

## Studies regarding the heavy metals pollution of Aries River

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Received: 13 October 2010; Accepted: 11 November 2010

### Abstract

Water is an important factor in the ecological balance and surface waters pollution with heavy metals is a current problem with serious consequences on health. Heavy metals in small quantities are needed for all vital forms. In the organism cells, metals are presented as cations, but their inclusion is strictly regulated in large quantities because they are toxic. The paper aims is to study Aries river water contamination by determination of heavy metals. The results show exceedances of copper content in the river research-points, and chromium, lead, cadmium and in particular in the Baia de Aries stationary.

**Keywords:** river water, heavy metals, pollution

### 1. Introduction

Water is the most common substance on our planet. Beside on other resources, is available everywhere and has an important role in the environment and human life. Due to human activities are discharged high quantities of heavy metals into surface water and groundwater, which can have serious consequences for aquatic ecosystems and human health [1,2].

Aries River is located in the central western part of Romania and it occupies the central part of the upper and middle sectors of the Apuseni Mountains and in the low Turda area - Campia Turzii the far west of the Transylvanian area. Aries river is constantly polluted with heavy metals from mines in the area, which are now mostly closed [3,4].

Among the inorganic contaminants of the rivers water, heavy metals are getting importance for their non-degradable nature and often accumulate through tropic level causing a deleterious biological effect [5,6, 13-17]. Human activities can contaminate water with various substances.

Many areas of surface water and groundwater are now contaminated with heavy metals. These metals are toxic and posses high density. High concentration of heavy metals causes poisoning. Heavy metals pollution causes damage to the nervous system and the kidney, and other metabolic disruption [7].

The study was accomplished by testing rivers water from Alba County for among of their inorganic` contaminants ( $\text{Cu}_{\text{diss}}$ ,  $\text{Cd}_{\text{diss}}$ ,  $\text{Pb}_{\text{diss}}$ ,  $\text{Ni}_{\text{diss}}$  and  $\text{Cr}_{\text{diss}}$ ).

### 2. Materials and Method

Water samples were collected from Aries River every year in August, between 2004 and 2008, and the samples were analyzed by using an atomic absorption spectrophotometer.

Samples were collected from five stationary (figure 1): I – Arieseni, upstream confluence with the Cobleș river, left tributary of Aries. II – Câmpeni, downstream confluence with the Sohodol river, right tributary of Aries. III - Baia de Aries, downstream confluence with Cioara river, right tributary of Aries.

IV – Moldovenesti, downstream confluence with the Remetea river, right tributary of Aries. V - Gura Ariesului, upstream of the mouth of 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 HNO<sub>3</sub> at 2 mL in order to preserve the metals and also to avoid precipitation.

Have been analyzed the most important heavy metals, that affect the quality of Aries water.

The indicators which have been determined: Cu<sub>diss</sub>, Cd<sub>diss</sub>, Pb<sub>diss</sub>, Ni<sub>diss</sub> and Cr<sub>diss</sub>, are dangerous substances, indicating anthropogenic pollution. In the laboratory samples were analyzed by flame atomic absorption spectrometry, using the following standards: SR ISO 8288 /2001, SR EN ISO 5961 / 2002, SR ISO 9174/1998 [8,9,10]. For the analysis of total heavy metals (dissolved and suspended), water (200 mL) samples were digested with 5 mL of diacid mixture (HNO<sub>3</sub>:HClO<sub>4</sub>: 9:4 ratio) on a hot plate and filtered by Whatman No. 42 filter paper and made up the volume to 50 mL by double distilled water for analysis of five heavy metals viz. Cu, Cd, Pb, Ni and Cr using atomic absorption spectrophotometer.



Figure 1. The locations of experimental stationary on Aries River

### 3. Results and Discussion

For showing the development of priority hazardous substances concentrations, in the figures presented in the study, were used also their maximum permissible concentrations in surface waters, established by Romanian legislation: Order no. 161/2006 for approving the Norms on surface water quality classification to determine ecological status of water [11].

Analyses carried out between 2004 and 2008 showed that the dissolved copper concentration exceeded permissible limits in all research-points throughout the Aries River [12]. In figure no. 2 it can notice that the highest values of dissolved copper are in the stationary Baia de Aries, due to high copper intake from Abrud River, affected by mining activities in the Roșia Montană area, but mostly because of the contribution of Valea Șesei River, polluted due to

mining activities and preparation of copper in Roșia Poieni area.

The concentration of copper in the Aries River decreases downstream due to the numerous tributaries unaffected by pollution.

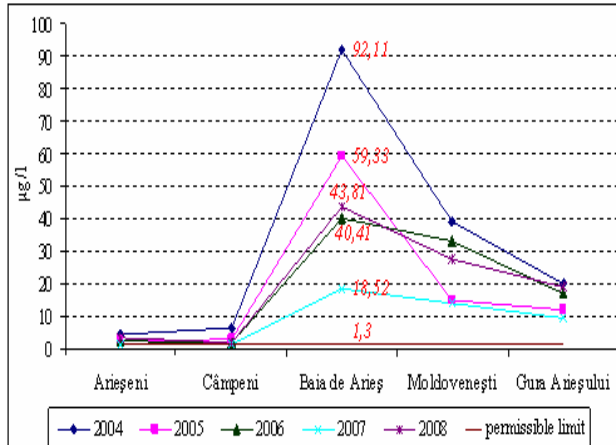


Figure 2. Evolution of dissolved copper concentration in Aries river

In 2004, in the research-point Baia de Arieș, it is registered the highest amount of copper dissolved, 92.11 µg/l in the Aries River.

Then the amount of copper is decreased with the reduction of mine production till 18.52 mg/l in 2007, when mining was stopped in all mines, with an exception at Iara mine.

In 2008 the concentration of dissolved copper increased to 43.81 mg/l, due to reopen a copper mine at Rosia Poieni (October 2007), but without reaching the maximum capacity of 2004 due to the restrict production.

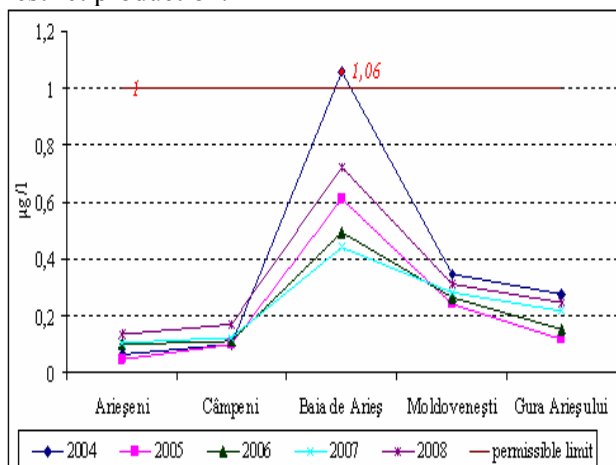


Figure 3. Evolution of dissolved cadmium concentration in Aries river

Regarding the evolution of dissolved cadmium content, the tests results conducted in the research stationary are presented in figure 3.

Permissible concentration of dissolved cadmium is below the limit of 1 µg/l in all the research-stationary except Baia de Arieș, which in 2004 exceeded the limit value; it is recorded 1.06 mg/l.

The results obtained from research conducted for the evolution of dissolved lead content in the research-stationary are presented graphically compared (Figure 4).

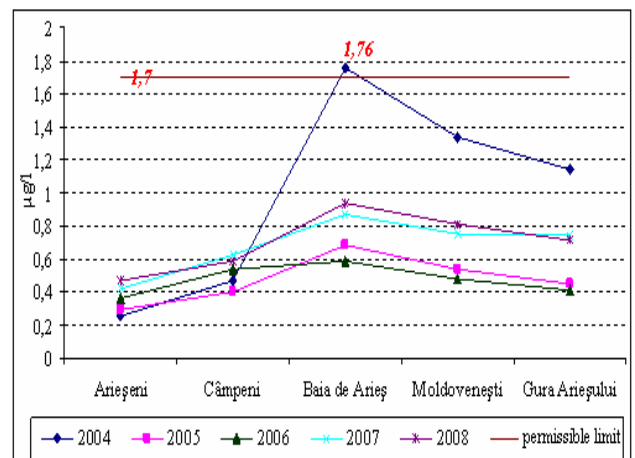


Figure 4. Evolution of dissolved lead concentration in Aries river

Permissible concentration of dissolved lead is below the permissible limits in all the research-stationary with the exception of Baia de Arieș stationary, which in 2004 exceeded the limit value; it is recorded 1.76 mg/l.

Experimental results of dissolved nickel are presented graphically compared in all the research-stationary (Figure 5).

Between 2004 and 2008 monitored parameters showed that the admissible concentration of dissolved nickel is below the limit of 2.1 mg/l in all the research-stationary, the maximum recorded in Baia de Arieș stationary, where in 2004 there was value of 1.51 mg/l.

Results obtained in research-points regarding the dissolved chromium are presented in figure 6.

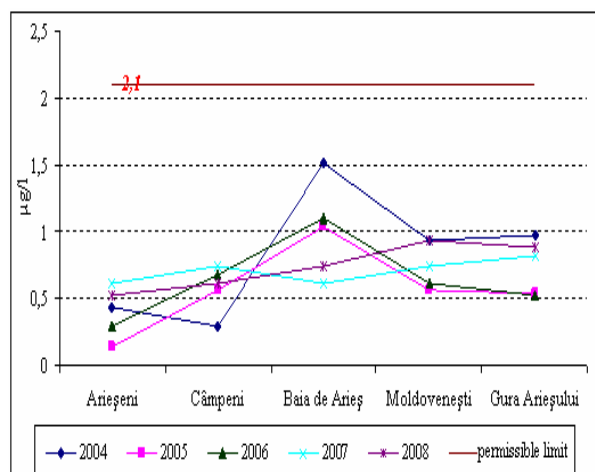


Figure 5. Evolution of dissolved nickel concentration in Aries river

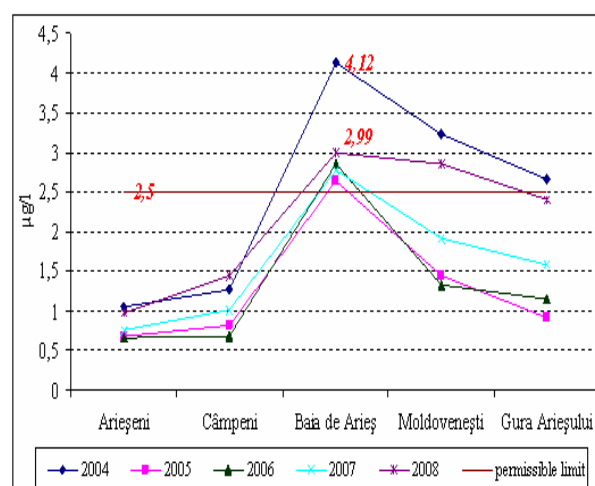


Figure 6. Evolution of dissolved chromium concentration in Aries river

Analyses carried out between 2004 and 2008 showed that the concentration of dissolved chromium was below the limit of 2.5 mg/l in the research-stationarys Câmpeni and Arieșeni. Maximum values were recorded in the stationary Baia de Arieș throughout the research period, maximum concentration (4.12 mg/l) was registered in 2004.

#### 4. Conclusion

The results of the dissolved metals, which are part of dangerous substances, show that anthropogenic pollution still affects the water quality of the Aries River from Arieșeni till Cimpeni. In this stationary's are exceeded only the indicator dissolved copper, with values less than the limit accepted.

Instead, starting with the stationary Baia de Arieș to Gura Arieșului, the dissolved copper value excide in all the research-points, up to 70 times the legal limit, with values from 92.11 mg/l, recorded in 2004 at Baia de Arieș and 9.46 mg/l, recorded in 2007 at the Gura Arieșului.

Exceedences of the maximum concentration of chromium are also recorded from stationary Baia de Arieș, in all the years of research, and cadmium and lead in 2004 in Baia de Arieș research point. The nickel content in analyzed water was not exceeding their maximum allowable concentrations during research.

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