Pollution cumulative effects on the environment in Roşia Montană mining area and neighborhoods (Romania) in the context of sustainable development

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ABSTRACT: In the present paper, we present the situation of one of the most polluted, but also very famous locality from Romania, Roşia Montană. Pollution is a serious problem for this place, because of its long history of mining, dating here from millennia. But a more dangerous form of pollution may be that produced by cyanide technology, one of the most cheap but also most poisonous method to obtain gold from ores. Because of the immense scale of the presumed project of RMGC, a Canadian company, the use of cyanide, supposed to be collected in a huge dam, with a capacity of approximately 250,000 tons of contaminated waste, represents a powerful chemical danger to the environment. And this is not the only aspect, even the most important, of the problems that affects or could affect the area in discussion.

KEY WORDS: Roşia Montană, mining, gold, cyanide, pollution, environment

1. Introduction

We are entitled to say that Roşia Montană is one of the most popular rural settlements in Romania, and also maybe one of the most well-known rural settlements around the whole world.

This famous community is a commune located in Metaliferi Mountains, part of Occidental Carpathians, and from administrative point of view, it belongs to Alba county. It also belongs to *The Gold Quadrilateral*, a surface which covers around 2500 km^2 of Metaliferi Mountains.

Its reputation is due, on one hand, to its long and rich history, as it was one of the most important attractions of the ancient world (and not only) respecting gold ores, which transform it today in one of the richest thesaurus of archaeological vestiges known.

On the other hand, probably many people have heard about this place as a result of the "advertising" made by RMGC company, which intends, for now by almost 20 years, to exploit the remaining precious metals ores, that means approximately 300 tons of gold and 1600 tons of silver (there cannot be told an exact quantity), and moreover, rare metals whose value is difficult to appreciate.

This project of the RMGC company has produced a strong conflict in Romania, between the two sides, Pros & Cons, which was very harmful for the people who lived or still live in Roşia Montană. Most of them left their birthplace, as a consequence of the financial offers of the company, or of the pressure put on them to leave.

2. Methods

In an attempt to outline the dangers that threaten Roşia Montană, we used in the present paper significant references, and we analised the main erosion processes which develops in the present in the area considered (weathering, ablation rainfall, shallow landslides, pellicular denudation and linear erosion (runoff, and river-torrential ravination), the risk for floodings, and some of the most aggresive polluting factors: cyanide from the propose dam in Corna Valley, the waste and heavy metals resulted from mining activity etc.

3. Results and discussion

3.1. The cumulative effects against the environment and sustainable development

The cumulative effects against the environment are considered a limitation element for the durable (sustainable) development (Cocean, 2010) together with the exhaustion of resources, the economical volunteering, the social gaps etc.

Often used with more or less dexterity, the term of sustainable development still remains a simple shape without an inner meaning. Most probably, this happens because of the difficulties implied by the attempt of harmonizing a society so split for reasoning with the idea of this concept with a mostly holistic sense, therefore theorizing it more than using it as a guide for a visible field activity.

Posea (2012) agrees with this sustainable development denigration, more considering it a way of disregarding the good of mankind, being an instrument of globalizing the world economies and controlling the entire world.

This vision is also shared by Yusufu Bala Usman (1996, quoted by Pascaru, 2007), a Nigerian who sees an even more drastically end. As a law teacher, he has been observing the political games from his country and the manner how politicians are manipulated and manipulate using different concepts on behalf of an ideology. Globalization is being considered a myth created by some political actors in order to impose their goods, investments, services and life style among the less fortunate people, making them to depend more and more on this new life style so that in the end, they would accept anything, even selling their own resources. At a closer look, eventually, these resources will be sold again to them by the third party, but this time even more expensive. These suppositions might appear as exaggerated, or even more, paranoid, but this does not mean we should not reflect on it. For instance, we could start by asking ourselves if our country is not close enough to be a second example after the one given by the Nigerian law teacher. And indeed, Roşia Montană is an example of this kind.

The pronounced pollution from Roşia Montană and Abrud area threatens sustainable development concerning population, environment and landscape. This tendency of separating

these spheres is basically impossible and subjective. Taking into consideration only one of these spheres is basically impossible and subjective. Taking into consideration only one component, for example the environment, would mean a big error and a big injustice for the people and most probably an impossible situation.

This point of view is also argued by Akeroyd (2012) who considers that biodiversity is a vital element for supporting the ecotourism and the ecological agriculture. Most obviously, biodiversity plays an important role of sustaining the whole society for now because maybe we can imagine that someday, the genetic engineers will discover a way of adapting people to some more callous conditions and our future generations perhaps will be satisfied eating a portion of sodium cyanide, or any other chemical compound they will desire.

Tourism (cultural, rural, agritourism, ecotourism etc.) and agriculture are two main variables to be considered when talking about developing projects and ideas without mining. We must take into the account that nowadays pollution affects these elements, that the pastures and the hays are already affected by the drilling activities of RMCG and the ones of Roşia Min. These activities have a main part in polluting the environment through the acid liquids; the toxic gases resulted from the pits, dust particles and other pollutants. Most of these toxic chemicals are transported by the winds towards over vegetation on great distances from where they were originally spread (Pascaru, 2007).

3.2. Pollution sources and factors in Roşia Montană

Gligor and Mera (2004) identify in the industrial area of Roşia Montană and neighborhoods some more pollution sources which affect not only locally, those areas but inevitable the rivers around like Aries, Mures, Tisa etc., by easily spreading pollutants in bigger areas.

Until 2006, one of the main pollution sources was considered the industrial liquids and components resulted from the mining activities from Roşia Montană and from processing the ores in Gura Roşiei. Although ore processing was stopped, pollution effects caused by the mining activity for such a long time still continues to affect the environment.

The main substances which cause pollution through mining and other activities (Gligor & Mera, 2004) are the Barium, originated from the barite rock from Roşia Montană, but also from Roşia Poieni and Bucium; Copper (found in chalcopyrite, copper sulphide, copper oxides, germanite, malachite, tetraedrita, bornite etc.) found in Roşia Montană, Roşia Poieni, Abrud, Bucium; gold and silver (found in a pure state in volcanic rocks or in sylvanite, argentite, limonite, pyrargyrite etc.) from Roşia Montană, Bucium, Roşia Poieni, Baia Aries; tellurium and germanite found in Bucium; strontium at Rosia Poieni; iron (magnetite, marcasite, germanite etc.) and arsen (arsenic pyryst, enargite, apatite) from Roşia Montană, Roşia Poieni, Bucium; sulphur, silicium, magnesium, manganese, lead; detergents, phenols, cyanides, unsaturated hydrocarbons, radioactive substances, carcinogenic substances, originated from organic or inorganic elements (components).

Cancer related substances (unsaturated hydrocarbons, aromatic polycyclic hydrocarbons, benzpyrene and benzanthracene, benzedrine, phenols, pesticides, detergents etc.) and the inorganic substances (arsenic, chromium, nickel, radioactive metals etc.) are found in some rivers where are waisted different kinds of junk scraps resulted from main material and substances products. Eventually, these wasted products get into plants, animals' bodies and then humans' bodies through different ways.

Cyanide and heavy metals, along with other substances, such as detergents, fertilizers, pesticides, etc., most of them carcinogens, pollute a vast territory in the Apuseni Mountains and water consumption, supposed to be potable, affected by such substances leads to increasing cases of cancer, which is one of the main causes of death. This disease is often caused by overwhelming the body with toxins which cannot be eliminated.

Considering the carcinogenic danger, the authors recall the case of the upstream inhabitants of Arieş River, living in Horea village (Arieşul Mare) and Avram Iancu (Arieşul Mic), who have suffered as a consequence of the „side effects" produced by exploitation of uranium dating back from communist epoch, effects which provoked a growing number of cases of various types of cancer, malformations in newborns, , diminishing life expectancy, phenomena which are highly probable to occur during Roşia Montană exploitation, because of the toxic, radioactive waste that will result.

The cyanide is toxic starting from concentrations of 0.01 mg/l. Salts of hydrogen cyanide (potassium, sodium and calcium salts) used during extraction of gold and silver from ores in the presence of O2 by a procedure called cyanidation, in the form of colorless crystals, is soluble in water, and of course, extremely toxic. Repeated exposure, even at very low doses of cyanide, leads to "*respiratory, cardio-vascular, thyroid and nervous system disorders. Cyanide accumulates in plants, aquatic organisms and mammals, enters the food web of the ecosystem along with other pollutants such as lead, mercury, cadmium "*(Gligor & Mera, 2004).

The same authors conclude that if these more than 250,000 tons of cyanide waste which are intended to be stored in Corna Valley Lake dam would be taken as pills, it could kill about 35 billion people**.**

Cyanide and its derivatives have drastic effects on the human body, preventing brain and heart to function properly, leading rapidly to coma and death. Lethal dose for humans is only 1 mg CN-/kg, and aquatic life, only 3 mg CN-/ liter of water is sufficient that in a river no longer exists life (Bran et. al., 2003).

According to RMGC (www.rmgc.ro) there are identified a number of hazardous substances that will be used in the project. One of the dangerous elements is even the extracted ore, which contains, in addition to the gold, silver and the above-mentioned metals, and other substances more or less aggressive to the environment: sodium cyanide, hydrochloric acid and the slurry cyanide, nitrate technical ammonium, cyanide-rich solution, the process water containing cyanide, mercury, sodium metabisulfite, sodium hypochlorite, copper sulfate, acidic water, gasoline, diesel fuel, etc.

Besides the factors listed above, whose destructive action on the environment is indisputable, there are many other aspects which will contribute to rapid and almost complete degradation of it.

Deforestation will take place in the area that will be submitted to mining, and that means the biodiversity in the area and surroundings will be strongly affected, with the extinction of animal and plant species, some of which being on the Red List of protected species in Romania (Akeroyd, 2012).

3.2.1. Hydrological risks - floods

In the following table we can see the magnitude of flood risks in the area within last 10 years. The damage amounts to almost three million dollars, a very high value, which, although not strictly

related to environmental damage, can give us an idea of the destructive force of these phenomena.

Table 1. Annual distribution of floods and flood waters in Rosia Montana and Abrud (1995-2004)

Numbers of events/floods											
Nr. crt.	**Year/ Locality**	**'95**	**'96**	**'97**	**'98**	**'99**	**'00**	**'01**	**'02**	**'03**	**'04**	**Damages (mil.$)**
1.	Abrud	1	-	-	1	-	1	2	1	-	-	2,74
2.	Roşia Montană	1	-	1	-	1	1	-	-	-	-	0,152

Source: http://www.rmgc.ro/Content/uploads/puz/Anexa%204.pdf

3.2.2. Geological risks - earthquakes

Although it is the hypothesis that the Apuseni Mountains would be protected from the possibility of earthquakes, there is in fact no guarantee that such events are impossible, and one cannot predict their intensity. The existing seismic hot spot in Banat area reprezents a threat that can not and should not be neglected to the Apuseni Mountains. Evidence of seismic activity in the vicinity of Roşia Montană are caves Dârninii (Valley Albac) and Humpleu (Warm Somes), but in other wells in the region, where there are several large stalagmite formations (from 1 to 5 m in diameter), which were separated and they rolled on the floor galleries (Cocean, 2012). According to seismic hazard map of Romania (part of a seismic map of Europe, carried out under the program Seismic Hazard Assessment Global – GshAP, 1999) Roşia Montană area is in the range characteristic of low and moderate seismic hazard, fom 0.8 m2/s to 1.0 m2/s, this result being correlated with the maximum acceleration of 0.082in 475 year event, determined by probabilistic analysis (http://www.rmgc.ro/Content/uploads/puz/Anexa%204.pdf).

3.2.3. Geomorphological risks - mass movement processes

According to a study belonging to the National Institute of Economic Research of the Romanian Academy (***, 2003, cited by Bran & al, 2003), in 2003, into the Roşia Montană perimeter were affected by landslides 50 ha, erosion of banks occupies 3 hectares, 30 hectares were occupied by torrential valleys, floodplains were 16 ha, 20 ha - wetlands, with an additional displacement of rocks and rock falls.

The effects of the above-mentioned processes would affect the land, with negative repercussions on the construction, agriculture, biodiversity, etc.

The relief of the area of interest presents altitudes between 400 and 1330 m, with a difference of about 730 m, falling in the category medium mountain, with a high degree of geomorphological fragmentation.

Fragmentation relief is between 2 - 4 km^2/km, and the average value of the relief energy are 200-300 m. There are identified 5 categories of slopes: 0-30, 3-60, 6-150, 15-350, over 350 .High susceptibility to erosion of pyroclastic rock influences land degradation in Roşia Montană-Bucium, which occurs mainly as the current process, linear erosion (gullies, ravines, streams). In northern and north-eastern of Roşia Montană depression, lithological substrate favors the action of the modeling processes (sandstone, shale and clay marl, gypsum), plus old slip processes and

colluvial deposits, reactivated the widening and regressive erosion of gullies (right side of the Roşia Valley). Susceptibility to erosion of the molasse deposits is also influenced by high values of the drainage network density (3.5-4 km / sq km). High density and and high value of depth fragmentation is specific to a relief strongly affected by erosion, with segmented profile slopes formed on a substrate with heterogeneous lithology and structure, with various slope and exhibitions. As a result, current morphodynamics is characterized by areal erosion (weathering, ablation rain, shallow landslides and runoff denudation), and linear erosion (runoff, and river-torrential ravination) (www.rmgc.ro).

4. Conclusions

We believe that facts presented above, even if not reprezenting an exhaustive discussion of all the dangers that threaten in the present and future, considering the RMGC project implementation, the Roşia Montană – Abrud area and surroundings, are arguments strong enough respecting the negative effects whose actions are very bad to the environment. This means that any risks taken by Romanian part are not necessary and not justified, in any way, at least from our perspective.

We conclude that an objective appreciation cannot but admit that the benefits uncertain offered RMGC have no ability to compensate in the least any potential losses that were highlighted here.

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