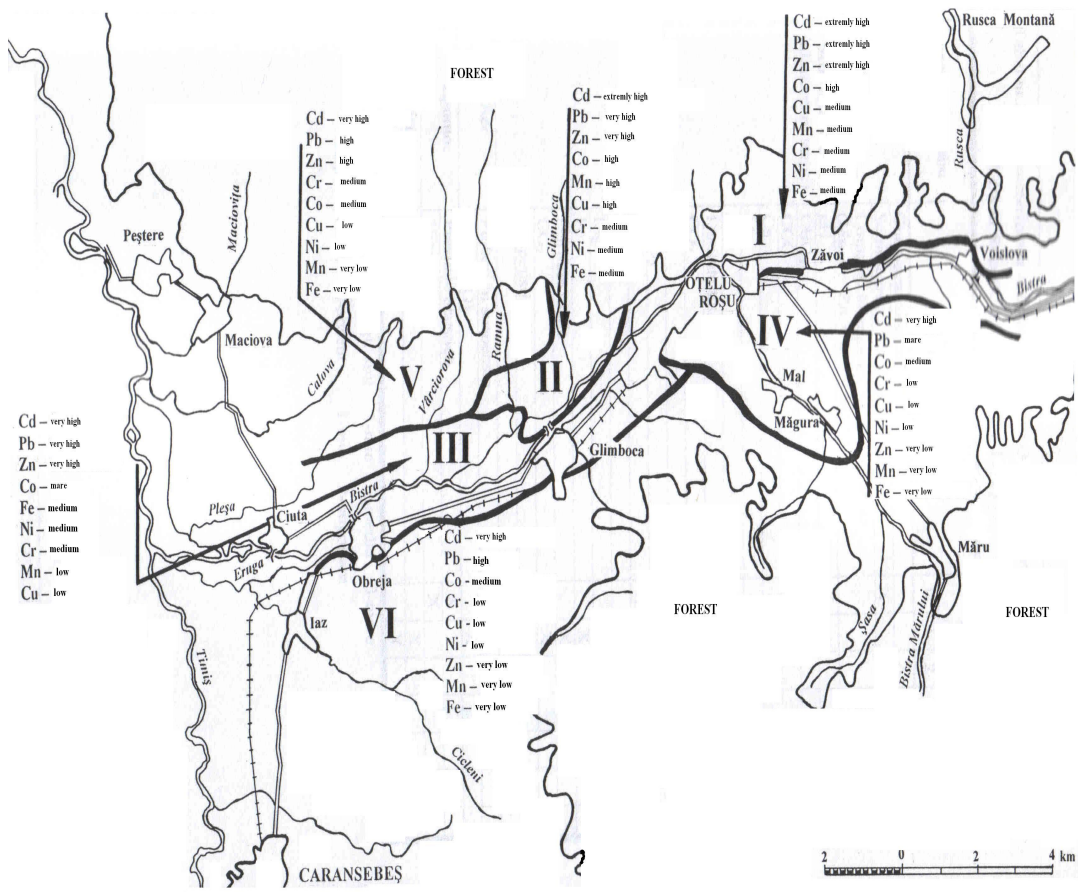


Figure 1. The heavy metals contents in Bistra Hydrographic area