ABSTRACT

The Doctorate Thesis with the title *"Researches regarding the Impact of Mining Activities upon the Quality of Water in Caras-Severin County"* has the purpose of studying the impact incurred by the main mining exploitations in Caras-Severin County, (county with a rich tradition in mining) upon the quality of certain receiving water courses, more precisely the studyng of the degree of loading these waters with pollutants from the respective exploitations.

In order to carry out the mentioned purpose, the reaching of the following objectifs is necessary:

- the study of the pollutant impact specific to the mineral fuels exploitation on the surface water;
- the study of the pollutant impact specific to the metalliferous ores exploitation;
- the study of the pollutant impact specific to the metallic ores exploitation;
- the study of the pollutant impact derived from uranium mining;
- the setting of the methods that decrease the mining pollution in Caras-Severin and consequently, the study of their possible negative impact on the surface waters.

The work lies on 300 pages and is structured in 9 chapters. It comprises 55 tables, 123 figures and 42 colored photos and 170 biographical titles studied.

The first part of the theses, chapters 1 and 2 respectively, deals with theoretical aspects related to the general characteristic of the surface waters, their pollution and the polluting character of the mining activities. The second part of the thesis, chapters 3 and 4, presents the physical-geographical frame for carrying out the research and the aim, objectives and research methodology as well. The third part comprising the chapters 5 to 9 presents the results of the own research regarding the mining developed within this natural frame, the origin and the composition of the different ores exploited, the variation in time of these pollutants concentration in the wastewater discharged by the respective and certain measures of decreasing the pollution made by them. The last chapter comprises the conclusions.

The paper is based on laboratory data and analysis made during 17 years through the System of Water Management Caras-Severin, on own research and studies made on the field and in the laboratory between 2004-2009.

The work comprises the intense activity and the preservation period, the close and post-close period as well.

The importance of the ecological reconstruction of the objectives subject to closing is emphasized, regarding the reach of the "water good condition" as it is defined and stipulated in the Frame Directive 2000/60/ECC.

The first chapter, *“Water- factor of the sustainable development”*, presents the study of the research regarding the water, from the sustainable development perspective. The problem of water at world and national level is treated and the qualitative characteristics of the natural water as well as the pollution general characteristics are shown here. The notion of water management is clarified as basis of sustainable development and the legislative and institutional frame regarding the water protection is presented.

Where there is water there is life. The water with soil and air represents one of the main factors of environment. All waters in the world formed hydrosphere, water shell of the earth. The hydrosphere, lithosphere and biosphere are in a natural balance but also in constantly changing due to the continuous cosmic transformations of the globe. The separation of these environment factors is only theoretical practical it is impossible.

Water in nature is found in three forms of aggregation (liquid, solid and gaseous) and it makes a permanent circuit. One of the consequences of this circuit is the qualitative difference of the water resources.

According to the last estimates, the hydrosphere contains about 13386 millions km3 of water, out of which the salt water represents 97,5% (having an average specific salinity of 35g/l) and fresh water represents 2,5% (having a lower and different mineralization depending on the stones it washed). The most precious category- liquid fresh water- represents only 0,036% out of the total amount of existent water.

Water has multiple uses, as it is a nutrition, energetical, transport, technologic and environment factor. But the disparity between the season variation of the flows and the amount of water that is relatively constant should be taken into account and also that only a part out of the existent flows can be captured. That is why only 20.000 km3 is estimated to be the availability of water, so only 4% out of the total of liquid fresh water.

The analysis of water resources points out the visible differences between the regions of the globe regarding the availability and accessibility of water resources. Asia and South America stand out clearly, as they store the biggest quantities (13.500 km3 per year and 12.000 km3 per year respectively). The smallest values are in Europe (2.900 km3 per year), Australia and Oceania (2.400 km3 per year). This potential availability of fresh water has decreased from 12,9 to 7,6 thousand m3water/year/km2/person due to the fast numerical increase of population recorded between 19970-1994.

An explosion of water volumes taken in order to turn it into drinking water was noticed between 1950-1980, phenomenon that can be explained by the increase of the living level of the population and the percentage of urban population and the comfort of average person implicitly.

Romania is relatively poor in water resources as it has only 1770 m3/inhebitant/ year (the 20th) in comparison with the average of 4000 m3/inhebitant in Europe. The Danube and the other border rivers raise this volume to 2660 and they situate us on the 11th place in Europe concerning quantity of water reported to population.

The hydrologic regime of the national water resources is characterized by very large variability both in space (due to the high weight of the mountain zone to form flows, as 50% out of the total of resources are formed on 17% out of the country surface and thus determines a specific average flow under 1 l/s in Romanian Plain, Dobrogea, Timis and Arad Plain, and about 40l/s in the high zones of Fagaras and Retezat mountains) and during the year (manifested through powerful floods in spring and beginning of summer followed by long droughts). It is a high torrent regime where Qmin/Qmax is between 1/1000 and 1/2000.

The available water resources in Romania are strongly influenced quantitatively and qualitatively by the human activities through:

- sampling at the limit of socio-economical resources (Arges river basin)
- a strong pollution (rivers Tur, Lapus, Cavnic, Aries, Cibin, Dambovita, Vaslui, Jijia, Bahlui)

The evaluation of the water resources in the national statistics is made considering the multi-annual average theoretical potential (140 mld mc water), the available potential in natural regime for drought years (92-109 mld mc water) and usable potential in arranged regime (40 mld mc water). In 2007, the samplings of raw water were 6,89 mld mc out of which 1,06 mld mc were for population, 4,84 mld mc for industry and 1,09 mld mc for agriculture.

Qualitatively, 6211 km first quality rivers, 11783 km second quality rivers, 5638 km third quality, 1921 km fourth quality and 953 fifth quality are recorded in 2007 when a considerable improvement was noticed comparatively with the previous years.

The pure water symbolized by H2O is never found in nature. Certain quantities of dissolved or suspension substances are always found in water such gases (O2, CO2, H2S), dissolved mineral and organic substances, colloidal or in suspension, saprophytic flora that offers properties grouped in physical characteristics, radioactive characteristics, chemical characteristics, biological characteristics and bacteriological characteristics to natural water. There have been established limits for all these indicators of the water quality condition through the Ord. MMGA 161/2006 in order to approve the Normative regarding the surface water classification to establish the ecological condition of the bodies of water.

As for the pollute of water, this is defined in various modalities and it represent at present, a major problem that will be amplified globally, because large towns are fast developed in the third world without proper sanity: the chemical industry and agriculture use more and more chemical products and the mining has technologies with serious impact on the nature.

The water quality is not constant in time and can vary due to many factors either produced by man (anthrop-demographical, urban, industrial factors) or by natural origin. The pollution sources of water can be organized or disorganized, artificial (domestic, industrial, agricultural) or natural, permanent or temporary, accidental.

The types of pollution can be also classified in various ways: natural or artificial pollution, controlled or uncontrolled, normal or accidental, primary or secondary. The most used classification is maybe the one depending on the nature of pollutants mentioning the physical, chemical or biological pollution.

Water has capacity of natural purifying up to a point improperly called self-depuration or self-purification. The self-purification is made through a series of physical, chemical, biological and biochemical processes.

The water pollution decreases or avoid of the receptor, as a consequence of the discharge of wastewater is most frequently performed by depuration before discharge. The water depuration represent the totality of the treatments applied to wastewater whose result is the decrease of the pollutants content so that the quantities remaining to determine small concentration in receptor water that should not generate ecological imbalance and hamper its later usage. Three stages can be notice in the general technological flow of the depuration process, such as: mechanical, chemical and biological. These methods can be framed within the more general notions of primary, secondary and third or advanced depuration depending on the degree of depuration provided.

The concept of water long-lasting management is presented further on, with stages of evolution, its principles and its instruments of performing.

Regarding the legislative and institutional frame of the water protection, the main regulatory is the Law of Water No. 107/97 amended and completed with Law No. 310/2004 and Law 112/2006 and the Environment Protection Law No 137/95 with its amendments. The association of Romania to European Union has imposed a series of sustained actions and orientations of the environment national policy, towards tits conformation with the medium and long term European strategies and policy in the domain of water management, respectively the adoption, application and development of the community aqua. The institution effectively dealing with the water management is the National Agency of the "Romanian Water" organized in 11 departments, each of them with more Systems of Water Management. It functions in the Ministry of Environment and Water Management (MEWM).

In the second chapter, called "*Current state of researches regarding the impact of mining activities upon the quality of water in Cara -Severin county*", the mining is treated as leader in generating industrial waste. Thus, the current trends regarding the mining are presented, that registered a sudden decrease of its activity after 1990, followed by a period of stabilization (1993-1999) an a slight increase afterwards. At present, the mines can be classified into three types:

- active, with present activity;
- in preservation, to which the Program of Closing and Greening was not applied;
- closed, that were subject to the Program of Closing and Greening.

Twenty-five mines, thirty-seven quarries and nine preparation plants were still active in 207; 557 objectives were approved to be close.

These changes causes are firstly the decentralization, the transition to the market economy and the adherence to the EU demands. Whether the policy applied in mining was the obtaining of mineral resources by any means until ’89, at present it is not possible. Only those mines will work where the mineral resources are obtained in profitable conditions obeying the new standard of labor and environment protection.

HG 856-2002 included the obligation of the economical agents to keep the waste record that they generate and to transmit the data every year to the territorial authorities of environment protection. In 2002, a total quantity of 372,4 million tones of industrial and agricultural waste was reported, out of which 344,5 million tones represent mining waste, tailings from the non-metalliferous and metalliferous excavations. There were in 2007 687 warehouses for industrial waste out of which 29% represented dumps of tailings. The dangerous tailings represent an apart category of industrial waste. According to the available data, in 201 a quantity of about 2,5 million tones of dangerous waste were generated. 77% of them come from mining. All these data give the title of leader in generating industrial waste to the mining industry.

As a consequence of the small percentage of useful substances extracted from the raw ores, the global quantities of waste resulted after the extraction of the useful substances represent many tones, if we take into consideration the important quantities of ores extracted and processed every year, only in our country. Beside the solid waste there are also other types of liquid and gaseous ones that quantitatively exceed the solid waste. The wastewater, for example exists in a ratio of 3:1 up to 20:1 compared with the processed ores.

A first classification of the waste can be made considering the aggregation status resulting five classes of waste: solid, liquid, gaseous, noise and vibrations.

Considering their origin, the waste came from the mining, ore preparation and extractive metallurgy.

Taking into view their specific characteristics, the waste from mining are stored as a rule, installation specially designed for this reason, as follows:

- waste from non-metalliferous and metalliferous exploiting and processing are stored in dumps of tailings and decantation ponds.
- wastes from oil and natural gases are stored in pits.

The information regarding the waste origin and management for 2001 provided by ICIM Bucharest shows that there were 200 dumps of tailings and 70 decantation ponds working. A problem of special importance represents the stability of the dumps of tailings considering their constructive characteristics and the type of material stored and especially the fact that other types of waste generated by the respective economical units are stored except for those strictly generated by mining. Another problem of special importance is the risk of damage of various installations afferent to the decantation ponds that may be amplified by occurrence of certain unusual natural phenomena (earthquakes, floods, landslides).

The mining waste characteristics are presented further on, depending on their aggregation status (solid, liquid, gaseous, noises and vibrations) and their origin (from exploitation or preparation).

The chapter two presents the mining impact on the surface water, identifying the main pollutants that arrive in the natural receptors and their real effects. The influence of bunds of tailing and decantation ponds numerous in Caras-Severin, the influence of mine on quarry water are detailed. The radioactive pollution of surface water is pointed out considering the important uranium reservoir in Ciudanovita-Lisava and the problems that has occurred here.

The description of the legislative and institutional frame regarding the mining waste ends the chapter two. The application of the International Law regarding the mining waste is made through HG 856/2003. The activity in the Romanian extractive sector is settled through the Law of Mines No. 85/2003. The National Agency for Mineral Resources (NAMR) is the competent authority that has the tasks and attributions to apply the previsions of the Law 85/2003. present, the central authority coordinating the waste management activity is the Ministry of Environment and Water Administration. Other institutions with responsibilities in waste managing are the National Committee for Nuclear Activity Control (NCNAC) and the Ministry of Economy and Commerce.

The chapter 3, called "*The Natural Frame of progress of research- Caras Severin County*" presents the physical-geographical characteristics of the mentioned county. It is situated in the Southwest of the country and it is the third county in size and the second as for forest covering. The geology of Caras –Severin is that of the Meridional Carpathians, identifying two large domains: Danube local and Getae layer. The relief, geo-morphologically is characterized by a large variety of shapes: mountains 65,4%, depressions 16,5%, hills 10,8% and plains 7,3%.

Hydrographically, the surface of Caras-Severin is strongly fragmented by the valleys of the rivers Timis (with a length of 87 km and a reservoir of 5248 square) Caras {76 km length and 1118 square reservoir), Cerna (84 km length and 892 square reservoir), Nera (131 km length and 11360 square reservoir). All these are then collected by Danube river. Floods with terrible effects are generated on the most rivers in the county due to certain successive rainy years and sudden heating in spring in Banat Mountains, the exceptional quantities of rain that coincide with the snow melting (the snow layer is has the biggest thickness in Semenic) and due to the massive deforestation made in the last years.

The climate in the county is mild temperate-continental, banatean subtype with sub-Mediterranean hues due to the placement in the SW of the country, not far from Adriatic Sea and the protection of the Carpathians. This is characterized by the circulation of the Atlantic air and by the invasion of Mediterranean air providing a moderate character to the thermal regime with frequent periods of heating in winter, early springs and high average multi-annual rains. The main climate characteristic of Banat is the predominant circulation of the wet air from west and southwest all over the year and the more intense frontal activity. It is worth to mention the local wind Coshava in Moldova Noua.

The forest fund is 48%out of the total surface of the county, representing 6,1% out of the national forest fund. The relief features, its arrangement in steps from west to east influenced layers of vegetation. From plains to the top of mountains, the following zones of vegetation are met: steppe and forest-steppe, forests (well represented and differentially laid, respectively the layer of quarcinee and the layer of beech) and the alpine zone (formed by two layers sub-alpine and alpine)

The fauna is rich especially regarding the hunting fund. The aquatic fund characteristic, important for the topic of thesis, given by the fact that the great majority of rivers are in the mountains and are little affected by pollution, so the living creatures have great demand of oxygen and need low temperatures.

The shell of *soles* in Caras-Severin is zonal with various and complex pedo-genetic particularities as a consequence of the differentiations that the physical-geographical have. The steps of relief, position and their degree of fragmentation, the categories of stones and parental deposits, the climate, the vegetation in layers, etc led to the formation of soils of intra-zonal type. In general it is characterized by good fertility and productivity except for certain small perimeters where the fields are degraded (e.g. Gargaun hill in Teregova, small sectors with swamps and bogs).

Regarding the anthrop influences, the population of the county is 360 627 inhabitants and Resita is the residence of county. It comprises 8 towns out of which 2 are municipals, 69 countryside and 288 villages. The economy is industrial-agricultural, the most important and well known traditions being the mining, metallurgy, machine building, wood works, agriculture, tourism, etc.

The mining in Caras –Severin dates from Neolithic. The oldest traces of mining are in Ocna de Fier, Dognecea, Sasca, moldova Noua and belong to the culture Cotofeni from the period of transition from Neolithic to the age of bronze4 dated between 1900-1700 BC. From then until the beginning of 1990, the mining knew a period of development, Caras-Severin county becoming leader, fact proved by the numerous records own in this field (the deepest mine in Romania is Anina, 1107m depth, the largest decantation pond in Europe is Tausani in Moldova Noua, etc). At present, there are not big active mines in Caras-Severin, but only small local quarries valuing the useful and decorating stones. Works of closing and greening are almost completed in the areas of the former mines.

The chapter 4 is called "*Purpose, objectives and research methodology*". In order to follow up the quantities of pollutants in the wastewater from the mines in Caras-Severin, I used the results of the experiences carried out by the Laboratory of the System of Water Administration Caras-Severin during years. It monitors the physical-chemical parameters from all the direct exhausts as water waste included the ones resulted from mines having as legal basis the Romanian Standard SR ISO 5667-10. It is identical to international standard ISO 5667-10:1992; it is a translation approved by ISO in Romanian of the French text. HG 352/2005 that amends and completes HG 188/2002 establishes the discharge conditions in the aquatic medium of the wastewater. It comprises NTPA 001/2005that settles the limit values of pollutants in the industrial and urbane wastewater discharged in natural receptors and applies to all the categories of effluents derived or not from depuration stations. Regarding the quality of the natural water, the Order no. 161/2006 for approving the Normative concerning the classification of the surface water quality, viewing to setting the ecological condition of the water is valid in our country. It repeals the Order MAPN No. 1146/2002 for approving the Normative regarding the objectives of reference to classify the surface water quality and STAS 4706/1988- Surface Water.

Out of the multitude of indicators for the water quality, the selection of only a few representatives for the mining industry was necessary/; general indicators (Ph, extractable, suspense substances) and specific indicators (cation and heavy substances: Cu, Ni, Zn, Fe). The study of the radioactive contamination of the Hydrologic reservoir of I.M. Banat was performed using the concentration of natural uranium in the surface water as indicators and the own laboratory of the respective enterprise made the measurements.

Diagrams of gas concentration variation both in exhausted wastewater and surface water (uranium exploitation) were plotted for all these indicators during about 17 years.

The chapter 5, called "*Researches regarding the impact of the exploitations of the mineral fuel upon the quality of water in Caras-Severin county*" starts by introducing the main mineral fuel deposits exploitations that worked in the county both underground and in quarry (oil shale). Among all these numerous mines (ones very well known such as Anina), none of them function nowadays, all of them being subject to the operation of closing and greening.

In order to better understand their chemistry, it is very important to know the conditions of generating the mineral fuel and the types of coals. The superior coal generating conditions in Caras-Severin existed during Superior Carboniphere-Inferior Permian and in Lias when a continental climate installed in this area that helped the luxuriant vegetation to grow. The degree of incarbonization and the coal quality do not always depend only on the age of formations but also on the degree of generating the respective tectonic formations. In this way it is explained why the Lias coals from Anina, Rudaria and Cozia have superior quality. The type of coals in Caras Severin is geosynclinals, namely they formed in the big synclinarium Resita-Moldova Noua and are characterized by a big number of coal layers resulted as a consequence of the slow oscillatory motion of the geosynclinals. Their age comprises a large geological interval, which begins with Paleozoic and finishes with Neogen.

The simplest classification of the waste generated by the mineral fuel exploitation is the one depending on their aggregation status. Thus, the dumps of tailings represent the solid waste. It is relatively difficult to estimate the number of dumps because the coal mining in Caras-Severin started in the 18th century. The dumps contain fragments of the stones where the carbonate substance is quartered. Their variety is huge specifying that the sterile belongs to the group of sedimentary rocks not to the eruptive or metamorphic ones. We mention as petrography variations: siliceous sandstones, calcareous sandstones, conglomerates, micro-conglomerates, clay schist, schist coal, clay, etc. The successive cycles of frozen – thaw determines the sterile mechanical disaggregating at smaller and smaller dimensions, and the wind and meteoric waters carry them in rivers. Their deposit depends on the distance to the sterile dumps, on the specific weight of the carried particles and on their degree of rolling. In general, the clay and fine coal particles are millimeter or sub-millimeter sized and can be carried and deposited at big distance to the proper dumps. The "self-ignition" is a characteristic of the dumps from the coal exploitations; in the dump composition bring coal waste beside coal dust and sterile.

The liquid waste is mainly represented by mine /quarry water that accompany the mining. The chemical composition is various and depends by the local conditions. The water from coal mining gets unpurified with: suspension, metallic salts, chlorides, sulfates resulting from coal alteration. The coal layer currently open and the air gaps and cracks are firstly subject to alteration. The alteration begins by absorbing oxygen at the coal surface and the oxidation of the organic substance, mineral inclusions such as pyrite ($FeS2$). The alteration depth differs from deposit to deposit, and can reach the depth of 90m. The alteration also changes the elementary composition of the coal: carbon content related to the organic mass decrease up to 1,6 times. The sulfur is released in the mine water by alteration.

The gaseous waste (gas, dust) is released during coal mining as they are contained in the cracks of rocks. Their distribution is on different zones. The mine gases have different solubility in the mine water and through them they reach the hydrographical network.

Further on, diagrams were plotted for the mineral fuel mines in the county namely Anina, Mehadia, Cozia and schist quarry Doman that monitor the evolution of the most representative pollutants concentration (suspensions, extractible substances and pH) exhausted through mine/quarry water in the natural receptors during the last seventeen years. The conclusion drawn from these diagrams analyses is that generally pH is within settled limits 6,5-8,5 pH units due to the buffer created by the alkaline character of the rocks where coal deposits are embedded in our county. In turn, the indicator suspension steadily exceeds the max-allowed concentration often reaching very big values. Their concentration decreases after the activity has been ceased. As for the extractible variation, it is constantly situated under the max allowed concentration with slight increase when works of closing are performed due to the equipment used.

The chapter ends by showing the wastewater volumes and flows exhausted from the respective mines.

In chapter 6, "*Researches regarding the impact of the exploitations of metalliferous deposits on the quality of water in Cara -Severin county*", the main mines are presented noticing that they although had an ample development (there are evidences of mining since Neolithic), at present all these mines are closed. Two banattite quarries in Moldova Noua are still under preservation. The se deposits origin and composition is shown further on and the pollutants resulted from their exploitation is presented depending on the aggregate state: solid (sterile dumps and decantation ponds) liquid (mine and quarry water) and gaseous (mine and explosion gases).

Variation diagrams of the main pollutant concentration (suspensions, pH, extractible, copper, iron, zinc) exhausted through wastewater into the surface receptors for the last seventeen years, were plotted for the main mines in the county: Bocsa, Moldova Noua, Sasca Montana and Ruschita. The indicator suspension showed frequently exceed of the max-allowed concentration. Their values decrease when the activity ceases. The pH is generally between admissible limits except for the decantation ponds at I.M. Moldomin S.A but once the pond Tausani was created and the preparation plant was refurbished, the values began to decrease standing however at the upper limit (7,3-9 pH units). There are exceeds recorded for copper in the wastewater exhausted from Tausani pond and from sectors Varad, Florimunda, Sasca- mine. It can be noticed that in the mine water, the high values of copper are recorded during the underground works of closing, when because of its flood, the water washes the ore lenses of copper, yet unexploited. The extractible does not exceed the limits generally being under the max allowed concentration; slight increase were recorded during closing due to the equipment used. The iron and zinc subordinated elements at the copper mines and for this reason they are found in small quantities in the wastewater, under the max allowed concentration. Slight increases, sometimes exceeding the maximum concentration is found at Sasca but also during closing.

The chapter closes with the presentation of the water volumes and flows exhausted in the natural receptors by the respective mines.

The chapter 7 called *"Researches regarding the impact of the exploitation of non-metalliferous deposits upon the quality of water in Cara -Severin county"* begins with the presentation of the main deposits of useful and decorative rocks exploited in the county and the pollutants resulted that unpurified the natural receptors. The fluctuation of the main pollutant concentration (suspensions, pH and extractible) in the wastewater exhausted in Pades River from the marble quarry Marmosim SA Ruschita is analyzed. The pH is between the settled limits but close to the upper limit; it recorded an accidental exceed of the upper limit in 2008. The suspensions often record exceeds of the max allowed concentration but their values decreased much after decanter rehabilitation in 2002. The extractible is generally situated under the level of max allowed concentration recording in 2008 an exceed of 28,62mg/l. But adopting the procedure of marble wet cutting and renouncing at the greased saws in 2006, their concentration decreases much. The wastewater volumes and flows exhausted from SC Marmosim SA Ruschita are presented at the end of the chapter.

A special chapter is *chapter 8*, called " *Researches regarding the impact of the uranium mining upon the quality of water in Caras-Severin county"*. The mine "Banat" Oravita is the only radioactive pollutant in Caras-Severin, which started its activity in 1954. Through HG816/1998 and HG 720/1999 the mines Lisava and Ciudanovita that only were working, were subject to preservation aiming to close them. The area including “Banat” Oravita is crossed by Jitin River (Ciudanovita) and Lisava (Lisava) left affluent of Caras River.

The radioactive elements that unpurified the water are uraium, radium and dissolved radon at uranium mines Ciudanovita and Lisava. During mining, there are introduced radioisotopes belonging to three radioactive families U238, U235 and Th232 the most important being U238 with its disintegration products Th230, Ra226 and Ra222. Exhausting of the mine water through the treatment moduls contaminates the hydrographic network (about 2000 cm/day radioactively contaminated water). The chapter monitors the evolution of the U238 concentration in ten control sections placed on Caras, Jitin and Lisava rivers during 1993-trim I-2009; when interpreted the results, as term of comparison max concentration value allowed for uranium was used (CMAI used in the text) hor drinkable water that is 0,021 mg/l according to STAS 1342/1991. This standard was valid until the new law no. 425/07.2002 of the drinkable water was published; this Law was amended and completed by Law 311/06.2004. The new law of the drinkable water expresses the radioactivity through the total effective dose calculated acc to Chapter IV art 24.2 © from HG 974/15.06.2004 and the reports started to be drawn up from 2002, trim II at max allowed derived concentration (noted CMA2) of 0,1mg/l U, much more permissible. It is noticed that for the sections placed on Jitin and Lisava the uranium concentration steadily exceeds CMA1 during the entire analyzed interval, but only in few cases it is exceeded in comparison with CMA2. Decreases are noted after 2000 coinciding with the underground closing and mine flooding, sometimes exceeding even CMA2. This is due to the water that washes the ore lenses charging radioactively. On the sections placed on Caras Rivers, the uranium concentration is much lower due to the large intake of clean water with which the river comes. The chapter also presents the table with the calculus of the total effective dose of U238and the variation diagrams between 2002, trim II – 2009, trim I.

The Chapter 9, called “*Ways of reducing the mine pollution in Caras-Severin county*” The approach was made depending on the stage where the mines are, and should be subject to the program of closing and greening. Separately, the case of mine Banat Oravita is developed due to its specificity. And at the end of the chapter, as a “freak”, certain researches were made in order to point out the fact that the works of closing and greening aiming to help the environment, may turn into real sources of pollution.

The thesis finishes with a chapter of conclusions on the results of the researches. The most important is the one that over time, the mines in the county have disrupted the water quality of the receptors, their upstream position with small flows and heavy rains had a contribution for that. The most frequent exceedances of the maximum permissible concentrations recorded in suspension, theses excesses were simultaneously analyzed very large majority holding. Along with reducing the rate of extraction but lower concentrations of suspension until close to the maximum permissible concentration. Exceedances were recorded and concentrations of copper, zinc and pH, but they werw as frequentmor as large as for suspensions. It is interesting that the values of these indicators are still high or has even increased (extractibile substances, pH to mine Lupac)even after closure of mining and during greening of closure and ecological rehabilitation. The used waters evacuated from non-ferrous mining deposits and from mineral fuels, should submit an acidic. Existence of limestones in geological landscape locale, provides basic buffer, which adjusts the pH to normal. Major overruns are recorded and in the case of uranium indicator, analyzed from the uranium mines, overruns which also increase in several sections of control, in period after closing.

The bibliography that helped to develop this paper is at the end of the thesis.