Control of the impact of mining activities on the transboundary areas of Romania

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Abstract: In Romania there are more than 200 mining tailing dams owned by different mining companies and economical units. Some of the tailing dams operations involve also dangerous substances or heavy metals, which in case of a technical accident (Baia Mare case), these can produce a significant transboundary impact, if necessary prevention measures are not taken in due time.
According with the actual situation centralized from the territory, a major part of the actual mining tailing dams are severely degraded and requires significant funds for rehabilitation activities. Many industrial deposits present a series of characteristic deficiencies, such as:
- Clogging of the ditches;
- Malfunction of the emergency tailing dams, where these are presents.
- Erosions the slopes produced by the precipitations and nonpermanent streams;
- Exfiltrations from the dam body.

A great part of the industrial deposits owners didn't conform to the actual legislation regarding the dam safety and until present they didn't have the safety evaluation documentations, without exploitation instructions and a systematic organization of the behavior monitoring in time.
There are many tailing dams with activity ceased, which were conserved but without the expertise documentations where the functional state is indicated.
Following the integration of Romania in EU, Romania has to implement the Community Aquis (the whole legislative body), which refers to the management of the wastes, including those resulted from the past, actual or decommissioned mining activities.
The paper presents the latest estimates of the impact of the mining activities over the environmental factors quality, especially in the transboundary areas of Romania. There are described the current and proposed measures for the assurance of a sustainable development of the mining activities in the environmental impacted areas, for a long lasting period, protecting both the health of the population and the environment. A particular aspect is represented by the presence of the tailing dams from uranium mining, for which is presented the methodology for monitoring and pollution risk evaluation, elaborated especially for the areas nearby inner river banks or Danube River.
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Keywords: impact, environment, lessons learned, transboundary, mining, technical accidents

1. Introduction.

The key components of the approach of the Ministry of Environment and Sustainable Development –MESD from Romania, regarding the mining sector, are the following: the management of wastes from the extractive industry and the decontamination issue of the air, waters, soil and subsoil, as a result of the mining activities.

MESD is engaged to speed up of the assurance of safety mining activities, in order to respect the European and worldwide standards for the environmental protection. All the activities concerning mining are carried out by allocation of financial resources, also by imposing the legislation for the mining activities which are going to be open or still running. A significant initiative led the approval of contracting by the Ministry of Economy and Finance of a significant amount of funds, almost 400 millions euro for closing down and cleaning up of the mining areas. Complementary, by the Sectorial Operational Program – Environment, there is already established the financing through European funds, during 2007 – 2013, of 5 projects on contaminated mining sites, totalling 171 millions Euro. Also, MESD elaborated the Governmental Decision for recovering the affected mining perimeters, binding the mining operator, public or private, to support the recovering measures of the environment. Together with the above mentioned Governmental Decision, it is under elaboration the Strategy for

Management of the Contaminated Sites and the methodological guidelines for recovering the geological environment of the contaminated sites. The observance of the European environmental requirements in the mining sector is a painful and expensive process. According to these, a global approach is necessary, not just by sectors, of the environmental problematic of the mining perimeter. The clarifications over the ownership regime for the mining companies and the assurance of the financial guaranties – for covering the possible damages and the mitigation of the negative effects against the environment, are key elements in this process.

Romania is improving communication between the public administration and the authorities involved in the management of natural disasters on one hand, between the public and experts from different sectors of the society involved in land planning on the other hand, to better allocate the resources necessary for hazard mitigation activity. The lessons learned from disasters that have recently occurred in Europe will lead to improved management of technical accidents at the mining facilities within EU and candidates countries, and will reveal the existent inherent gaps in mitigation activity.

The monitoring system of the environmental factors is being modernized, especially by adding automatic stations for the continuous surveillance of water quality parameters. These are located mainly downstream of pollution sources and upstream of the border of the transboundary watercourses. Guidelines concerning the effects of pollutants on the environment and intervention procedures required for mitigation have been elaborated.

2. Mining Related Issues in Romania

Because of the new requirements of the new Seveso II amended Directive, the CA from Romania have to adapt the implementation requirements to the new safety approaches related to the operation of tailing dams.

In Europe, the development of new technologies for mining extraction (especially for precious metals exploitation) lead to new exploitation operations, which emphasizes the need for better and safer requirements to be adopted at the entire level of EU and candidates countries (including Spain, Turkey and Romania where this activity is developed due to existence of the gold mines) (Fig. 1).

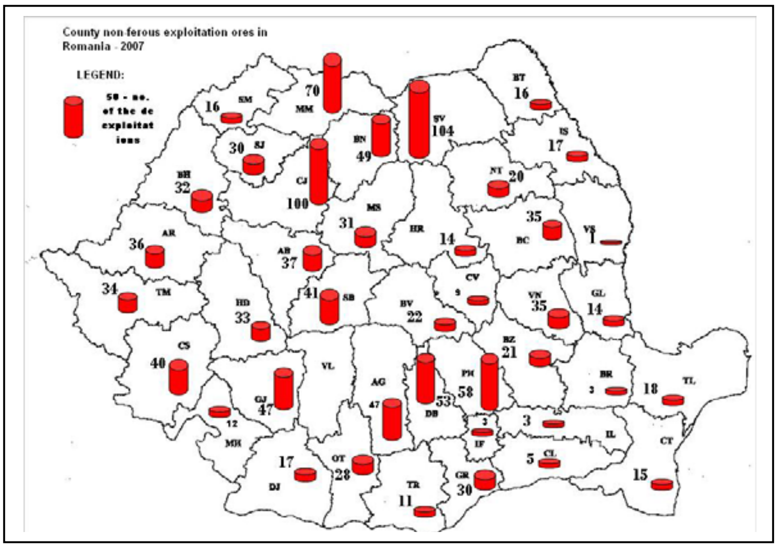

Fig. 1. Present status of the active mining exploitations in Romania by counties

The impact over the soil and vegetation could be severe, because of the loss of stability of a waste dump if appropriate in-situ remediation measures are not established. (Fig. 2).

Fig. 2. Impact of instable waste dumps upon the soil and vegetation (Valea Galbena, Alba county, Romania)

Reduction of agricultural and forestry activity by occupying the surfaces intended for the waste dumps construction and the impact over the natural heritage is significant in the mountainous areas (Fig. 3).

Fig.3. Mining activities often are a continuous threat of the cultural and landscape heritage in Romania (a disaffected church is surrounded by invasive acidic tailings, treated with lime – white color in photo – Valea Sesei, Alba county)

Also, there are recorded modifications of hydro-geological conditions, drainage works, deviation of water bodies, abandoning works without environmental reconstruction, and modifications of the infrastructure from a technical and social point of view,

3. Measures taken by the Romanian authorities to reduce the environmental risk of the mining activities

3.1. Measures taken at national level

Concerning the safety operation of the disposal facilities (Aurul or Novat pond type), MESD has promoted a number of legislative acts in order to improve the legal framework for an adequate expertise of the hydrotechnical works, which can pose risk for environment and for human beings. These legal acts are the followings:

- The Joint Order of MESD and Ministry of Public Works and Territorial Planning for the approval of “The methodology concerning the establishment of the dams importance category”[2], "The methodology concerning the assessment of reservoirs and dams operation safety”[3], “The methodology concerning the assessment of operation safety for dykes from the industrial waste deposits”[4].

It was issued a Law concerning dam safety [5]. We have to underline that by dam it is understood all kinds of retaining works including those carried out for the industrial waste disposal.

- According to this law, the regulations for the issuing of dam and other hydrotechnical works safe operation permits will be updated.
- A “Governmental Program of technical expertise of dam safety operation” has been elaborated and on this basis the settling ponds from mining, power generation and chemical industry sector is under verification.
- It was carried out an intensive activity for experts’ attestation for conducting expertise at the hydrotechnical works including the mining settling ponds.

The monitoring system is modernized by adding automatic stations for the continuous surveillance of water quality parameters. These will be located mainly, downstream of pollution sources and upstream of the border of the transboundary watercourses; Meantime on Somes river there was undertaken a complex monitoring program for water quality monitoring including sediments and biota; guidelines concerning the pollutants effects on environment and the intervention procedures for their mitigation were elaborated [1]; Also, it was elaborated a complex program for the control of the pollution sources in Tisa river catchment area, including Somes river (Fig. 4);

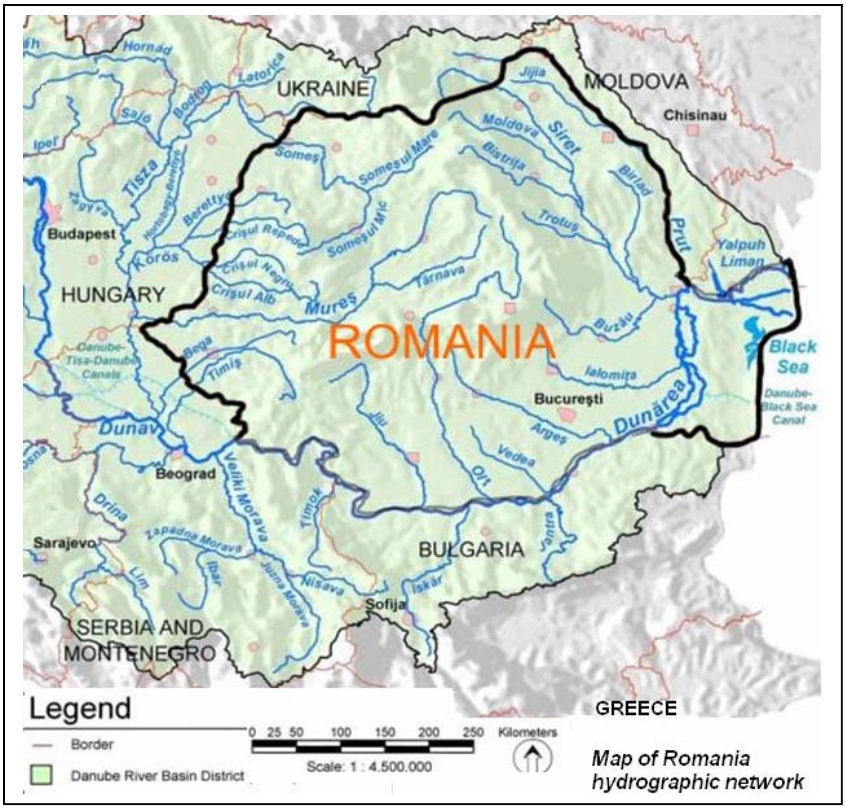

Fig. 4. Location of the transboundary water courses on Romania is mainly in the western part of the country (Romanian-Hungarian border) – map adapted from ICPDR (www.icpdr.org)

Until now several methodologies have been elaborated/adapted by National Administration “Apele Romane”, in order to improve the framework activity of water quality control (Table no. 1):
- the methodological guidelines for defining the abiotic typology of streams;
- the methodological guidelines for the delineation of surface water bodies-rivers and lakes;
- the methodological guidelines for the preliminary identification of artificial and heavily modified water bodies-rivers and lakes;
- the methodological guidelines for the development of the integrated water monitoring national system;
- the methodological guidelines for the identification of the pollution point and diffuse sources and for the assessment of their impact on surface water;
- the methodological guidelines for cost recovery in the water field at the river basin scale;

Table. 1. Costs of Water Frameworks Directive implementation in Romania, in order to assure a good status of the waters, including the transboundary courses

DIRECTIVE	Transition period (years)	Implementation limit	Stat budget and local budgets -bln. EU	EU funds -bln. EU	Other sources -bln. EU	Total -bln. EU
Directive 75/440/EEC on quality of surface water intended for drinking water abstraction, Decision 77/795/EEC concerning the common procedure for information exchange and Directive 79/869/EEC concerning sampling and analysis methods for surface waters	0	1.01.07	0.2	0.1	0.05	0.35
Directive 76/464/EEC concerning hazardous substances discharges and 7 daughter directives, and also the Directive 80/68/EEC concerning groundwater protection and pollution abatement caused by certain hazardous substances	3	31.12.09	0.2	1	0.8	2
Directive 91/676/EEC concerning water protection against pollution with nitrates from agricultural sources	0	1.01.07	0.8	1	0.1	1.9
Directive 91/271/EEC concerning urban wastewater treatment	12	31.12.18	2	3.2	2.8	8
Directive 98/83/EC and 80/923/EEC on drinking water quality	9	31.12.15	0.823	2.845	0.632	4.3
Water Framework Directive 2000/60/EC*	0	22.12.15	0.7	0.8	0.1	1.6
Total costs	-	-	4.723	8.945	4.482	18.15

In order to complete the existing gap from the European level regarding the implementation of the Seveso II amended Directive, and the newly created mining waste directive, the following measures are under development:

- To develop operating procedures for the safer operating conditions of the tailing dams from the chemical industry and mining;
- To identify hazard sources and accidental scenarios related with NATECH events (Natural phenomena which triggered Technological Accidents) for the Tailing dams;
- Elaboration of the Risk evaluation indexes for the tailing dams and Failure Consequences Index (FC);
- Learning from past accidents from the Tailing dams in order to improve the safety management systems and emergency response actions;
- Development of inspection procedures, safety report elaboration methodologies, safety management system guidance, for the Tailing dams;
- Adaptation of the existing data base of dangerous substances installations and reporting of accidents (SPIRS and MARS) at the specific of the Tailing Dams technical aspect, differing from the conventional installations;
- Study of the implementation of safer methods for design and commissioning, to eliminate the possibility of dam failure at the tailing ponds.

In practice, the proper evaluation of the behaviour in time, of the studied geomining hazard phenomenon, in case of a tailing dam, by numerical simulations, for example DKR Control method [11], consists of the following procedural steps:

- identification of yield / failure zones (Fig. no. 5) ;
- determination of stability level of the waste dump and sliding danger;

- there can be simulated exploitation scenarios in order to determine the adequate geometrical parameters for the structure in given situation;

- there are estimated the effects due to a potential failure event;

- there can be elaborated solutions for elimination or reduction of damage effects due to an eventual failure.

The practice proved that identification of the areas where it is necessary to place measurement stations in order to eliminate / reduce the risk of misinterpreting the geomining phenomenon evolution, will improve the confidence level and knowledge degree of the safety assessment.

After validation, the numerical model is used to compute the state of stress and deformation / displacement for considerate time intervals, by taking into account the tendency of relative errors obtained in validation.

The studied geomining phenomenon is monitored to the extent that the beneficiary has access to computed values for in situ points of chosen control system.

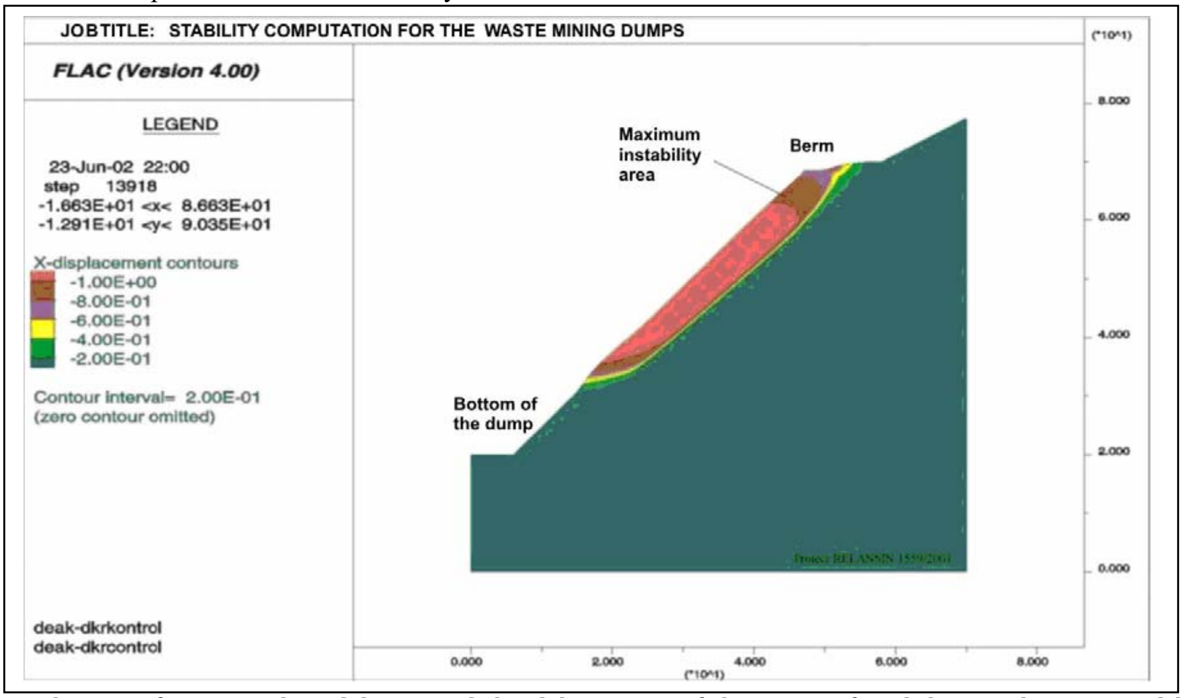

Fig. 5 The use of numerical models insured the delimitation of the areas of rock layers characterized by the same properties, in order to enhance the geo-mechanical and rheological dump behaviour in time (DKRControl method-FLAC code)

3.2. Measures taken at the international level

- Elaboration, together with Hungary and Ukraine, of a Harmonized Plan of response in case of emergency for the rivers from Upper Tisa river basin. This plan was carried out on the basis of the potential pollution sources inventory (agreed upon during the trilateral meeting held in Cluj, between 23-24 May, 2000).
- An updated List of the hot spots has been done in the framework of Danube pollution Reduction Program. The List of hot spots, very important for transboundary impact, has been agreed upon within a National workshop. The identification has been done on 3 sections: municipal, agriculture and industry and they are divided into high and medium priority. The List of Hot spots has been reviewed according to the conclusions of the last trilateral meeting held in Cluj (Romania, Hungary, and Ukraine).
- Also, as a part of its mandate, the Baia Mare Task Force (the International Task Force for Assessing the Baia Mare accident) was given the task by the European Commission and the Governments of Hungary and Romania of publishing an “Inventory of High Risk Sites” in the mining, extractive and ore-processing industries within the Tisa river basin.
- Carrying out joint harmonized projects with neighbouring countries under international financial assistance;
- Short and long terms programs for the safety operation of the potential pollution sources.

The objective of the new monitoring system is to ensure the decisional support in the integrated water management field, through the knowledge of waters' status at the national level.

Comparing the previous system with the new one, the last one covers:

- 7231 stations in comparison with 5999 existing in present;
- 15 new monitoring programs in comparison with one existing program;
- Monitored parameters - 240 in comparison with 50 monitored, presently.

The water monitoring will be carried out through the 41 laboratories of the National Administration "Apele Romane", which have been differentiated and specialized in performing the physical-chemical and biological analyses. A part of these stations is forming the transboundary informational system in the Danube River Basin, Back Sea catchments and at the European level (EUROWATERNET network).

4. Water quality status of the outreaching rivers from the transboundary waters of Romania

In the border sections of watercourses flowing towards Hungary from Romania, the quality of waters in 2004 and the past 10 years and the analysis of status is presented and evaluated according to the 5 quality classes' classification system within the common Romanian-Hungarian Regulation (Table no. 2).

Analysis is based on the average values of water quality parameters, the 10% percentile of dissolved oxygen and the 90% percentile of other components.

Table. 2 Dissolved oxygen is used as a main parameter for identifying the pollution problems of transboundary waters

Water quality parameter	Unit	Class limit values				
		I.	II.	III.	IV.	V.
A/ Parameters of oxygenation						
O2	mg/l	>7.0	6	4	3	<3.0

Data used in analysis and evaluation are the results of the joint examinations performed by the partners, as prescribed by the "Rules concerning the Water Quality Monitoring on the Border Water bodies or on the Shared Border Water bodies. The water quality of watercourses is determined by natural and anthropogenic pollution loads. The quality of waters arriving to the Hungarian-Romanian border section depends essentially on the pollution in border regions.

Water quality of the watercourses in the Hungarian-Romanian border region showed a generally improving tendency between 1993 – 2004. The evaluation of the transboundary water quality trend was based on the 10-year values of the main water quality components, especially for Dissolved oxygen contents (O_2), which varied between 1.3 – 8.4 mg/l, and showed an improvement on the main cross-border Rivers (Figure no. 6).

Generally, the most important weight of the potential pollution sources of the surface waters are represented by the local communities, chemical industry, followed by the extractive industry and metallurgy.

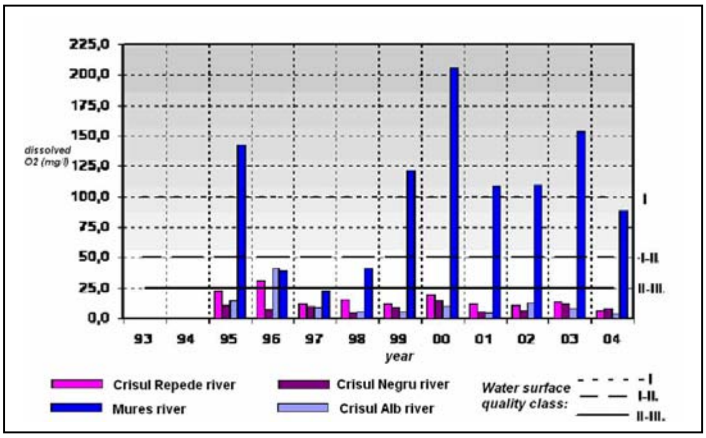

Fig. 6. Annual 10% percentil values of dissolved oxygene (1993-2004) in the main transboundary rivers

5. Conclusions:

Further activities involving public authorities should be urgently implemented in Romania, in order to control the environmental problems, related with the mining activities, with transboundary impact, as it follows:

- Implement a standardized computer-supported methodology to facilitate the national process of collecting and accessing information[6];
- Harmonize EU safety policies and current and possible future requirements regarding disaster reporting and consider the possible issuance of EU guidelines[7];
- Complete the existing databases with lessons learned from disasters and multi-hazard risk analysis [8];
- Further investigate how the effects of such disasters historically extend beyond the hazard areas, and how they have affected the population and environment, and even other countries [10];
- Based on the various lessons learned from previous disasters, establish a set of possible prevention and emergency measures that might be useful in reducing the overall risk of such environmental accidents [9];
- For the tailing dams with dangerous substances there should be conducted preliminary evaluations of the safety state by computation of the studied dangerous geomining phenomenon, in order to prevent tailing dams failure (for example DKRControl method). The risk assessments should take into account identification of yield / failure zones, determination of stability level of the waste dump and sliding danger, which can be simulated by exploitation scenarios in order to determine the adequate geometrical parameters of the structure in a given situation. Also, there have to be determined the estimated effects due to an eventual failure event, and elaboration of solutions for elimination or reduction of damage effects due to an eventual failure. The risk analysis will determine the vulnerable areas where it is necessary to place measurement stations in order to eliminate/reduce the risk of misinterpretation of geomining phenomenon evolution, in order to improve the confidence level and knowledge degree [11, 12, 13].

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