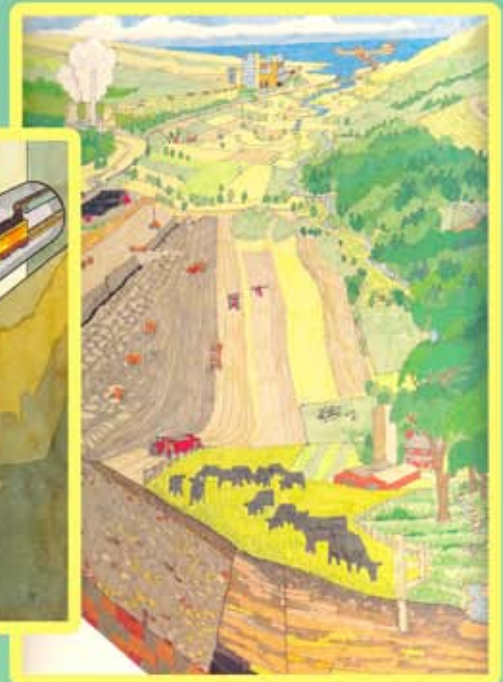


INTEGRATED INTERNATIONAL SYMPOSIUM  
INTEGRISANI MEĐUNARODNI SIMPOZIJUM

# TIORIR '11



***PROCEEDINGS  
ZBORNIK RADOVA***

***Volume 1, Knjiga 1***

***8th International Symposium Mine Haulage and Hoisting ISTI '11  
VIII Međunarodni simpozijum Transport i izvoz ISTI '11***

***International Symposium  
Sustainable Development of Mining and Energy Industry ORRE '11  
Međunarodni simpozijum  
Održivi razvoj rudarstva i energetike ORRE 11***

***Zlatibor,  
September 11 – 15, 2011.***

**TIORIR '11**

**INTEGRISANI MEĐUNARODNI SIMPOZIJUM – ISTI, ORRE i IRSE**  
**INTEGRATED INTERNATIONAL SYMPOSIUM – ISTI, ORRE i IRSE**

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Urednik / Editor  
Prof. dr Miloš Grujić

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**Izdavač/Publisher:** Univerzitet u Beogradu, Rudarsko-geološki fakultet, Beograd

**Za idavača/For publisher:** Prof. dr Vladica Cvetković

**Grafička priprema/Technical desing:** SaTCIP, Vrnjačka Banja

**Štampa/Printed by:** SaTCIP, Vrnjačka Banja

**Tiraž/Copies:** 200 primeraka

**ISBN 978-86-7352-257-9**

Publikovanje ovog zbornika radova odobreno je od strane Nastavno-naučnog veća Rudarsko-geološkog fakulteta Univerziteta u Beogradu.

**Svi radovi u zborniku su recenzovani**

**Ovaj zbornik radova je štampan uz finansijsku pomoć Ministarstva za nauku i tehnološki razvoj Republike Srbije**

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SRPSKO ODELJENJE MEĐUNARODNE AKADEMIJE NAUKA ZA EKOLOGIJU I BEZBEDNOST  
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## PREDGOVOR

Rudarsko-geološki fakultet Univerziteta u Beogradu i Srpsko odeljenje Međunarodne akademije nauka za ekologiju i bezbednost (MANEB SRBIJA) organizuju integrisani naučno-stručni skup TIORIR '11. Ovaj susret stručnjaka i naučnika integriše tri tradicionalna naučna skupa i to:

- Osmi međunarodni simpozijum o transportu i izvozu ISTI '11,
- Međunarodni simpozijum Održivi razvoj rudarstva i energetike ORRE '11 (ranije Rudarstvo i zaštita životne sredine MEP),
- Treća konferencija Istorija rudarstva u srednjoj Evropi IRSE '11.

Sadašnje stanje rudničkog transporta je u opštem slučaju neodgovarajuće, imajući u vidu potrebe za mineralnim sirovinama. Zbog toga je neophodno da se stalno traga za takvim rešenjima transporta i izvoza, koja ispunjavaju potrebu da sve faze u dobijanju mineralnih sirovina budu visokoproduktivne. Trend rasta potražnje za energetske, metalne i drugim mineralnim sirovinama predstavlja novi podsticaj za razvoj rudničkog transporta i izvoza. U tom poslu se moraju aktivirati svi koji se bave rudničkim transportom (naučni radnici, projektanti, proizvođači transportne opreme, tehničko rukovodstvo rudnika i dr). Na taj način je moguće doneti prava rešenja sa kojima će svi biti zadovoljni.

Polazeći od osnovnih odlika koncepta održivog razvoja definisanog u Agendi 21 koji zahteva integrisanje ekonomskih, ekoloških, društvenih i zdravstvenih aspekata razvoja, kao i preventivno delovanje, definisana je potreba da se sirovinaska, energetska i ekološka osnova, neophodna za ljudske aktivnosti, održi. Rudarstvo i energetika su po svojim aktivnostima pri vrhu onih delatnosti, kojima održivi razvoj mora biti najvažnija smernica pri planiranju i delovanju. Ovaj Simpozijum je u neku ruku naslednik Međunarodnog skupa Rudarstvo i zaštita životne sredine MEP koji je održavan od 1996. do 2003 (svake druge godine) i koji je prestao da se održava, uglavnom, iz tehničkih razloga. Tema održivog razvoja predstavlja prošireni logični nastavak i viši stepen tretiranja ove problematike.

U dužem vremenskom periodu region srednje Evrope spadao je u najrazvijenije delove Kontinenta. Raznovrsnost i potrebe za metalnim mineralnim sirovinama, prouzrokovale su rani razvoj rudarstva na ovim prostorima još od praistorije, preko antičkog doba pa sve do srednjeg veka, kada je rudarstvo steklo punu afirmaciju i postala glavna i najprofitabilnija delatnost čitavih oblasti. U kasnijim periodima, novijem dobu, došlo je do razvoja i energetskog rudarstva, što je opet srednjoevropske države izbacilo u prvi plan. Sve masovnija eksploatacija uglja, nešto skromnija nafte i gasa i u poslednjem veku urana, potvrdile su tezu da su zemlje srednje Evrope, bile rudarske zemlje kroz istoriju, a da i u sadašnjem trenutku zauzimaju značajno mesto u ovoj bazičnoj delatnosti.

Za simpozijum TIORIR 11 je poslato i štampano u ovom Zborniku 93 rada, a broj autora tih radova je 180. Autori dolaze iz 13 zemalja iz preko 40 raznih naučnih, projektantskih i privrednih organizacija. Nadamo se da će oni u punoj meri doprineti uspešnosti ovog skupa.

Urednik

## PREFACE

The Faculty of Mining and Geology, Belgrade University and the Serbian Division of the International Academy of Ecology and Life Protection (MANEB Serbia) are organizing the integrated professional-scientific symposium TIORIR '11. This gathering of scientists and experts integrates three traditional scientific conferences, as follows:

- 8<sup>th</sup> International Symposium on Mine Haulage and Hoisting ISTI '11,
- International Symposium – Sustainable Development of Mining and Energy Industry ORRE '11 (previously Mining and Environmental Protection- MEP),
- 3<sup>rd</sup> International Conference –History of Mining in the Central Europe IRSE '11.

The current situation of mine haulage is, generally, inappropriate, having in mind needs for mineral raw materials. Therefore it is necessary to constantly search for such haulage and hoisting solutions that could satisfy the need that all phases in mineral processing are highly productive. Tendency of the increase in demands for energy, metallic and other mineral raw materials represents a new incentive for the growth of mine haulage and hoisting. Therefore, all those involved in the mine haulage area (scientific workers, designers, manufacturers of mine haulage and hoisting equipment etc.) must take a more active part in this work. In this way, it will be possible to give the right solutions, satisfactory for all actors.

Starting from the basic characteristics of the sustainable development concept, defined in the Agenda 21, which requires the integration of economical, environmental, social and health aspects of the growth, but also preventive actions, it is determined that there is a need for the mineral, energy and environmental basis, necessary for human activities, to be conserved. Mining and Energy industry are among those activities for which the sustainable development should be the most important tendency in planning and taking actions. This Symposium is in a way the successor of the international convention Mining and Environmental Protection (MEP), which was being held from 1996 to 2003 (every two years) and which is not held any longer, mostly due to technical reasons. The sustainable development topic represents an extended logical continuation and higher level of dealing with this kind of issues.

For a longer period of time, the region of the Central Europe has been deemed as one of the most developed parts of the Continent. The diversity of and demand for metallic mineral raw materials gave rise to an early growth of mining on this territory, starting from the Pre-history through Antiquity to the Middle Ages, when mining gained the full recognition and became the main and most profitable business activity of some regions. Later, in modern times, there was also a growth of energy mining, which, in return, put to the fore the Central European countries. More and more extensive coal exploitation, a little bit lower exploitation of oil and gas, and in the past century of Uranium, have confirmed the thesis that the Central European countries were mining countries through history, but that they also currently hold a significant position in this basic field.

For symposium TIORIR '11 is sent and printed in this volume of papers 93, a number of authors of these papers is the 180. The authors come from 13 countries from over 40 different scientific, engineering and economic organizations. We hope that they will fully contribute to the success of this event.

Editor

## ECONOMIC DEVELOPMENT OF MINING IN MACEDONIA

## EKONOMSKI RAZVOJ RUDARSTVA U MAKEDONIJI

Risto Dambov<sup>1</sup>, Biljana Petrevska<sup>2</sup>, Orce Spasovski<sup>3</sup>, Dusan Nikolovski<sup>4</sup><sup>1</sup>University of Stip, Faculty of Natural and Technical Sciences, Mining Institute, Stip, Macedonia,<sup>2</sup>University of Stip, Faculty of Tourism and Business Logistics, Gevgelija, Macedonia,<sup>3</sup>University of Stip, Faculty of Natural and Technical Sciences, Geology Institute, Stip, Macedonia,<sup>4</sup>International Slavonic Institute G.R. Derzavin Faculty of Economy and Entrepreneurship Organization, Sv. Nikole, Macedonia

**Abstract:** The minerals as natural resource very rapidly became a significant contributor to the industrial and overall economic development of Macedonia. The intensive development started in all spheres of mineral complex like: metal ores, non-metallic mineral products, other mining and quarrying, water etc. During the transition period from 1990-2002, almost all mining activities stagnated and consequently many of the current mine capacities were either closed or sold unsuccessfully. Recently, with creation of new ownership conditions, it is expected that the entire mining industry soon will recover and restart and that new mine capacities will be open or the already existing ones will restart the production process. This paper fully addresses the most important mine capacities in Macedonia which normally function or are currently in the transformation process. Furthermore, the paper presents variety of tables defining the major productions accordingly to the sector or the type of mineral ores. In addition the comparative analyses are present in several tables dealing with the evaluated growth and the potential strategic goals necessary for development of the mining industry in Macedonia.

**Key words:** mineral resources, economic development, data, mining industry,

**Apstrakt:** Minerali kao prirodni resursi postali su veoma brzo značajan doprinos industrijskom i celokupnom ekonomskom razvoju u Makedoniji. Intenzivni razvoj započeo je u svim oblastima mineralnih kompleksa, kao što su: rude metala, nemetalski mineralni proizvodi, drugi rudarski i kamenolomski resursi, voda, i tako dalje. Za vreme perioda tranzicije od 1900-2002.godine, gotovo sve rudarske aktivnosti su stagnerale i, kao posledica toga, mnogi od sadašnjih rudničkih kapaciteta su bili ili zatvoreni ili prodani pod nepovoljnim uslovima. U novije vreme, sa novim uslovima vlasništva, očekuje se da će se celokupna rudarska industrija brzo oporaviti i obnoviti, i da će biti otvoreni novi rudarski kapaciteti, ili da će stari ponovo početi svoj proizvodni proces. Ovaj rad se u celosti bavi najvažnijim rudarskim kapacitetima u Makedoniji koji normalno funkcionišu, ili su trenutno u procesu transformacije. Osim toga, rad prezentuje različite tabele koje definišu glavne produkcije u zavisnosti od sektora ili tipa mineralne sirovine. Pritom, tu su komparativne analize u nekoliko tabela, koje se bave procenjenim rastom i potencijalnim strateškim ciljevima potrebnim za razvoj rudarske industrije u Makedoniji.

**Gljučne reči:** mineralne sirovine, ekonomski razvoj, podaci, rudarska industrija,

## 1. INTRODUCTION

The early facts for usage of minerals in Macedonia date even from the Hellenic period, which can be verified with much material evidence. Since then, with minor or major interruptions, the mining was constant occupation of the people living in these areas. The ancient authors (in first line, Greek ones) left many data on active mining in Ancient Macedonia. Further on, the mining activities proceed in the Roman period as well.

The significant mining activities which produce serious influence on the economic development can be noted from the middle of 19<sup>th</sup> century. Ever since until the period of 1990-1991 when new economic

relations have been established, mainly in the post war period, a brand new environment is launched being fully compatible for more intensive development of mineral economy in Macedonia.

## 2. HISTORIC OVERVIEW AND DEVELOPMENT OF MINING INDUSTRY

The geographic position of Macedonia, being situated in the central part of the Balkan Peninsula, presenting a crossroad to many nations, cultures and soldiers, the nearness of the Mediterranean and above all, the convenient geological-mineral structure, influenced that the mining activity in Macedonia has been present (with interruptions of different intensity depending on the historic events) even from the Ancient time and Roman period, and particularly in the middle century.

The period before and after the Second World War is particularly characteristic for mining activities for the private, as well as for the public capital. In the “Radusha” mine (1878-1978) for one century, the chrome ore with high quality has been extracted. Based upon the mine reserves and the “Radusha” mine, in 1957 the first metallurgic complex “Jugohrom” has been built in Macedonia. The period after the Second World War is marked by fast development and opening of several new mines for different mineral ores.

So, after the 1950, the discovered reserves of iron are a fundamental base for creation of mine capacities as “Tajmiste”, “Demir Hisar” and “Damjan”, as well as the biggest metallurgic entity in Macedonia named “Zelezarnica” Skopje in which frames is “Fakom-Skopje”, the “Banjani” mine for production of limestone, lime and construction aggregates. On the basis of nickel mine, the “R’zanovo” mine and the metallurgic complex of “Feni - Kavadarci” (nowadays “Fenimak”) are build.

Due to the remarkable results in increasing the mine ore reserves, it became possible to reconstruct and intensify the capacity of “Zletovo” mine thus resulting in creation of new mines “Sasa” and “Toranica”. New preconditions were established for opening of Smellitig for zinc and lead “Zletovo”, the factory in Mak.Kamenica, the Chemical factory “Veles” for artificial fertilizers production etc. The reserves of cooper are the base for creation of “Bucim” mine and the gold mine “Goldmak” - Radivish.

In the period from 1999 till 2009, more than 300 concessions were issued for initiating detail geological researches either for already active mines or mines in the phase of final researches or reactivation. Our intention is not to make a detail analysis of their size and meaning, but only to enumerate them according to their fundamental characteristics and purpose.

Among the biggest enterprises in the area of exploitation and reproduction of construction stone, in the first line calcite and dolomite marble with high quality and world famous brand are: Marble Factory Prilep (Sivec mine), Larin with Bela Pola mine etc.

The enterprises in this area, beside annually production of over 30 000m<sup>3</sup> blocks, additionally have capacities for reprocessing of over 500 000 m<sup>2</sup> plates and other forms of architectonic and construction rocks. Besides all above mentioned enterprises, there are major numbers of smaller workshops for monuments, which is estimated annually to 300 000 m<sup>2</sup> products of marble, onyx and other architectonic rocks.

The following enterprises are very successful in accomplishing their work, especially for production of mineral ores as non-metallic mineral ores: “Ograzden” – Strumica, “Mermeri” – Gostivar, “Sivec Mine” – Prilep, “Banjani” – Skopje etc. In this context, there are also other enterprises specialized for concrete aggregates and asphalt concrete base are “Opalit” – Cheshinovo and “Strmosh” – Probishtip. The “Ograzhden” – Strumica is famous for the production of natrium felspat and separated marble limestone usually used in construction and chemical industry.

The mine, as well as the factory for reproduction of gypsum “Knauf – Radika” – Debar has great assortment of products, construction gypsum, modeling gypsum, medical gypsum, gypsum slabs, decorative products etc. “Sileks” – Kratovo is famous for production of quartz and quartzite as well as for exploitation of the findings “Crni Vrv” near Kratovo and “Ratkova Skala” near Zletovo. Kratovo consequently to the outstanding physical and mechanical characteristics is used for specific purposes, the quartz extracted from “Crni Vrv” and “Ratkova Skala” due to the presents of over 98% of SiO<sub>2</sub> represents

a material with astonishing quality for production of ferro-siliceous and siliceous metal. The factory “USJE” – Skopje (TITAN) within its frames has established several spots for production of high quality laporcement as well as limestone as basis for production of cement, different types of materials for isolation and asbestos-cement slabs.

### 3. TECHNICAL AND ECONOMICAL INDICATORS

The intensive construction activity like building and road construction, from one side and the vast number of spots of different non-metallic ores, being dispersed in the whole territory of Macedonia, have strong influence on the dynamic development of production of non-metallic ores. The tables below represent the most important economic indicators regarding quantitative values, as well as, indices. In this respect, the Table 1 and Table 1<sup>A</sup> represent indicators for accomplished results for several years according to the Nomenclature of the State Statistical Office.

*Table 1 Industrial production in natural data*

Name of the product	Measurement unit	2007	2008	2009
Mining of coal and lignite extraction of peat				
Lignite	t	6 569 220	7 669 103	7 395 915
Mining of metal ores				
Copper ores	t	4 109 464	4 239 500	3 766 500
Copper concentrates	t	33 467	38 337	35 430
Lead concentrates	t	48 702	67 401	63 227
Zinc concentrates	t	61 913	77 473	77 296
Other mining and quarrying				
Marble and travertine merely cut in slabs <= 25 cm thick	t	33	58	52
Limestone flux	t	848 498	827 100	694 968
Bentonite	t	22 509	13 689	9 033
Quartzite	t	12 599	21 038	1 135
Construction sands (excl. silica sands, metal bearing sands)	m3	23 426	39 559	30 631

*Table 1<sup>a</sup> Production of some ores of the active mines for copper, lead, zinc, and ferronickel*

Products	Unit measures	2007	2008	2009	I -IV-2010 (≈2010)
Copper ore	t	4109464	4239500	3766500	1407500(>4000000)
Concentrates of copper	t	33467	38337	35430	12761(39000)
Lead Concentrates	t	48702	67401	63227	19624 (60000)
Zinc concentrates	t	61913	77473	77296	23654 (72000)
Ferronickel	t	15321	15026	12000	4531(13500)

*Source: State Statistical Office (2010). Statistical Review: Industry and Energy, Industry 2004-2009, p. 16.*

The Table 2 stands for quantities of exported major products in 2009, mainly representing only a part of products created as a result to the mining exploitation accordingly to the Nomenclature of the State Statistical Office.

*Table 2 Export of major products in 2009*

	Quantity in tonnes	Value in '000 US\$	Structure (%)
Total	2 945 517	2 691 528	100.0
Other structures and parts of structures, of iron or steel	17 784	28 847	1.1
Zinc ores and concentrates	69 509	22 025	0.8
Marble, travertine, ecaussine and other calcareous monumental or building stone, roughly trimmed or cut into blocks	57 979	19 312	0.7

*Source: State Statistical Office (2011). Statistical Yearbook of the Republic of Macedonia, 2010, p. 487.*

The Table 3 presents the number of active business enterprises in the mining industry. It is noticeable that in 2008 the number shows slight break-down, which in the year ahead is significantly enlarged in total of 144 entities.

*Table 3 Active business entities in mining*

2007	2008	2009
107	104	144

*Source: State Statistical Office (2011).*

*Statistical Yearbook of the Republic of Macedonia, 2010, p. 464.*

The data represented in Table 4, dealing the number of employed in the mining sector in 2009, are much more interesting.

*Table 4 Active business entities and number of employed in 2009*

Sections of activities	Total	0 <sup>1</sup>	1-9	10-49	50-249	250+
Total	70 710	6 243	59 398	3 706	1 159	204
Mining and quarrying	144	33	70	30	7	4

*Note: <sup>1</sup>Including enterprises with unascertained number of employees*

*Source: State Statistical Office (2011). Statistical Yearbook of the Republic of Macedonia, 2010, p. 465.*

It is noticeable that the major number of the active enterprises is working with 1-9 employees. That practically means that there is vast number of smaller mines and capacities for reproduction of mineral ores from different kind, in the first line for cutting, shaping and forming stones as marble, onyxes, granites etc. According to statistics, there is undefined number of employees since in some sectors this industry depends on weather conditions. Consequently, these employees cannot be included in the number of permanent employees (See column 0<sup>1</sup> of Table 4). Their total number in Macedonia is 6 243 representing unascertained number of employees.

The Table 5 is focused on indices of employees in mining industry in Macedonia, whereas 2005 is the base year. It is obviously that the number of employees in the mining sector, according to the indices, show decline thus resulting with 77% in 2009.

*Table 5 Indices of employees in mining*

	2004	2006	2007	2008	2009
Total	105	97	96	95	89
Mining and quarrying	104	100	93	85	77
Mining of coal and lignite; extraction of peat	102	99	101	102	99
Mining of metal ores	103	102	90	76	65
Other mining and quarrying	109	95	93	89	79

*Note: 2005 = 100*

*Source: State Statistical Office (2010). Statistical Review: Industry and Energy, Industry 2004-2009, p. 42.*

The Table 6 represents the indices of industrial production, whereas 2005 is the base year. It is visible an increase in the production while simultaneously the number of employees is decreased. The general conclusion may be that although the number of employees is decreased, there is a slight increase in the production. The increased quantum of productivity is due to the enlargement of work discipline and efficiency in working time, application of contemporary high productive engines and machines, excellent trained workers and professional management staff which in major part of mines, are capable to resolve the challenges in systematic and proficient way during all tasks in the production management process.



*Table 6 Indices of industrial production*

	2004	2006	2007	2008	2009
Total	94	104	107	113	105
Mining and quarrying	71	111	123	135	118
Mining of coal and lignite; extraction of peat	104	97	95	111	108
Mining of metal ores	0	118	200	250	238
Other mining and quarrying	97	124	114	104	72

*Note: 2005 = 100*

*Source: State Statistical Office (2010). Statistical Review: Industry and Energy, Industry 2004-2009, p. 15.*

#### 4. ECONOMIC CONTRIBUTION OF MINING

After 1950, accordingly to the enlargement of basic ores as well as human resources, further dynamic development of mining industry was initiated. In 1960 the production of mineral ores was boosted to 675,4 thousands, in 1970 over 2,9 millions, in 1980 over 7 millions thus resulting with 14,66 million tones mineral ores.

Due to the enlargement of mining ores, construction of variety of mines as well as the dynamic increasing of production of metal and non-metallic mineral ores, positive conditions were created for expansion of electro-economy, black and colored metallic industry, non-metallic industry and reproduction. The largest part of these products was not present in the 1970s in Macedonia.

*Table 7 GROSS DOMESTIC PRODUCT, 2003-2009<sup>1</sup> at current prices (in million denars) For Mining and quarrying*

2003	2004	2005	2006	2007	2008	2009
976	1 029	1 397	1 569	2 604	4 350	4 150
Distribution (%)						
0.4	0.4	0.5	0.5	0.7	1.1	1.0

*Note: <sup>1</sup> Revised data for GDP for the period 2003-2007*

*Source: State Statistical Office (2011). Statistical Review: National Economy and Finances, Gross Domestic Product, 2009, p. 34-35.*

The gross domestic product at current prices (in million denars) for the period of 2003-2009 is presented in Table 7. The absolute amount is given in the second row of Table 7, while the distribution in percentage is presented in the final row of the same table.

*Table 8 Volume indices by economic activities*

Description	2004	2005	2006	2007	2008	2009
Mining of coal and lignite; extraction of peat	217.0	104.7	100.6	148.4	553.2	91.1
Mining of metal ores	129.6	370.3	199.3	173.3	200.7	78.4
Other mining and quarrying	101.4	101.6	98.1	100.6	104.3	132.9

*Note: Previous year = 100*

*Source: State Statistical Office (2011). Statistical Review: National Economy and Finances, Gross Domestic Product, 2009, p. 69.*

The Table 8 deals with the volume indices by economic activities and addresses the issue of: mining of coal and lignite, extraction of peat, different types of metals and other mining and quarrying. All above noted volume indices are calculated on the previous year as a base.

According to all the knowledge and perspective that are projected from expert in this field, it is emphasized that mineral resources in Macedonia as well as in the whole world, will be a basic ranged human potential for the development of the overall economy of a country.

Respective mining companies, government and ministries should be done for these tendencies to be achievable in the further period. The perspectives for the development of this activity in Macedonia as well in the world, directly depend on the activities undertaken in the sphere of legislation, prepared by-laws -

regulations and the appropriate documents (Tariffs) for regulation the basic duties, taxes and fees. With the introduction of incentive measures, appropriate interest rate policy of the commercial banks and similarity of the legal provisions for new concessions and appropriate the technical documentation of mining only part of the measures should be taken in this important economic activity. As a consequence of growth of prices on world markets for metals, greater demand in world terms, in the future will be created better conditions for the already existing mines and will give incentives for investment activities of domestic companies and even before the entry of foreign capital in the most active capabilities for their promotion of technological process, obtaining concessions for geological researches and opening of new mines.

## **5. LEGISLATION**

Geological research of any type and volume, the mining of mineral raw materials, supervision and control as well technical inspections are regulated by the Law on mineral resources. (Official Gazette of RM no. 24/07, 88/08, 52/09).

According to this Law which so far has a few changes and supplements in the last year of the regulated manner of obtaining the concession for detailed geological research, mining permit, concession fees, necessary technical documentation for all permits related to this activity, as well as penal provisions prescribed by this Law. As part of this paper to briefly give the method of obtaining the concession for exploration and exploitation. The procedure for a new concession of detailed geological research starts with getting a license for geological research, which in turn is achieved by applying the published public tender conducted by the authority in charge of this activity in the Ministry of Economy. At this public auction stand out (publish) a number of concessions - new locations of raw materials of general interest such as: all kinds of metallic non metallic materials and resources, groundwater, thermo mineral waters and others. All these concessions are public in the year general program adopted by the government after a request for research by interested domestic and foreign legal entities.

After the conclusion of a concession contract for detailed geological research, entity has the opportunity of two to four years (depending on the type of mineral raw materials) to perform geological surveys and preparation of report for mining reserves on the particular areas, a major mining project for exploitation, elaborate on the impact of environmental and other documents required by this law to obtain permission for the exploitation of mineral resources.

The granted concession for detailed geological surveys are paid one-time charge which offered the concession granted to the public tender, while the exploitation of mineral raw material is paid an annual fee according to the space occupied by mining activities and compensation for the exploitation of mineral raw material obtained by annual amounts, area of concession (1000evro/km<sup>2</sup>) and depends on the type of the mineral resource in the percentage that ranges from 0,5 to 1,5%.

## **6. STRATEGIC MEANING OF MINERAL ORES**

Geographical position of Macedonia and geological conditions, caused to form the formations of many different rocks masses ranges with the presence of a large number of useful mineral resources.

Although relatively with small area Macedonia is rich on different mineral resources metal ores, non - metals, rare minerals, dimension stone blocks for the architecture, energy raw materials (coal) and other raw materials that make Macedonian mining industry.

More significant research works to define the larger ore reserves to which were initiated and carried out in the middle of the XIX Century. Since then today is made lot of numerous geological researches, mining research activities to a smaller extent and be established the new mineral fields with economic significance. All of this activities contribute to create conditions for development of mining industry as an important segment in the overall economy of the Republic of Macedonia. The rapid expansion in exploitation and processing of architectural - dimension stone over the past years in the R. Macedonia, particularly in the region of Prilep, had as a result to open lot of small quarries for white marbles, granites, onyxes etc. at the present time.

These raw materials are almost with various entities throughout the territory of Macedonia and a large number of different quantitative and qualitative characteristics. They represent a potential raw materials for the development of small quarries, small businesses for processing and shaping, which has already been proven and in previous decades. With relatively small investments, limited resources and rapid turnover of the capital for several years, in these existing facilities are established stable low capacity, high quality raw materials and teams succeed for management and appearances on local and world market.

Especially here invoked the large number of low capacity for receiving and processing (large number of fractions with granulation from several microns up to several centimeters) of different types of limestone, igneous rocks of technical stone, and especially set as acquiring queries and processing of decorative white marble, with high quality with trade mark.

As a result to application of technical and technological treatment to the mineral ores, the old materials are significantly improved or even new materials are produced with new physical and mechanical characteristics. Through the centuries, men discovery spirit has evolved, the intellectual capacity has developed and the knowledge regarding physical, chemical and mechanical characteristics of the mineral ores has enhanced. Accordingly, many inventions followed, like: electricity, power machine, engine with internal flaming, atom power, telecommunication systems, microprocessor and information as the highest product of the latest technologies.

## 7. CONCLUSION

Macedonia is rich on significant quantities and different types of mineral ores which enables ordinal processing even in the special conditions of work. The higher valorization of mineral ores in the future period will have important contribution to the development of overall economic activities in Macedonia.

With regard to the above note, contribute many legal entities that gain concessions for implementation of activities for detail geologic researches, further successful work of the current mines or initiating exploitation of newly opened mines for mineral ores.

Over the past years Macedonian industry has seen fast increase in export, from \$7 million in 2002 to more than \$15 millions in 2005 with over 1500 employees. In past 2-3 years the export increased with 20-30% for all types of ores, commercial dimension stones, technical crushed stones etc. Several kinds and unique quality dolomite white marbles, onyx, travertine, granite etc. are a real stone potential and invaluable wealth of Macedonia. Prilep region has also been acknowledged by seventy concessions issued for exploitation of dimension stone of which, forty-five are for the region of Prilep.

Our opinion is that now is the right moment for the economy in the country to do something more in order to promote and protect the regions that abound in ADS. We are confident that in the years to come, with our enormous efforts, the mining industry in Macedonia will expand in correlation with the global world economy in this sector.

## REFERENCES:

- [1] KAMEN & STONE. (2005). *Journal of Macedonian Stone Industry*, No 1, and 5, Prilep, Macedonia.
- [2] KAMEN & STONE. (2006). *Journal of Macedonian Stone Industry*. No 2, Prilep, Macedonia.
- [3] Kennedy, B.A. (Eds.). (1995). Editor, Surface Mining. US Bureau of Mines, Ohio, USA.
- [4] Montani, Carlo. (2009). *STONE 2009, World marketing handbook*, Faence Editrice, Milano, Italy.
- [5] State Statistical Office (2010). *Statistical Review: Industry and Energy, Industry 2004-2009*, Skopje.
- [6] Statistical Office (2011). *Statistical Review: National Economy and Finances, Gross Domestic Product, 2009*, Skopje.
- [7] State Statistical Office (2011). *Statistical Yearbook of the Republic of Macedonia, 2010*, Skopje.
- [8] Official Gazette of Republic of Macedonia No. 24/07, 88/08, 52/09