

The Arieş river anthropic pollution due to mining activities

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Abstract

Due to the human activities it is discharged into the surface waters and groundwaters a large amount of the priority hazardous substances, which could have serious consequences for aquatic ecosystems and human health. The Aries River basin is located on the central-western of Romania territory, it occupies the central upper and middle part of the Apuseni Mountains and in the downstream the lowland Turda – Campia Turzii from the western Transylvanian Depression. Aries is continuously polluted with heavy metals from the mining in the area, which currently have been mostly closed. The paper aims is to study Aries river water contamination due to mining activities by determination of the evolution of priority hazardous substances concentrations.

Keywords: Aries River, pollution, priority hazardous substances

1. Introduction

Some metals are naturally found in the body and are essential to human health. Iron, for example, prevents anemia, and zinc is a cofactor in over 100 enzyme reactions. Magnesium and copper are other familiar metals that, in minute amounts, are necessary for proper metabolism to occur. They normally occur at low concentrations and are known as trace metals; for example, high levels of zinc can result in a deficiency of copper, another metal required by the body.

Water is a very important factor in the ecological balance and its pollution with priority hazardous substances represent a current problem with serious consequences over the population health. Therefore, the knowledge of the priority hazardous substances quantities from the surface waters is a very important problem for the human health [1].

As a result of mining activities carried out in various perimeters of the country, from extraction and processing of various types of ore have resulted and continue to result in significant amounts of waste water and solid waste that have been accumulated in the environment, the large areas of tens or even hundreds of hectares [2]. These waste materials usually contain high concentrations of acid with metal ions toxic action for the environment.

A good example in this way are the mining activities developed over the time into the Aries River basin, which currently are mostly closed.

The researches made between 2004 and 2008 on the priority hazardous substances content from the Aries river, have been revealed the pollution phenomenon magnitude and its decrease during the researches due to the closure of mining activities from the area.

The main mines in the area, which have had or still have an important contribution to pollution of the river Aries are:

Rosia Poieni copper-mining, founded in 1977, which over time has changed its name several times and the owner currently the mining have been done by SC Cupru Min Abrud, state-owned company, within this period in the privatization process;

Baia de Aries gold & silver mining, which although has stopped the work on 8/25/2004, at the present is still making pressures of soil quality by storing in 7 tailings dumps, an area of 3.9 ha and through the three decantation ponds flotation tailings.

Rosia Montana gold & silver mining, who has ceased activity in 2006.

Iara Mining of iron, silica sand and dolomite, Cluj county, located in the territory of settlements Băișoara, Mașca and Cacova Ierii, about 6 km northwest of the village Iara, in operation at present.

2. Materials and methods

Laboratory methods used to highlight water quality, are commonly used in water quality laboratories. Samples were collected from the following stationary: Arieseni, upstream confluence with the Cobles river, left tributary of Aries, Campeni, downstream confluence with the Sohodol river, right tributary of Aries, Baia de Aries, downstream confluence with Cioara river, right tributary of Aries, Moldovenesti, downstream confluence with the Remetea river, right tributary of Aries and Gura Ariesului, upstream of the confluence with Mures river.

The samples were collected from a depth of 1ft below the surface using Nansen type water sampler and kept in polythene containers (500 mL) with the addition of 2 mL concentrated HNO₃ at 2 mL in order to preserve the metals and also to avoid precipitation. Water samples were collected from Aries River every year in August, between 2004 and 2008, and the samples were analyzed by atomic absorption spectrophotometry, using the following standards: ISO 8288/2001 – for: Cu_{diss}, Pb_{diss}, Ni_{diss}; SR EN ISO 5961/2002 - for Cd_{diss}, ISO 9174/1998 - for Cr_{diss};

3. Results and discussion

To show the evolution of priority hazardous substances concentrations, to the plot also were used maximum limits of their concentrations into the surface waters, established by Order 161/2006 approving the Norms concerning the classification of surface water quality to establish ecological status of water bodies.

Evolution of priority hazardous substances concentration in Aries river. Copper was extracted, processed and used by man since ancient times, as iron is the metal most used. About half of the world's copper is consumed by the electrical industry, the rest is used in combination with other metals, machine building industry. It is also used in electroplating, the manufacture of paints and primers, the manufacture of the pesticides and fungicides.

Copper toxicity to aquatic life is affected by alkalinity and hardness, hydroxyl ions and carbonate ions decreasing toxicity. Toxic action of copper on fish mucus is manifested by the appearance of abundant gills and skin, lips bleeding, stress, loss of balance and eventually death.

Analyses conducted between 2004 and 2008 showed that dissolved copper concentration allowed is exceeded in all research stationary [4,5] (Table 1.) throughout the river Aries.

Table 1. Dissolved copper concentration in Aries river

	2004	2005	2006	2007	2008
<i>Arieșeni</i>	4,42	2,67	2,33	1,38	3,52
<i>Câmpeni</i>	6,64	2,9	2,19	1,43	2,15
<i>Baia de Arieș</i>	92,11	59,33	40,41	18,52	43,81
<i>Moldovenești</i>	39,42	15,07	33,2	14,04	27,65
<i>Gura Arieșului</i>	19,98	11,92	17,09	9,46	18,91

As can be seen in Figure 1, the highest values of dissolved copper are recorded in Baia de Aries stationary, because high copper intake of Abrud river affected by mining in Rosia Montana area, especially due to the intake stream of Valea Șesei, highly polluted due to mining activities and extraction of copper from Rosia Poieni perimeter.

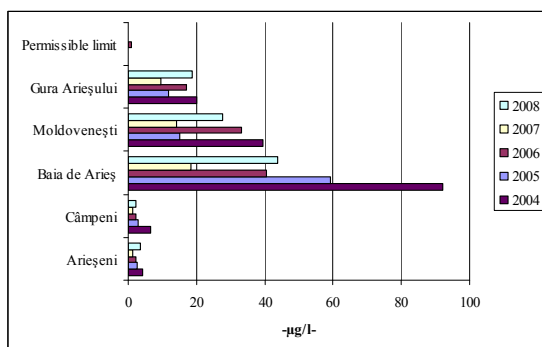


Figure 1. Evolution of dissolved copper concentration in Aries river

The concentration of copper in Aries river decreases downstream to the confluence with the Mures river, through numerous tributaries intake unaffected by pollution, but also after partial cessation of mining activities after 2004, the year which saw the highest values of Cu dissolved in Aries river.

Regarding the content of cadmium (Figure 2) and lead (Figure 3), the tests performed showed that the allowable concentration of dissolved cadmium and dissolved lead was below the permissible limits in all research stationary except stationary Baia de Aries, where in 2004 has exceeded the allowable dissolved cadmium (1 µg/l) [3], and dissolved lead (1.7µg/l) [3].

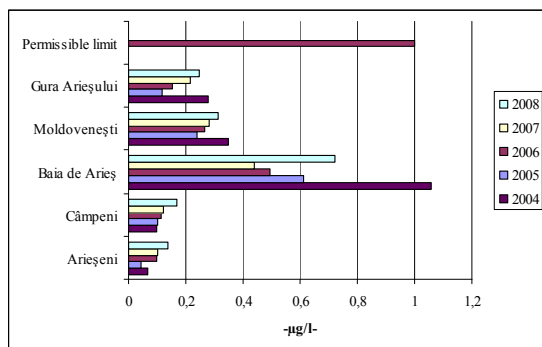


Figure 2. Evolution of dissolved cadmium concentration in Aries river

Regarding the content of dissolved nickel (Figure 4), the tests performed between 2004 and 2008 showed that its concentration is below the allowed limit of 2.1 µg/l [3] in all research stationary, the maximum value was recorded in stationary Baia de Aries, in 2004.

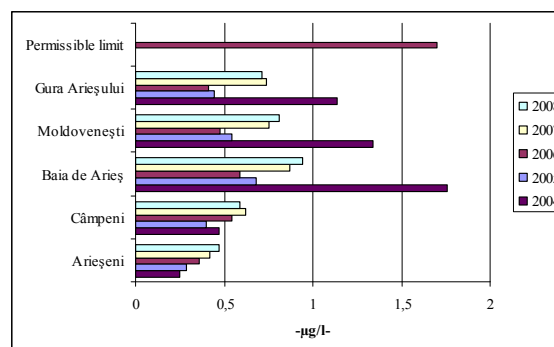


Figure 3. Evolution of dissolved lead concentration in Aries river

Table 2. Dissolved chromium concentration in Aries river

	2004	2005	2006	2007	2008
Arieşeni	1,06	0,68	0,66	0,76	0,97
Cămpeni	1,27	0,82	0,68	1,01	1,44
Baia de Arieş	4,12	2,65	2,85	2,77	2,99
Moldoveneşti	3,22	1,45	1,34	1,91	2,85
Gura Arieşului	2,67	0,91	1,16	1,58	2,41

Analyses have shown that dissolved chromium (Figure 5) concentration was below the allowed limit of 2.5 µg/l [3] in research stationary Campeni and Arieseni (Table 2).

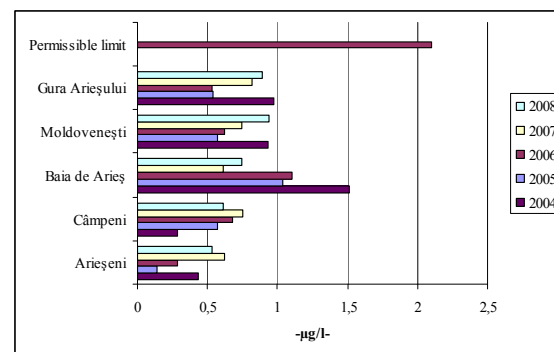


Figure 4. Evolution of dissolved nickel concentration in Aries river

Maximum values were recorded in Baia de Aries stationary throughout the period of research, the maximum concentration was recorded in 2004.

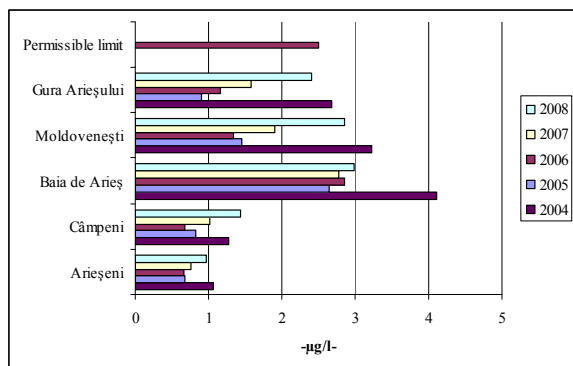


Figure 5. Evolution of dissolved chromium concentration in Aries river

4. Conclusions

The results obtained from analysis of indicators of priority hazardous substances category, prove that anthropogenic pollution of the river Aries decreased during research, due to the closure of mines. Their impact on river water quality Aries were strongly felt throughout the length of the river Aries, from Baia de Aries stationary to the confluence with the Mures river, where there were exceedances of the dissolved copper allowed limits

in all research stationary, the maximum being 92.11 $\mu\text{g} / \text{l}$, recorded in 2004 in Baia de Aries, and the minimum being 9.46 $\mu\text{g} / \text{l}$, recorded in 2007 in Gura Arieşului stationary. Exceeded maximum permissible concentrations is also registered with the chrome from Baia de Aries stationary, in all the years of research, and cadmium and lead in 2004 in Baia de Aries stationary. Nickel did not exceeded maximum admissible concentrations recorded during the research.

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