THE STUDY ON MASTER PLAN FOR PROMOTION OF MINING INDUSTRY
IN REPUBLIC OF SERBIA
FINAL REPORT(Summary)

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Chapter 1 Outline of the Study

1.1 Background of the Study

The Republic of Serbia (hereafter Serbia) is a country rich in metal and mineral resources. During the Socialist Federal Republic of Yugoslavia era, Serbia was a metal supply station as well as a major European producer of base metals such as copper, zinc, and lead. However, mining production decreased dramatically due to economic sanctions imposed by the United Nations, and competitiveness has decreased during the transition from a socialist economy to market economy.

Today, the mining industry is a pillar of the Serbian economy and exports of non-ferrous metals amounted to 17% of total Serbian exports in 2004.The mining industry is an effective way for the government to obtain foreign currency, and reformation and development of the mining industry will make it a significant player in the economic development of Serbia. Therefore, a mining industry policy is needed for internal and external investment promotion.

1.2 Purposes of the Study

The purposes of this study are as follows: (1) Elaboration of a Master Plan for developing the Serbian mining industries under a market economy; (2) Creation of a road map for sustainable development of the Serbian mining industry; and (3) Technical transfer so that Serbia can independently expand and improve upon (1) and (2) long into the future.

1.3 Target Area of the Study

The target for this study is the entire territory of Serbia.

1.4 Method and Content of Study

The study consists of two stages: a basic survey stage (A) and a Master Plan formulation stage (B).

A. The Basic Survey Stage consists of:

- Review and analysis of information related to investment and the environment
- Review and analysis of information on mineral resources (publications related to geology, exploration reports).
- Support for development of a GIS database for mineral resources
- Preliminary work for an outline of the Master Plan for mining industry development

B. The Master Plan Formulation Stage consists of:

- Creation of a Master Plan for mining industry development
- Preparation of an action plan
- Case study and feedback for the Master Plan
- Recommendations for mining development

1.5 Local Survey

1.5.1 Implementation of the Study

The first local survey was carried out from January 14 to February 22, 2007 (40 days), the second survey was carried out from May 10 to June 10, 2007 (32 days), the third survey was carried out from July 1 to August 9, 2007 (40 days), and the forth survey was carried out from October 2 to 31, 2007 (30 days). The JICA team completed the local survey with eight to nine members on schedule. The fifth local survey was carried out from January 27 to February 12 (17 days).

1.5.2 Study Team Members (Table 1.1)

Name	Assignment	First site survey	Second site survey	Third site survey	Fourth site survey
Yuji NISHIKAWA	Team Leader / Mining Promotion Policy / Macro Economics / Investment Promotion	Jan.14-Jan.28, 2007 Feb.14-Feb.22, 2007	May 15-May.31, 2007	Jul 15-Jul 31, 2007	Oct 11-Oct 24, 2007
Richard THOMPSON	Investment Promotion B		May 14-May 23, 2007	Jul 15-Jul 21, 2007	
Mitsuo OZAKI	Mining Accounting		May 13-Jun.1, 2007	Jul 20-Aug 5, 2007	Oct 7-Oct 29, 2007
Masaharu MARUTANI	Geology / Exploration	Jan. 14-Feb.12,2007	May 10-Jun. 3,2007	Jul 9-Aug 1, 2007	Oct 2-Oct 29, 2007
Kazuki SHINGU	Mining	Jan.25-Feb.21,2007	May.10-Jun.7, 2007	Jul 8-Aug 5, 2007	Oct 8-Oct 31, 2007
Hisamitsu OOKI	Mineral Processing / Management of Tailings Dams	Jan.14-Feb.2, 2007	May 13-Jun.10, 2007	Jul 7-Aug 3, 2007	Oct 8-Oct 31, 2007
Shinichiro MUTO	Smelting	Jan.25-Feb.13, 2007	May 19-Jun. 2, 2007	Jul 8-Jul 31, 2007	
Masatoshi MURATA	Environment	Feb.8-Feb.21, 2007	May.10-Jun.7, 2007	Jul 7-Aug 3, 2007	Oct 8-Oct 27, 2007
Kazunari WADA	GIS Database	Jan.25-Feb.21, 2007	May.10-Jun.3, 2007	Jul 1-Aug 1, 2007	Oct 11-Oct 24, 2007
Toshio INOUE	Coordinator	Jan.14-Feb.2, 2007	May.13-May.30, 2007	Jul 12-Jul 26, 2007	

1.5.3 Minutes from the Meeting with the Serbian Side

The Japanese Team had its 1st meeting with the Steering Committee, which represented the Serbian side in "The Study on a Master Plan for the Promotion of the Mining Industry in the Republic of Serbia", and reached an agreement on the following points (the meeting minutes are presented in Appendix II-1).

- The 1st meeting with the steering committee was held on January 19, 2007.
- The content of the Inception Report and the study schedule.
- A case study of a small/medium-scale mine will be conducted based on study team recommendations and the counterparts' agreement.
- The 2nd meeting with the steering committee was held on July 17, 2007.
- The contents of the Progress Report
- Information on the status of the privatization process and the case study implementation
- The MEP organization, etc., described in the Progress Report must be revamped.
- The MEP must cooperate with the MEM in order to make the most efficient use of geological data.
- Data accuracy must be improved for ore reserves and other areas described in the report.

The 3rd meeting with the steering committee was held on October 14, 2007. In attendance were the MEM and the MEP from the Serbian side, and the Japanese Embassy, the JICA Balkan office, and the study team from the Japanese side. The participants agreed to the following points

(Appendix I-1).

- The contents of the Interim Report
- The current state of privatization and the case study implementation.
- Schedule and content of the Interim Workshop, Regional Workshop and Tokyo Investment Seminar, etc.

The following comments were made.

- The content and orientation of the Interim Report is reasonable.
- The tailings survey in the case study yielded results.

The 4th Steering Committee meeting was attended by representatives of MEM, MEP, financial officials, the Japanese Embassy, the JICA-Balkan office, and the Japanese Study Team. The Draft Final Report was explained and approved. The following is a list of what was covered at the meeting:

- ➢ Contents of the Draft Final Report
- ➢ The state of privatization, industrial law, and mining policy
- ➢ The results of case studies

In addition, the following comments were received:

- The Draft Final Report can become the Final Report by including the comments from the Serbian side.
- Capacity development is needed at various stages to reform the mining sector.
- The Master Plan proposed by the Study Team is now being materialized. It would be desirable to now receive support from the Japanese government.

1.5.4 Workshop

At the Progress Workshop on May 25, 2007, the Minister of Energy and Mines (MEM), the Japanese Ambassador, the Vice Minister of Environmental Protection (MEP), a JICA Representative, and the World Bank Serbia task manager presented addresses, and the MEM, the MEP, Belgrade University, representatives from privatized mines, and study team members spoke at the Nikola Tesla Conference Hall. There was a total of 94 participants.

The theme of the workshop was "From State Ownership to Private Sector Management". To help participants understand the current status of the mining industry and the plans for the future, the study team presented a workshop, which was also useful for creation of the Master Plan (Appendix I-6). Also, the theme of the Interim Workshop to be held on Oct 19, 2007 was "Charting the Course for Rebuilding the Mining Foundation".

The Minister of Energy and Mines (MEM) and the Japanese Ambassador gave addresses, and the representatives of the MEM, MEP, SIEPA, Privatization Agency, JTI and the study team gave presentations. There were a total of 83 participants. Through this workshop, the mining orientation in the future was understood and also technical transfers were implemented by presentations of the team members.

It should be noted that a regional workshop was carried out in Vranje in Oct 16, 2007 to promote harmonious co-existence between mining activities and local communities. The Mayor of the city, the Japanese Ambassador and a JICA Representative of the Balkan Office gave addresses, and the representatives of the MEM, MEP and the study team gave presentations. There were a total of 77 participants including city related people, the Grot Mine and local companies. Mining activities in local communities, contribution of the mining sector to local communities and environmental conservation were understood and technical transfers were implemented to the counterparts and local people.

On February 6, 2008, a seminar with the theme “Master Plan and Roadmap for the Mining Sector” was hald at the SAVA Center in Belgrade. In attendance were about 130 people involved with the Serbian mining industry, Canadian companies undertaking exploration acativities in Serbia, international organizations (World Bank, EBRD), Japanese companies, the news media, and others. This final seminar entailed discussing and confirming the future course of the Serbian mining sector, with presentations given according to the program (Appendix 4(1), P.22) by the Minister of MEM, the Japanese Ambassador, the JICA main office, the World Bank, MEM, MEP, the Study Team, and Canadian companies. As a result of this seminar, attendees were able to gain a thorough understanding of the Master Plan, and confirm the future course of the mining sector.

1.5.5 International Investment Seminar

In order to give international investors a good understanding about the potential of Serbia ‘s mining sector and mineral resources, an international investment seminar was held in Tokyo on November 27, 2008 under the auspices of the Serbian Embassy, JBIC、JOGMEC、JICA、JOI、and JETRO.

On January 30, the AMA Semonar was held at Armourers’ Hall in London, UK. Participating and making arrangements were 5 members of the Study Team (including one from the UK), while the Serbian side was represented by 3 people from the MEM (including the vice minister, whose expenses were covered by JICA), 1 person from SIEPA, and 3 people from Serbian companies. The seminar program (see Appendix 3(1), p.16) included addresses from the Serbian Ambassador to the Court of St. James’s and the vice minister of MEM, presentations by MEM and Study Team members, and reports on exploration results and the attractiveness of investment in exploration in Serbia by British and Canadian companies. Attendees included representatives of British mining companies, exploration companies, mining and exploration consultants, international organizations, and banks, among others. Representing Japan were 2 people from the JOGMEC London office, and 1 person from JICA’s UK office.

1.6 Case Study

Candidate mines for the case study are limited because many mines have already been privatized.

The paths to privatization are tender, auction, bankruptcy, and reconstruction. Mines currently under tender or auction processes are not being targeted for this case study.

The target mines were selected for the case studies which were conducted during the 2nd and 3rd local surveys under the auspices of the MEM and Privatization Agency.

Table 1.2 Target Mines for the Case Study

Target Mine	Current Status	Case Study
Grot Mine	To be auctioned in March 2008	OK for exploration, mining, mineral processing, accounting
Lece	Bankrupt	OK for tailings dam
Suva Ruda	Sold, reconstruction started	OK for exploration, mining, mineral processing
RTB Bor	Under negotiation	OK for tailings dam

It should be noted that the Rudnik Mine was added for making comparisons.

Chapter 2 Investment Foundation

2.1 National Economic Development Plan

In November 2006, the Finance Ministry announced "the Memorandum on Budget and Economic and Fiscal Policy for 2007 with Projections for 2008 and 2009" as a national economic development plan. This Memorandum lays out policies, targets and methods through 2009 for Serbia to make the transition to a market economy.This includes:

- National Plan for Joining the European Union
- Strategy for Poverty Reduction
- Strategy for National Economic Development

Strategy for Sector Development

2.2 Economic Conditions

2.2.1 Economic Policy

The following is a list of Serbia's main economic policies covered in the above 3-year development plan.

- Maintaining the stability of the macroeconomy and Serbian currency, and keeping inflation under control
- Rapid implementation of economic and social reforms (completing economic reforms and privatization)
- System reform (including national and local governments)
- Increase employment and living standards

Policy targets include a GDP growth rate of 7.2%, and the inflation rate to be reduced to 4.5% by 2009. These high-priority economic policies are each composed of individual policies. In other words, this means the formulation of policies for inflation, exchange rates, finance, international relations, employment, raising revenues, and so on.

2.2.2 National budget

The national budget is formulated and implemented based on the Budget System Law that was implemented in 2002. This law, which covers preparations, procedures, and implementation of budgets, bonds and guarantees, budget accounting and reports, budget management and auditing, and the national treasury, among other things, lays out detailed rules for making draft proposals at the ministry level, obtaining government (ministry) approval, obtaining approval from the national legislature, and so on. The budget contains detailed information, including the nation's overall budget, the budgets of all ministries and government agencies, assets, loans, and payments made on government bonds.

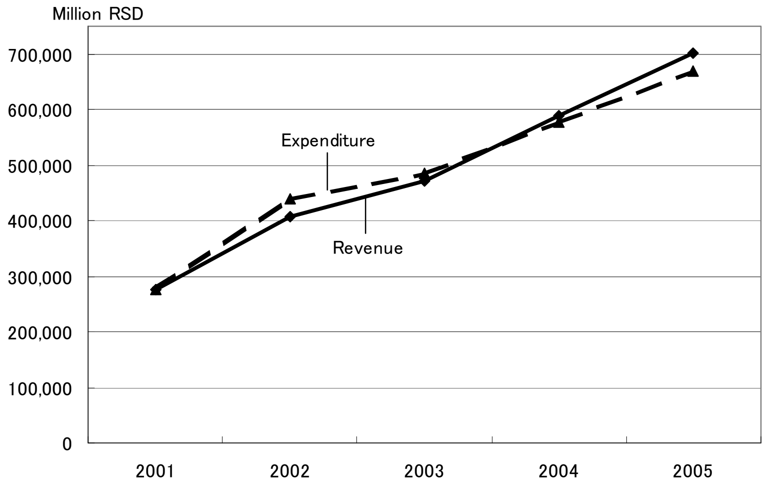


Fig. 2.1 Trends in Revenues and Expenditures

Looking at revenues and expenditures in the national budget, both are sharply increasing, and there has been a budget surplus since 2004. This means that rebuilding is having a desirable effect on the budget and may be reducing the economic burden imposed by national debt.

2.2.3 Macroeconomics

(1) Macroeconomics

The macroeconomics since 2001 that have involved economic policies such as finance and budgetary reform, keeping inflation under control, free trade agreements, bank restructuring, and promotion of privatization have been undergoing a rapid transformation. In 2005, GDP growth stood at 6.5%, while per capita GDP has been rising steadily, reaching US $3,158 (Finance Ministry data). This is the result of promoting investment, restructuring enterprises, and restoring productivity.

Table 2.1 Main Indices for Economic Growth (2001-2005)

Item	2001	2002	2003	2004	2005
GDP in current prices, in billion CSD *	784	1,020	1,172	1,431	1,750
GDP, real growth, in %	5.1	4.5	2.4	9.3	6.8
Inflation, period average, in %	91.8	19.5	11.7	10.1	16.5
Inflation, end of the period, %	40.7	14.8	7.8	13.7	17.7
Current account of the balance of payments, without donations, % GDP	7.4	11.0	9.6	13.5	9.8
Unemployment rate, in %**	24.7	27.1	27.8	28.0	29.2

* Estimates ** Including insured farmers (Source: MoF and NES)

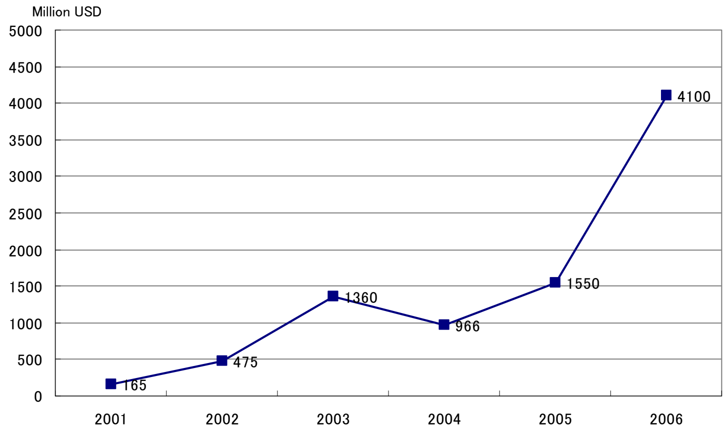
(2) **Investment Promotion**

The Serbian Investment and Export Promotion Agency (SIEPA), which is under direct control of the Deputy Prime Minister, serves as a window for private investors.. The recent increase in direct foreign investment (rising from US $1.5 billion in 2005 to US $4 billion in 2006) is closely linked to the development of the investment climate.

However, there has been relatively little investment in the mining sector. Although SIEPA considers mining to be a major sector, investment has not been actively promoted, and it still falls outside the range of SIEPA activities.

Foreign investment has been increasing dramatically, rising from US$ 1.55 billion in 2005 to US$ 4.1 billion in 2006 (Fig. 2.2). This increase shows the progress of privatization, the revitalization of economic activities, and the on-going improvement of the Serbian investment climate. At the same time, however, there is potential for a rise in the unemployment rate.

Fig.2.2 Trends in Foreign Investment



2.3 General State of the Mining Industry

2.3.1 Role of the Mining Industry in the Economy

The revitalization of the mining sector has only just begun. Metal mines produce international commodities which are directly linked to processing industries, so they can be considered both as domestic suppliers and as producers of industrial products for export. In addition, they are instrumental in local community development, provide places of employment, and are sources of government revenues from royalties and taxes. In this way, the mining industry not only makes a macroeconomic contribution to GDP, government revenues, trade revenues, employment, etc., but also has an enormous effect on the economy as it is directly related to local economies, industrialization, export industries, and derivative industries. Therefore, it is necessary to fix reasonable rates for royalties and taxes in the Mining Law, based on the current state of the mining industry as well as its role in and contribution to the national economy.

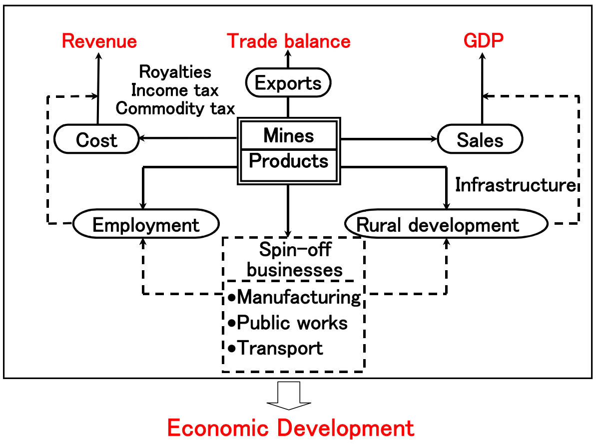


Fig.2.3 Role of the Mining Industry in the Economy

The Serbian mining industry is involved with the extraction of coal, industrial materials, building materials, and metals, primarily copper and zinc. Its estimated contribution to GDP was 3%, and is moving at about the same rate as it was in the late 1990s.

2.3.2 State of the Mining Industry

Mining has a long tradition at the foundations of the Serbian economy and dates back over 3000 years. By 1990, annual mineral production revenues were nearly US$3.5 Bn at today's prices but unfortunately, output has declined to an estimated US$1.3 Bn.

Modern mining had its start in 1904, when a French businessman established the Bore Mining Company and began full-scale operations. After the Second World War, a wide range of mining activities was developed; for a long time, mining was one of Serbia's premier industries and formed one of the foundations of the country's economy. This was especially the case with the RTB Bor complex which was comprised of core companies possessing mining and smelting facilities and equipment. The complex had 15,000 employees, and more than 6,000 others were employed in subsidiary companies that were involved in the processing of copper or the refining of precious metals from copper ore.

However, due to the money-consuming operations, unsustainable financial situation, etc., of the "autonomous management socialism" era, the industry ran up enormous debt. The excessive number of employees and a lack of investment in replacing aging machinery had a direct effect on declining production, and falling copper prices led to a decline in management. Revitalization plans were drafted that included company production, organization and financial integration, etc., and in September 2006, work started on the privatization of RTB Bor. With assistance from privatization, the World Bank, etc., plans have been made that should help to reduce the large debt that had been amassed, resolve pollution problems, and make reinvestments in equipment and machinery to prevent environmental and other mine-related problems.

In addition, lead and zinc are being mined at the Rudnik, Lece, Grot, Veliki, Majdan, Suva Ruda and elsewhere Mines, with total annual production of lead and zinc concentrate. Precious and rare metals are recovered as by-products at base metal processing plants. Some slag actually contains a higher grade of precious and/or rare metals than deposits in the mines. However, with the exception of Rudnik which has already been privatized and is operating in the black, these mines, like the abovementioned Bor, are either stalled in the privatization process, or are privatized but dormant, because of difficulties in management. Only some mines started to prepare their reopening.

Coal is being mined in large open pits in the Kolubara and Kostolac coal regions. About 95% of this coal is destined for coal-burning power plants. Large-scale coal mines are currently being revitalized, and the privatization process is not materialized yet. 99% of these mines belong to the state-owned Electric Power of Serbia (EPS). Small- and medium-scale open pits, quarries, etc., are producing industrial materials, building materials, etc., and they are playing an important role in the Serbian mining sector.

Because the Bor complex is located near the border with Romania and Bulgaria, it is also a source of transborder pollution. In addition, like Bor, zinc and lead mines show signs of soil and water contamination from heavy metals, and there is concern that tailings containing heavy metals may be carried downstream. There is precedent: in 2001, part of the tailings dam at Velijki Majdan ruptured, discharging liquid tailings downstream. Despite these problems, there is still no concerted effort being made to address them.

The mining sector is still being managed with approaches from the old socialist era, but mining policy, mining law, etc., are being reformed with support from the World Bank.

Table 2.2 Features and Current State of the Serbian Mining Industry

Features	Current State
• Possesses "full set" of technologies (exploration, mining, dressing, smelting, manufacturing) • All mines except Bor are small/medium scale • Both underground and open-pit mines exist • Mostly base metals are mined • Mining methods, geological survey methods, regulations, etc., remain from Socialism era	• Privatization is leading to the restructuring of all mines and smelters • There is still a sense of self-managed Socialism • Technologies, equipment, etc., are aging • The system will be made more economical • Pollution is becoming more noticeable

2.4 Finances and Accounting

2.4.1 Serbian Accounting Standards and the Introduction of IAS

As a result of the implementation of the Accounting and Auditing Law in 2002, Serbian accounting standards have begun adopting International Financial Reporting Standards (hereafter, IFRS) and International Accounting Standards (hereafter, IAS). The 2002 law applies to all corporations, companies, banks, financial institutions, insurance companies, brokerage houses, etc., regardless of their size. In addition, individuals who undertake economic activities for the purpose of making a profit and who must file income tax returns are also subject to this law (Appendix I-1).

The 2006 Accounting and Auditing Law picks up where the old 2002 law left off. The new law stipulates that corporations and individual business owners to whom Articles 15 and 24 apply should record their transactions using accounting forms (designated by the Ministry of Finance) that are completely compatible with IAS and IFRS. As a result, corporations and individual business owners are required to do their accounting on unified forms designated by the Ministry of Finance or the National Bank of Serbia (in the case of financial institutions) in an effort to fully adopt international accounting standards (IAS, IFRS).

In addition, to enhance the implementation of international accounting standards, the Chamber of Certified Auditors (hereafter, "Chamber") has been recently established. The Chamber is a public organization under the jurisdiction of the Minister of Finance that has been given important duties related to the monitoring and dissemination of international accounting standards through observations of accounting practices and by improving the quality of auditors through education, training, and the issuing of licenses.

2.4.2 Overview of Accounting Standards

With the implementation of the Accounting and Auditing Law in 2006, Serbian accounting standards are being given clearer guidelines for creating accounting statements that are in accordance with IFRS and IAS. The following is an overview of these standards.

(1) Scope of Application of the 2006 Law

All corporations and sole proprietors are responsible for creating and reporting financial statements based on international accounting standards. However, it would be more desirable if small companies and sole proprietors could do this on a voluntary, rather than mandatory, basis (Article 2).

(2) Auditing

Article 37 stipulates that all medium- and large-scale companies which are subject to the 2006 Accounting and Auditing Law must undergo an audit in accordance with International Audit Standards by an auditor having the same type of license as under the old law. In addition, companies that are required to file a combined statement, and companies that issue stock, are also required to undergo the same type of audit. Article 38 states that an auditor can express any of three opinions: Positive, Negative, and Withheld. In the case of small companies and sole proprietors, financial statements can be checked by the tax office (Article 37).

(3) Registration and Keeping of Financial Reports

Medium- and large-scale companies must register a financial report with the National Bank of Serbia once a year. (In Article 31 of the old law, the registrar is referred to by the ambiguous term of "the authority"). The accounting year in Serbia begins on January 1 and ends on December 31 of each calendar year. Annual reports must be submitted no later than February 28 of the following year, the Auditor's Opinion must be submitted by September 30, and combined financial reports must be submitted no later than April 30 (Article 31).

Financial reports are handled as public information that can be viewed at any time during that 20 years that it is stored by the National Bank of Serbia (Article 33).

2.4.3 Special Features of the Serbian Accounting Standards

Accounting standards in effect in Serbia include the 2006 Accounting and Auditing Law which already includes provision for the application of international IAS and IFRS accounting standards. There are no discrepancies between Serbian accounting and auditing standards and international standards. However, in actual practice, the implementation of the 2006 law is in accordance with the rules and bylaws of the Ministry of Finance (Article 15 designates the Account Framework and official financial statement forms).

Incidentally, the biggest difference between accounting and auditing under the old socialist system, and under the new laws implemented since 2002, appears to be that in the old system, fixed assets were appraised only by book price and there was no use of the current (market) price appraisal system (although fixed assets were reappraised in times of severe inflation). Under the socialist economy, price controls and government-mandated prices were the norm, but these concepts are almost non-existent in a market economy, so these differences might have arisen because there was no concept of current market price of fixed assets in the socialist economy.

In addition, regarding the use of accounting standards, the National Bank of Serbia, which receives financial statements and is responsible for their management, conducts the final monitoring and evaluation. However, this central bank manages all the financial statements of all corporate and single proprietor industries, not just financial institutions.

2.4.4 Accounting Standards and Issues with Financial Affairs

As stated earlier, Serbian accounting standards are mandated by the 2006 Accounting Law to employ IFRS. Where there are still a few minor problems remaining, for all intents and purposes the legal system has reached a level that is compatible with international standards. Thus, both the system and legal framework of Serbian accounting standards conform to IFRS and IAS, and there are no major discrepancies between Serbian and international accounting standards. However, in actual practice it is possible that international standards are not being implemented exactly as prescribed by the 2006 Accounting Law.

In the case of financial statements of mining companies, they are not publicly disclosed because the mining industry is still being privatized. The Grot Mine, for example, only discloses its balance sheet and profit-and-loss statements, and does not compile other financial statements at the present time. At the Rudnik Mine, which has been privatized with Serbian capital, international accounting standards (current Serbian standards) have only recently been introduced, and financial statements are only now starting to be created.

2.5 Serbian Infrastructure

Serbian infrastructure is comparatively well-developed, and it is attractive to potential investors in mining. The following is a basic description of the country’s roads, railways, river transportation, electricity and electronic communications.

2.5.1 Roads

Serbian roads are categorized into primary roads, regional roads and local roads according to the Road Law. In 2002, the total length of Serbian roads was 40,845km. Detailed data are shown in Table 2.4.

Fig. 2.5 shows mainly the primary roads of the Serbian road network. This map does not include all regional and local roads.

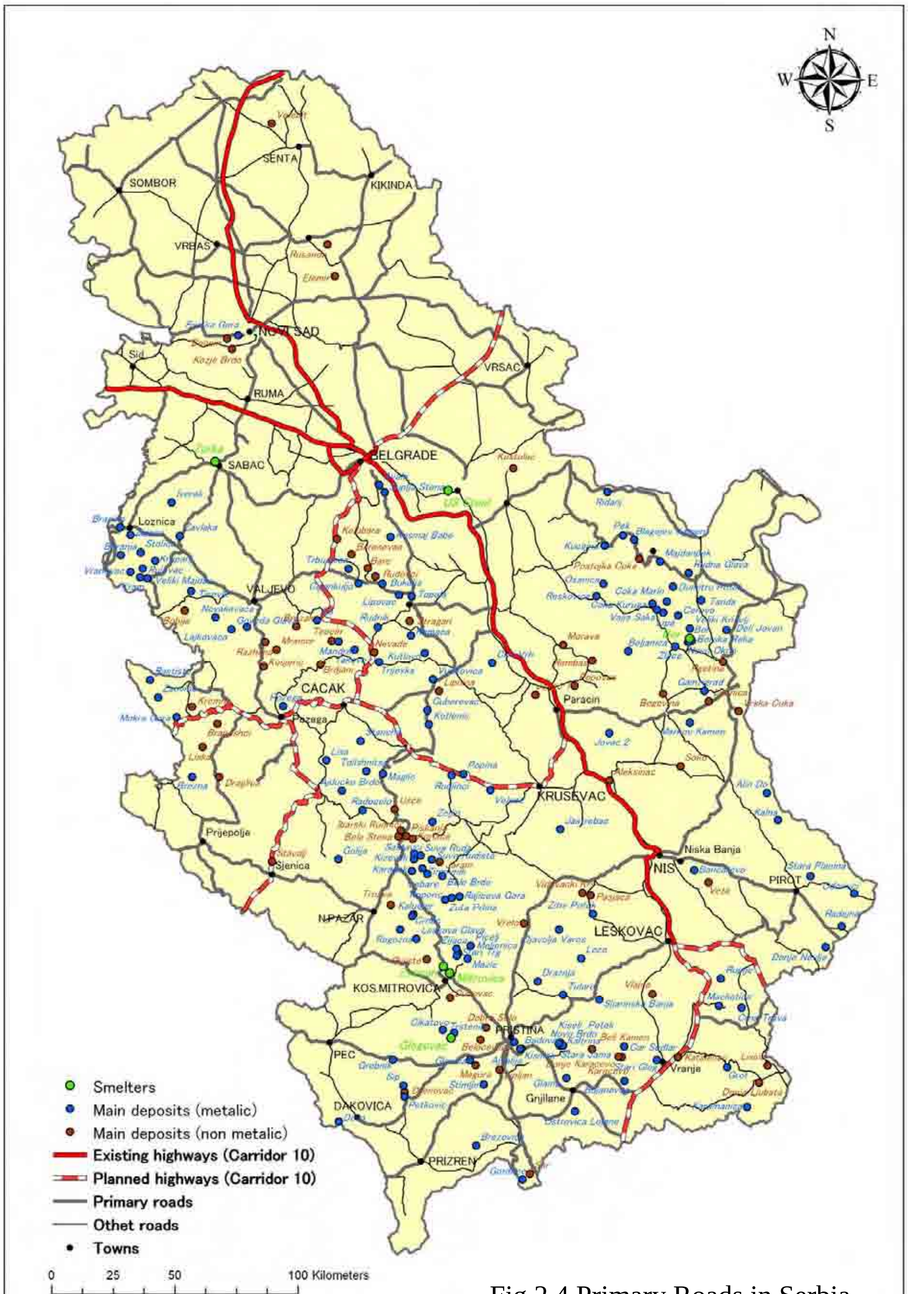


Fig.2.4 Primary Roads in Serbia

Approximately 40% of the length of the primary road network includes major thoroughfares connecting Europe with the Middle East of 2,150km total length. In the 3rd Pan European Transport Conference held in Helsinki, Finland in 1997, Corridor 10 was included in the European road network. The length of the Corridor 10 network in Serbia is 800km.

2.5.2 Railways

Basic activities of the Serbian railway system include the carriage of passengers and goods, hauling trains and cargo, maintenance of traction units, trains and rolling stock, track maintenance and inspection, and inspection of permanent way and station structures, among others. The following is a list of some basic facts about the Serbian railway network.

Line length: 3,808.7km

Electric line length: 1,196.051km

Main route length: 1,767.5km

Private sidings length: 772.6km

Tractive stock: 417

Passenger rolling stock: 797

Number of train cars: 4800

Annual carriage amount: 9.325 million tons (as of 2002)

Number of employees: 22,271

A platform in Belgrade Station.

Spur lines for cargos in Belgrade

Using loans from EBRD and the European Investment Bank, Serbian Railways will upgrade and modernize freight rolling stock, particularly in the international Corridor 10. This modernization will be able to increase the capacity for goods transport and have a positive effect on overall economic growth in Serbia.

Railways are also widely used by the Serbian mining industry to, for example, transport concentrates from the Majdanpeck Mine to the smelting plant at RTB Bor, and to transport coal produced at the Kolubara Mine to the generation plant. Fig.2.5 shows the Serbian railway network.

Fig.2.5 Railway Network in Serbia

2.5.3 Waterway Transport

The Danube River is the backbone of the Serbian inland waterway system and is part of the Rhine-Main-Danube system of the Trans-European inland waterway, which is the main inland waterway system in Europe.

The Danube River, as a major river, is distinguished from all other systems by some unique features. The Danube is not particularly noted for its natural properties, such as total length of some 2,680km or catchment area of 817,000km^2, but rather for its strategic and economic position in Europe. This is the only river in the world which is fully navigable through ten countries.

According to the available data, the currently used transport capacity of the entire Danube River is only 10%, and even less than that in Serbia, especially after the NATO bombing and destruction of bridges in Novi Sad in 1999. At that time, the international transport on the Danube was virtually stopped, and the internal river transport was carried out under restricted and dangerous conditions.

In the mining industry, products of US Steel are transported by inland waterways to foreign countries.

2.5.4 Electricity

(1) Electric Conditions in Serbia

- Administration of Electric Power: Department of Electric Power in MEM, which consists of Analysis Division (5 staff) and Inspection Division (7 staff).
- Ratio of Generation: 2/3 by lignite-fired thermal power and 1/3 by hydro power.
- Total generation: 35～38GWh.
- Supply/Demand Balance: shortage in winter (October to March), surplus in summer (April to September). Annual supply is balanced with demand.
- Electricity price: Price for family-use is different from industrial use. The price system is complicated, but the average price is 4.72 euro cents/kwh.
  - New generation plant: There is a plan to construct a new generation plant (two 700Mw) in 2012. Construction budget is 1,000euros/kwh.

(2) EPS (Serbian Public Electric Power Enterprise)

The EPS ("Public Electric Power Enterprise"), which was established on July 1st 2005, is a 100% -owned enterprise of the Serbian government, which appoints all board members.

The basic task of EPS is to meet all the electric power requirements of the economy and people of Serbia. Supply and sales of electric power to almost 3.3 million people in Serbia are carried out in the scope of electric power distribution activities of EPS.

EPS is the largest enterprise in Serbia with a total of 35,000 employees. The most current figures (January 2007) show the total installed capacity of EPS's power plants to be 8,355MW. It consists of lignite-fired thermal power plants with a capacity of 5,171MW (62%), gas-fired and liquid fuel-fired combined heat and power plants with a capacity of 253MW (4%) and hydro power plants with a capacity of 2,831MW (34%).

EPS is the largest lignite producer in Serbia, with annual output of about 33.65 million tons (as of 2004). EPS has two main coal mines, Kolubara and Kostolac, which are somewhat close to thermal power plants. Kolubara produces 75% of all lignite and Kostolac produces the other 25%. Lignite produced at the Kolubara mine is transported 30km by train to the Nikola Tesla Power Plant, and lignite produced at Kostolac is consumed by the Kostolac Power Plant.

- In 2004, annual stripped waste was 67.73 million m^3 in Kolubara and 22.72 million m^3 in Kostolac.

2.5.5 Telecommunications

(1) Fixed Telephones

- “Telekom Srbija” is the only public telecom operator that has a license for the public landline telecommunication network and for providing public landline telecommunication service. Since 2003, “Telekom Srbijahas” has been owned by two shareholders: Public Company of PTT Traffic “Srbija” (80%) and OTE Greece (20%). In 2005, the number of landline telephone users reached 2.53 million, accounting for about 37% of all Serbian households.

(2) Mobile Telephone Service

Currently, about 90% of Serbia is covered by mobile telephone service. During 2006, RATEL (Republic Telecommunication Agency) issued three 10-year licenses for public mobile telecommunications networks and services, one each to Telekom Srbija, Telenor ASA and Mobilkom Austria AG. In recent years, the number of mobile phone users has increased dramatically, reaching 5.5 million in 2005.

(3) Internet Service

Internet users have increased rapidly, reaching 756,675 in 2005. However 93.6% of them use the old dial-up system, and there is still little use of other systems.

(4) Cable System

RATEL issued authorizations for distributing radio and television broadcasts via the cable network in December 2006. In 2005, there were 540,000 subscribers to the cable system.

Chapter 3 Current State of the Mining Industry

3.1 Privatization

Privatization of the mining sector has been steadily implemented by the Privatization Agency since the first auction for privatization was held at Rudnik Mine (Pb、Zn、Cu) in September, 2004. Due to the high prices of base metals, gold, and rare metals in 2006, privatization of mines has accelerated, and closed mines, such as Zajaca (Sb), Velijki Majdan (Zn) and Suva Ruda (Cu), have been privatized through auctions. RTB Bor also started a tender offer process for privatization in September 2006, and the government negotiated with the awarded company in April 2007, but the negotiation was unsuccessful. In September 2007, RTB Bor restarted a tender. Currently, Grot Mine (Zn) and Lece Mine (Zn, Au) are managed by an assignee due to their bankruptcy, and their auctions are scheduled for 2008. Sabac Smelter (Zn) started a tender process in February 2007, but this tender was not successful, so it started another tender process in July. Currently, the government is negotiating with the winning bidder. Generally speaking, the privatization of metal mines is behind schedule.

Table 3. 1 Mine Privatization

Target	metal	Current state
Zorka Smelter	Zn	Second tender was carried out in July 2007.
Grot Mine	Pb, Zn	Bankrupt, but operating. Auction is scheduled.
Lece Mine	Zn, Au	Bankrupt, and auction is scheduled.
Veliki Majdan	Pb, Zn	Privatized, preparing to reopen.
Suva Ruda	Zn	Bankrupt, and auction was finished. Under preparation to reopen.
Karamarica	Zn	Operated in the past, foreign company attaining exploration license.
Zajaca Mine	Sb, Zn	Closed, 3 mines privatized. Under preparation to reopen.
Rudnik Mine	Zn, Cu	Privatized in 2004
RTB Bor	Cu, Au	In progress of the second tender as of September 2007. Under negotiation with the awarded company.

Major issues with Serbian privatization are 1) lack of considering a system for supporting production at privatized mines, and 2) lack of evaluations of the mining ability of companies which intend to acquire mines.

3.2 Investment Climate and Investment Promotion

3.2.1 Investment Climate

Current metal prices are very high, creating a good opportunity to increase mine and smelter production to previous levels through foreign investment.

However, the lack of opportunities for investment while the mines were state-run has resulted in the following;

- Mineral exploration to delineate new reserves at mines was not possible for financial reasons.
- Needing to meet centrally planned production objectives, some operations did not attach to environmental and social obligations.

These factors, and also the age of some mines and smelters, appears to have lead to unfavorable economic results and bankruptcies, due to the age of the infrastructure and equipment. The legacy of environmental and social issues, uncertainty over ore reserves, and the resulting inability to make meaningful estimates of return on investment, together with the significant costs of upgrading equipment and processing plants, and the retraining of personnel in new techniques and modern processes suitable for the market economy, have all contributed to the unattractiveness of these operations to any investor. To create a privatization plan, an understanding of the current investment climate and conditions within the sector are needed. To improve the investment climate under the market economy, the following points are required;

- A commitment to implementing policy, legal, and fiscal reforms to reinforce macroeconomic stability and contribute to sustainable growth.
- A thorough understanding of the geological resources, in order to maximize the benefits derived from the country's mineral resources, and compilation of data for investors.
- Review, evaluation, and prioritization of geological resources and mineral prospects to determine those that favor growth.
- Policy, legal, regulatory, and sector fiscal regime need urgent reform. Currently this reform is in first process. Up to two years may be needed before these reforms are debated and put in place.

3.2.2 Analysis of Investment Climate

Investors are confused by the current legal and administrative structure in the mining sector. At the present time, the legal framework in the sector is governed by the Mining Law of 1995 with amendments made in 2006, and the Law on Geological Exploration dating from 1995. Regulatory control is a combined responsibility of the Ministry of Energy and Mines, the Ministry of Agriculture (and water), and the Ministry of Environment.

In Serbia, minerals belong to the state. Current law requires that a Serbian legal entity (company) applies for exploration and exploitation licenses through the Ministry of Energy and Mines. The implication here is that foreign investors need to establish a Serbian registered business (office or company). However, this is not always good for investment promotion. Serbia has no mining regulations to support the 1995 legal framework for mining sector development. These are the most serious issues, confronting investors with a lack of clarity and transparency, as well as the burden of administration and inefficiency. These are all causes for concern at the risks involved in investing in Serbia.

The main tasks faced by such investors can be summarized and categorized as follows:

(1) Political and Economic Stability

For investors, political and economic stability is important. Mining requires significant initial investment of capital, and returns are earned over a long term. This requires that investors find a regulatory regime that will remain stable throughout a project's life.

(2) Legal

The confidence given by clarity of the law may be further improved by ensuring that the implementation of the law is accompanied by transparency in all legal and regulatory transactions between the investor and the government. The law should be there to encourage the investor, and not to be used by government to impede the investment process.

(3) Concessions and Permits

General international practice allows investing companies the right to explore for and mine all minerals found on a licensed property. The administration of all permits and concessions is today, normally undertaken by a cadastral office and is based on an internationally agreed system of geographical coordinates. Serbia needs to establish an office or organization to oversee this.

Once a permit is granted, the investing company must be assured of the security of their tenure. In this respect, the new law should allow for permit holders to move from exploration to mine development, and then to production, based on principles enshrined in law.

Applications for exploration rights should be handled on a first-come, first-served basis. There should be no barrier to the transfer of rights, so long as such transfers are conducted in accordance with the governing laws. For an investor to move from exploration to production, they may need to introduce new partners, or even owners, and the rights of the original investors should be transferable without barriers to new investors or lenders, so that projects may proceed to completion.

(4) Geological Information

Serbia needs to provide better geological information to investors. Good practice today is based on the provision of detailed 1:25,000 scale geological survey maps of a jurisdiction. 1:100,000 and 1:250,000 scale regional maps, and 1:1,000,000 scale national maps are also provided. One Ministry should take sole responsibility for the planning, mapping, and distribution of all geo-science data.

Another geological issue is the need for investors to obtain approval for technical decisions on exploration techniques, the drilling patterns and disposition of drill holes on a concession, and the drilling data to be processed and reported. It is vital to remove these hurdles by giving investors the freedom to drill properties based on their own initial assumptions concerning the appropriate level of investigation related to the potential and subsequent infill drilling based on initial results, to reinforce the data.

3.2.3 Investment Promotion

Investment promotion is led by the SIEPA, with steady improvements the investment climate. However, it should be noted that social tax and meal expenditures borne by the company are regulated by labor laws, and are a significant expense for privatized companies. Debt and investment in reconstruction of national companies is an requirement for investors. Also, it needs time to recover production by the private sector. Therefore, there might be a negative impact on investment promotion unless some exoneration is allowed while improvements are made to management and the laws and regulations to meet the market economy.

For that purpose, it is necessary to identify unfavorable issues for investment promotion and address them. In particular, national enterprises should not investment in staff and materials, as competitiveness in the mining sector is comparatively low. It would be more effective to support privatized mines in decreasing expenditures, which could be linked with investment promotion. It would be difficult to achieve sustainable development without systematic improvements such as revising mining laws and changing the organization of the sector, even if the government appeals the use of Serbian resources and the reconstruction of privatized mines through international seminars. Therefore, it is necessary to study systematically which governmental organization, the SIEPA or a newly established tentative investment committee, should be in charge of improvements to the investment climate. The SIEPA (or the committee) needs to identify the tasks for investment promotion after privatization

3.2.4 Investment from Japan

Only one company invested in the Serbia is Japan Tobacco International (JTI). The JTI opened a local office in 2001 and investigated the investment climate including marketing for neighboring countries for 5 years. Based on the investigation result, the JTB bought and upgraded a former national cigarette factory in May 2006, and also constructed a new factory with Japanese yen 17bln, and started production in March 2007. The JTB's successful investment points in Serbia are as follows;

- The investment climate in Serbia has become better year by year.
- Serbian people are high in quality as human resource, so production activity is possible according to management.
- After risk analysis, strategy was made based on 5-year investigation of the investment climate.
- Marketing targets are not only Serbia, but also neighboring countries.

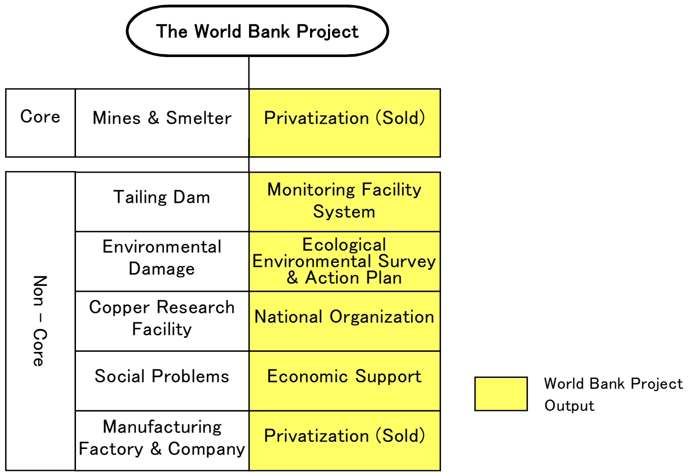
A new cigarette factory was built to establish a full-scale production system.

3.3 World Bank and Internationally Supported Projects

3.3.1 World Bank Projects

The World Bank is supporting financial analysis of the reconstruction plans for RTB Bor and relevant areas, finance for environmental protection, and measures for displaced workers.

Fig.3.1 The World Bank



This plan targets a significant reduction in production due to superannuated facilities and machines, insufficient management and production systems, and lost markets, accumulated deficits (US$ 500 million, as of 2004), contaminated environments, and socio-economic reconstruction of the Bor area.

3.3.2 International Support

International support for the mining sector has been implemented mainly through the World Bank. The World Bank addresses the privatization of RTB Bor, including investigation of and solutions for environmental and social issues. It also addresses the revision of mining laws, and formulation of mineral laws.

3.3.3 EU Fund

The EU Fund is called as IPA (Investment for Pre-accession Assistance), and Serbia has received it to prepare joining the EU since 2001.The EU government has received annually 1.8 million Euros every year from the EU. It is gratis in aid. Annual budget for projects is 5 to 20 million Euros per project, and more than 10 projects have been selected by the Ministry of Finance. Outline of project concept is submitted by each ministry, and is reviewed and investigated by the Ministry of Finance and EU.

3.4 Mining Policy

A draft for the framework of a Mineral Policy was created by a Canadian mining consultant (John Gamman Associates, Inc.) with World Bank support in May 2007.

Strategic points in the framework include the following:

- Creating a competitive business environment and attracting private sector participation.
- Fostering world-class environmental stewardship and oversight.

Ensuring mutual benefits between mining companies, local communities and residents.

3.5 Mining Administration

3.5.1 Ministry of Energy and Mines (MEM) and Ministry of Environmental Protection (MEP)

(1) MEM

The MEM is responsible for the steady fulfillment of mining regulations, and coordinates all mining activities in the country, as shown in the new mining law enacted in 1997. The principal purposes of the MEM are; 1) to take charge of the production of mining, energy, oil and natural gas; 2) to implement detailed geological exploration (excluding ground water), and create annual and medium-term plans; 3) to take charge of the application of laws, such as mining laws, geological exploration laws, and energy laws. The total staff of the MEM is about 70 and its organization is shown at the right.

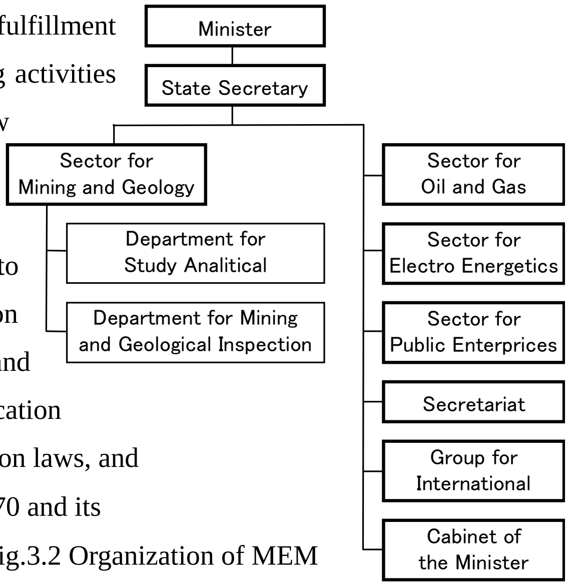


Fig.3.2 Organization of MEM

(2) MEP

Main services of the MEP are as follows;

- Establishment of systems concerning maintenance of natural resources and their continued use, planning and research on programs concerning sustainable use of natural resources
- Establishment of plans for research and basic geological investigation of groundwater resources, and establishment of standards for geologic map making
- Establishment of a system for environmental preservation and improvement
- Warning of environmental pollution accidents and environmental crisis management
- Ionizing and non-ionizing radiation protection
- Chemical substance management
- Waste management
- Control of fishing and hunting
- Management of the protection and conservation of nature in wildlife parks
- Integration with EC and intraregional cooperation with EU
- Environmental inspection and services for pollution control

(3) Geological Institute

The Geological Institute is a governmental organization which merged with the “Geozavod” on September 1, 2006, as an independent institute that doesn't belong to any ministry.

The organization of the institute consists of six basic departments.

- ➢ Department of Geology
- ➢ Department of Mineral Exploration (metallic and non-metallic)
- ➢ Department of Hydrogeology and Engineering Geology
- ➢ Laboratory Department
- ➢ Computer Data Processing

- Drilling Department

There is a total of about 200 staff, including 120 geologists, geophysicists, and chemists. In 2006, the budget was 4 million euros. 86% of the work was done by domestic and overseas companies and public organizations, and the remaining 14% was geological and exploration work by the MEP.

(4) Mining Institute

The Mining Institute in Belgrade was established in 1960 by the government and a group of mining companies with the purpose to create a leading organization designed to introduce the newest methods and technologies to the Yugoslav mining industry, by means of extensive research and transfer of knowledge and experience, and with a view to provide optimum safety at work and environmental protection.

The activities and development of the Institute have been conducted in following two principal trends;

(1) Research, fundamental and applied investigations in the field of technical, technological and natural sciences being directly or indirectly related to the mining industry and mining technologies.

(2) Design and process engineering enable the Institute to use and employ recent technological solutions and to be permanently involved in resolving different kinds of problems in the field of the mining industry in developing new mines, or rehabilitating/updating existing mines.

The Institute operates as an independent enterprise, and was recognized as an institution for research and investigation, based on the resolution issued by the ministry of Science and Technology. It is provided with necessary specialists and staff, equipment and facilities.

(5) Reserves Verification Commission

The Reserves Verification Commission is a national organization whose purpose is to verify mineral resource reserve reports submitted to the MEM by mining and exploration companies, and to register the reserves with the government. Membership is determined by the Ministry of Energy and Mines according to geological exploration laws.

- Commission meetings are held almost each month usually at least 10 commissions per year, only Vojvodina commissions are held every 3-4 months.
- At each meeting, six or eight petroleum, coal, metal and nonmetal deposits are discussed. Common deposit types are lead, zinc, marble, limestone, and building stone.

3.6 The Mining Law and Procedures for Mining Licenses

3.6.1 The Mining Law and Issues

Serbia has mining laws and geological exploration laws. The former were revised partially (new mining laws) in April 2006 with World Bank support. There is no major difference between these laws, except for the establishment of a Mining Agency and provision of royalties. There is no procedure to transfer mining rights to third parties, nor a procedure to transfer rights through privatization.The geological exploration laws define the conditions and methods for geological exploration, payments for information provided to the MEM (5% of exploration costs), and reporting on exploration results. Some national management of exploration still remains from the socialism era. Both laws have barriers to free exploration and mining activities in a market economy, and need basic amendments.

3.6.2 Acquisition of Mining Rights

The maximum area for exploration is $50km^2$ and exploration is permitted for one year. After exploration results are submitted, and a new application excluding unpromising areas is approved, another year is permitted for exploration. Exploration rights are thus basically annual.Moreover, there are many issues, such as lack of disclosure of concession maps, overly complicated procedures, and unclear exploration periods, which are barriers to promoting exploration activities. It is thus necessary to establish an office or company to issue exploration licenses.

To obtain exploitation licenses, it is necessary to calculate Category A, B or C1 reserves after detailed exploration and to acquire a certification of reserves of mineral resources from the Reserves Verification Commission. It is also necessary to get approval for the mining exploitation project and to include measures to protect agriculture, forests, water, and the environment from the relevant departments of the Ministry of Agriculture, Forestry, and Water Management and the MEP.

3.6.3 Procedures and Issues for Geological Exploration Rights

(1) Procedure for Acquiring Geological Exploration Rights

1) Procedure for Acquiring Rights

1. Inspection of the cadastral conditions of the proposed exploration area
2. Preparation of a geological exploration plan
3. Obtaining permission for geological exploration from related ministries and organizations
4. Technical review of the project by another licensed organization
5. Submission of a geological exploration plan
6. Approval of geological exploration rights

2) Issues

- Before applying to the MEM for a geological exploration license, a plan for the geological exploration project should be prepared in detail. The applicant should obtain the permission of the MEP, the Institute for Protection of Cultural Monuments, and municipal authorities. The applicant can expect these procedures to take one year.
- In reality, it takes the MEM three or four months to investigate a project.
- After obtaining geological exploration rights, a mining rights holder should submit three

quarterly-reports and one annual report on the geological exploration results at each licensed area for each year. The preparation of quarterly-reports imposes a burden on the geologists of the project.

- Because geological exploration rights are non-transferable, exploration in Serbia is highly risky for European and American subsidiary companies.

(2) Verification of Mineral Reserves and Acquisition of Certification of Mineral Resources

1. Notice of commencement on geological exploration work
2. Execution of detailed geological exploration
3. Preparation of reports on the geological exploration results
4. Technical review of the report on exploration results
5. Preparation of reserve studies of mineral resources
6. Submission of reports on reserve studies of mineral resources
7. Review of the reserve study
8. Oral explanation of the reserve study at the Commission for Verification of Reserves
9. Issuance of certification on reserves of mineral resources

(3) Acquisition of Mineral Exploitation Licenses

1. Preparation of plans for mining projects
2. Technical review of the mining exploitation project
3. Obtaining approval from the relevant ministries
4. Application for mineral exploitation licenses
5. Obtaining an exploitation license

(4) Obligations and Implementation of Mineral Resource Exploitation

1. Technical supervision, preparation, and maintenance of geological documents
2. Creation of an ore reserve table
3. Implementation of geological exploration and exploitation
4. Submission of a reserve study to the Reserves Verification Commission
5. Technical reviews of the reserve study
6. Oral explanation of the reserve study to the Reserves Verification Commission
7. Issuance of certification of reserves

(5) Issues

- Before obtaining a mineral exploitation license, the license holder shall acquire a certification of reserves of mineral resources.
- The acquisition of a certification of reserves involves a lot of procedures, such as obtaining the MEM’s approval and execution of a detailed geological project, reviewing a report of exploration results by another licensed organization, and submitting geological and exploration documents to the Reserves Verification Commission for examination. Thus,

exploration activity and evaluation of mineral reserves are under government control.

- Every 5 years, the license holder will prepare the above-mentioned documents, and submit them to the MEM. The holder should be undertaking exploration activity, and reporting it to the government.

The above matter imposes an undue burden on the license holder, so a simpler procedure is needed.

3.6.4 Mining Law

There are not large differences between the old Mining Law and current Mining Law revised in May 2006, except regulation of royalty rates and establishment of the Mining Agency. A German consultant (Bergassesor Dipl-Ing) made a draft for the completely new Mining Law under supports of the World Bank. This draft of the Mining Law will be provided to people related the mining industry, revised based on their comments, and presented to the parliament after authorization of the MEM and government to be acknowledged. It may be enacted March to May 2008, if all goes smoothly.

3.6.5 Compilation of Digital Spatial Datasets and Information Disclosure

In 2001, the MEM created a text-based mineral resource database and GIS spatial datasets through a project supported by the Bureau of Geological and Mining Research, France (BRGM). In 2002 a capacity building project was created by the United Nations Development Programme (UNDP) to implement GIS software and training. Then, the MEM constructed a database for information related to mining licensed areas, and has now started to manage GIS spatial datasets such as mining license areas, mineral deposits and occurrences, abandoned mines and their reasons for abandonment, tailing dam sites and infrastructural datasets through voluntary projects.

The present MEM website provides information, such as government announcements, mining policies, mining laws and related regulations, taxes, organizations, a list of active state/private companies. The content is revised and updated frequently and seems to show a commitment to utilize the website effectively. On the other hand, some important information, such as mining laws and related regulations are simply shown on the page without any instructions for clients. Thus, it can be said that there is a lack of user's perspective. Furthermore, there are no spatial datasets, for instance geology or distribution of ore deposits. Although translation to English is said to be in progress, and the frame windows for future English content are already shown, progress seems to have stalled. The MEM-DGM developed a pilot system of web-GIS for mining licensed areas and other spatial information. But due to a governmental budget shortage, there was no web server installed, a lack of spatial datasets, need for coordinate conversion to the WGS84 world standard coordinate system, and need for further development of additional web site functions, that information has still not been made available on the Internet.

The MEP has fundamental databases for environmental monitoring and underground water development. On the other hand, the MEP started a three–year project called "The Geological Information System of Serbia", or GEOLISS from 2004, to design a database structure for future geological information, with financing of Euro 125,000, and faculty from the Mining and Geology department at the University of Belgrade. Furthermore, the MEP started to forecast geology and mineral resource potential areas, and to construct a database of mineral deposits and occurrences in a five-year project (from 2006 to 2010) in cooperation with the faculty of the Mining and Geology department at the University of Belgrade and the Geological Institute. Based on this, the MEP plans to establish mid and long-term geological exploration strategies.

The Geological Institute has produced geological maps, hydro-geological maps, and other maps with the scales from 1:50,000 to 1:2,000,000 in Serbian territory. Especially for 1:50,000 scale geological maps, the Geological Institute started to create GIS datasets based on the GEOLISS database structure. However, the process of converting geological information to GIS datasets is moving slowly at the present time, because of a lack of budget for field surveys, and there is some dissatisfaction with the current situation.

The databases for "mineral deposits" and "mining districts" of Serbia which were constructed by the Bureau of Geological and Mining Research, France (hereinafter, BRGM) and the DMG in the MEM in 200~~2~~1 were provided to the JICA Study Team from the BRGM. The content is analyzed to pick up issues and things which shall be improved. The website for the DMG was constructed, making a flow-chart of mining license application procedure, introducing the international aid organizations' activities and designing a download function for reports by this research in English and Serbian language. A web-GIS database which is able to provide spatial information such as a current mining license and mineral resource information, and geological maps and satellite imagery, has developed, confiding the local consultant. The site is expected to be opened until the end of January 2008. On the other hand, the results derived from the GEOLISS and the related projects such as "a compilation of mineral resource information of mineral deposits and occurrences" and "Metallogenetic and Minerallogenetic Geological Economic Estimation", will be a backbone for mineral resource information archive in Serbia, and their proceedings are evaluated and considered on future usage approaches and are incorporated into the MP.

3.7 Mining Activities

3.7.1 Foreign Investor Activities

So far, 104 exploration licenses have been issued. About 90% of these are non-metallic, and 10% are metallic. Gold exploration is being carried out by Canadian companies Ivanhoe and Dundee. Rio Tinto is exploring for borate. The targets of Phelps Dodge are gold and copper. Non-metallic targets, which include groundwater, limestone, and quarrying, can be exploited on a small scale, so they are mined actively and mainly by Serbian companies. However, metallic exploration demands greater investments of capital and time, requiring foreign investors. But currently there are not many foreign investors in Serbia.

3.7.2 Current Status of Mining Concessions

A list of mining concessions has not been made available. However, companies implementing detailed geological investigations in 2006, based on MEM data.

- A total of 104 companies conducted detailed geological investigations. These investigations were: 46 water (mineral water), 24 limestone, 14 quarry, 8 brick, 5 gold (silver and copper), 2 lead & zinc, one iron, one boron, 2 oil, one clay.
- The 5 companies that investigated gold were: Balkan Mineral Exploration, CMR Balkan, Dundee Precious Metals, South European Exploration, and South Danube Metals.
- The Grot and Suva Ruda mines were the two companies that investigated lead & zinc.
- Metalfeer investigated iron.

3.7.3 Metal Deposit Exploration Activity

Exploration activity is mainly conducted by Canadain, USA, and UK exploration and mining companies that are prospecting epithermal gold deposits.

- Hereward Venture (Target: Gold)
- Dundee Precious Metals (Target: epithermal gold), a Canadian junior company
- Dinara Nickel (Target: Nickel), a subsidiary of London-based Europe Nickel.
- South Danube Metals (Target: Gold and Copper), a subsidiary of Canadian junior company, Euromax Resources
- Rio Save Exploration (Target: Boron)
- South European Exploration (Target: Epithermal Gold), a subsidiary of Canadian junior company, Reservoir Capital.

3.7.4 Mining Activity in Regions and Provinces (the Vojvodina Autonomous Region)

The Vojvodina Autonomous Region is potential area for oil and coal, and also it has their production activities. In addition, there are mining activities of limestone and quarries, so the regional government has the Mineral Resources Department which employs experts including geological engineer and others as its staffs. Mining activities are managed under the current Mining Law and environmental related laws in close relationship between the central and regional governments.

3.7.5 Medium-Term Mine Plans

There are neither long-term plans nor reconstruction plans for medium/small mines, with the exception of RTB Bor. RTB Bor created a 20-year long-term plan in 1999, and a 6-year medium-term plan for the Veliki Krivelj Mine in 1999. Majdanpek created a 14-year long-term plan in 1999, and revised it in 2004 and again in 2006. In these plans, annual investment, profitability, and improvements to production are discussed, based on a production schedule and financial analysis. However, the plans to reconstruct RTB Bor were unrealistic, resulting in deviation between the plan and the implementation due to shortage of funds. Medium/small mines have concentrated on immediate management, because their production dropped due to post-1990s internal conflicts. They have not been able to afford to prepare long/medium plans. Also, mine management based on a self-managed model has not harmonized with the market economy, and there is lack of staff to create plans.

3.7.6 Mining Technology

Mines and institutes have not invested in developing mining technology due to domestic confusion and the battered post-1990s economy. Serbia has full basic technologies, including exploration, mining, ore-processing, and smelting. However, the specific technologies that form the mining industry have not advanced efficiently due to socialist-era mine management. For example, the transportation systems from mines to ore-processing facilities are inefficient because the corresponding equipment has different capacities. It is indispensable for each mine and smelter after privatization to study an effective production system as well as renovation of facilities and machines.

3.8 Geology and Mineral Potential in Serbia

3.8.1 Geology of Serbia and Southeastern Europe

The geology of Southeastern Europe is composed of the Variscan shield in Meso-Europe in the European tectonic province, the Alpine orogenic belt in Neo-Europe, and sedimentary basins. The major physical divisions of Serbia include the mountainous Carpathians, Balkanides, Dinarides, and Hellenides of the Alpine orogenic belt, and the Pannonian Basin.

The Carpathians and Balkanides cover eastern Serbia. They are mainly composed of Late Paleozoic and Mesozoic sedimentary rocks underlain by Precambrian – Early Paleozoic metamorphic and granitic rocks. Intermediate and acidic volcanic activities are known to have occurred in this area during the Late Cretaceous and Paleogene periods. The Dinarides and Hellenides are widely distributed in western and southern Serbia. They are composed of Precambrian metamorphic rocks, Paleozoic sedimentary rocks, and Mesozoic sedimentary and volcanic rocks. These orogenic belts are characterized by ophiolite formations composed of volcanics and ultra-basic rocks of the Jurassic to Early-Cretaceous periods. The Pannonian Basin covers northern Serbia, Hungary, and Romania, and it consists of Late Neogene sediments.

3.8.2 Metallogenic Province of Serbia

Serbia has high potential for metal resources in Europe, and various types of deposits have formed through various geological ages. The metallogenic provinces of Serbia from east to west are divided into the Dacian, Carpatho-Balkanian, Serbo-Macedonian and Dinaric provinces.

Table 3.2 Ore Deposits and Metallogenesis in Serbia

Geochronology	Age (Ma)	Major metals	Type	Magma complex	Tectonic environment
Neogene	30 - 5	Pb-Zn Sb Cu, Mo	Skarn Hydrothermal Porphyry	Granodiorite Volcanic - intrusive complex	Regional fracture zone
Cretaceous to Paleogene	100 - 50	Cu, Mo, Pb-Zn, Fe	Porphyry Vein, skarn	Volcanic - intrusive complex	Global rift
Jurassic	170 - 150	Cu Cr, Ni	Massive Magmatic	Ophiolite complex	Oceanic crust
Middle Jurassic	220 - 200	Zn, Cu Mn Pb, Zn, Cu	Massive Stratiform Hydrothermal	Basaltic magma	Graven
Carboniferous to Permian	350 - 250	W, Au U, Fe	Skarn Hydrothermal	Granitic complex	Orogeny?
Devonian	400	Fe, Mn	Volcano- sedimentary		Rifting?

Detailed information on each metallogenic province in Serbia is from Jankovic et al. (2003). The Carpatho-Balkanian metallogenic province is composed of the Ridanj-Krepoljin zone (Fe, Pb, Zn, Cu), Neresnica-Bbeljanica metallogenic zone (Fe, Mn, Au, W), Bor metallogenic zone (Cu, Mo, Au, Pb, Zn), Porec-Stara Planina metallogenic zone (Fe, Au, Cr), and Stara Planina district (U, Au). The Bor metallogenic zone, which is also called the Timok magmatic complex zone, is a typical mineralized zone in Serbia.

The Serbo-Macedonian metallogenic province consists of the Sumadija metallogenic zone (Pb, Zn, U, Ni), Kopaonik metallogenic zone (Pb, Zn, Ag), Lece-Halkidik zone (Pb, Zn, Au, Ag, Cu), Besna Kobila –Osogovo zone (Pb, Zn, Mo, U), Golija district (Pb, Zn), Boranja district (Sb, Pb, Zn, Cu), Lajkovaca district (Cu), Cer district (W, Sn), Fruska Gora district (Ni, Pb, Zn), Maljen district (Ni), and Drenica district (Ni). This metallogenic province contains the most important antimony, and lead and zinc mineralized zones in Serbia.

The Dinaric metallogenic province is composed of the Zlatibor (Ni, Cr), Srednje Polimlje (Cu), Orahovac (Cr) and Djakovica (Cr) districts.

3.8.3 Mineral Potential in Serbia

Since 2006, the Serbian government has implemented the "Strategy for Sustainable Development of Mineral Resources in Serbia" project with support from EBRD. The final report, will include information on future strategies for mineral resource development and the latest data on mineral reserves and resources. Draft data from the report are shown in Table 3.3. The data is based on results of survey and exploration works, but it does not include grass route prospecting projects.

Geological reserves and potential resources of copper ore in Serbia amount to 2,467 million tons and 528 million tons, respectively. Metallic copper in geological reserves and potential resources amounts to 9.4 million tons and 8.1 million tons, respectively. Almost all of this copper is in the Timok magmatic complex, which includes Bor, Veliki Krivelj, and Majdanpek. Copper deposits in the Timok magmatic complex are accompanied by 154 tons of gold as geological reserves. Geological reserves and potential resources of lead and zinc ore amount to 105 million tons and 46 million tons, respectively. Lead and zinc metals in minable reserves amount to 650,000 tons and 490,000 tons. Lead and zinc metals of potential resources amount to 2.05 million tons and 2.75 million tons. Geological reserves from Kosovo correspond to 88 million tons. In Serbia, almost all of the 2,940 tons of silver occurs in lead and zinc deposits.

Table 3.3 Ore Reserves and Potential in Serbia

(after MEM and MEP 2007)

Commodities	Geological reserves	Minable reserves (Balanced reserves)		Non-minable reserves (Non-balanced reserves)		Potential resources		Grade		Comment
		Ore	Metal	Ore	Metal	Ore	Metal			
	Mt	Mt	Mt	Mt	Mt	Mt	Mt			
Cu (whole Serbia)	2,467	1,090	4.2	1,377	5.2	528	8.1			
Cu (Timok magmatic complex)		1,088	4.145	1,367	5.195	470		0.39% Cu	0.14 g/t Au	(as of 31.12.2006)
Au (by-product)			Au 153 t		Au 1 t		Au 50t			
Ag (by-product)			Ag 1,120 t							
Cu (ophiolite melange)		1.89		9.78		58				(as of 31.12.1993)
Cu (Leckom volcanic complex)				150						(as of 31.12.1994)
Pb-Zn (whole Serbia)	105.03	16.27	Pb 0.65 Zn 0.49	2.69		46.17		4% Pb	3% Zn	(as of 31.12.2005)
Pb-Zn (Kosovo)	88.07	31.26	Pb 1.27 Zn 0.95			27		4.05% Pb	3.03% Zn	(as of 31.12.2005)
Ag (by-product, whole Serbia)			Ag 2,940 t							
Ag (by-product, Kosovo)			Ag 1,920 t							
Cd (by-product, whole Serbia)			Cd 110 t							
Fe (whole Serbia)	119.39	3.97	1.49	115.42	27	52.6				
Cr (whole Serbia)		0.089	0.014			0.1	0.02	20% Cr_2O_3		(as of 31.12.1993)
Ni-Co (whole Serbia)	38.65	19.92	Ni 1.49 Co 0.011	18.73	Ni 27					
Ni-Co (Starog)						8	Ni 0.064			
Ni-Co (Kopaonic)						30	Ni 0.345 Co 0.015			
Ni-Co (Sumadijski)						3	Ni 0.045			
Mo (whole Serbia)	1,115	1,115	0.035			1,645	0.249			
Mo (porphyry copper)		1,090	0.012			1,500	0.126	0.0011% Mo		(as of 31.12.2006)
Mo (Mackatica)		25.16	0.023			145	0.123	0.09% Mo		(as of 31.12.1993)
W (whole Serbia)	0.33			0.33	700 t		1,000 t	0.24% W ?		(as of 31.12.1993)
Sn (whole Serbia)						500 t				
Sb (whole Serbia)	4.198	0.978	0.015	3.22	As 0.012	3.1	0.03	1.53% Sb		(as of 31.12.1993)
Al (whole Serbia)	3.89	2.69	0.69	1.2		19.9	4.2	48% Al_2O_3		(as of 31.12.1998)
Al (Kosovo)		1.66	0.43							
U (whole Serbia)	3.654	2.154	727 t	1.5		7	1,000 t	337g/t	U_3O_8 ?	(as of 31.12.1993)

Table 3.4 Mineral Potential and Explored Areas

No	Zone	Commodity	Deposit Type	Main Deposit	Exploration Activity
1	Bor metallogenic zone	Cu	Porphyry	Veliki Krivelj, Majdanpek	Coka Kurga (DPM)
		Cu, Au	Porphyry		Brestovac-Durian Potok (SDM)
		Cu, Au	Volcanic Massive Sulfide	Bor, Borska Reka	Brestovac (SEE)
2	Ridanj-Krepoljin zone	Pb-Zn	Skarn, vein	Ridanj	Au: Rakita (SEE)
3	Besna Kobila Osogovo zone	Pb-Zn	Skarn	Blagodat	Karamanica (Bosilmetal)
		Mo	Porphyry	Mackatica	Surdulica (DPM)
4	Lece Halkidik zone	Cu, Au	Epithermal vein	Lece	Ivan Kula (DPM-Ivanhoe)
		Au, Pb-Zn	Epithermal vein		Lece (SEE)
5	Sumadia metallogenic zone	Pb-Zn	Skarn	Rudnik	(DPM)
6	Kopaonic metallogenic zone	Pb-Zn	Vein, stockwork	Kizevak, Stari Trg	Rudnitze North (SDM)
		Cu, Au	Porphyry		Rudnitze (SDM), Plavkovo (SEE)
7	Boranja-Lajkovaca zone	Sb	Hydrothermal	Zajaca	
		Au	Hydrothermal		Zajaca (SEE)
		Pb-Zn	Volcanic	Velijki Majdan	

DPM: Dundee Precious Metals
SEE: South European Exploration, a subsidiary of Reservoir Capital
SDM: South Danube Metals, a subsidiary of Euromax Resources

Among the above mineral commodities, copper, lead, zinc, gold and antimony are particularly important in Serbia. Western Junior companies have a great understanding of the high potential of mineral resources in Serbia, and they have implemented exploration activity including geophysical and geochemical surveys and drilling work around operating mines and old mining sectors. Mineral potential areas in Serbia are shown in Table 3.4 and Fig.3.3 including the above-mentioned exploration activity.

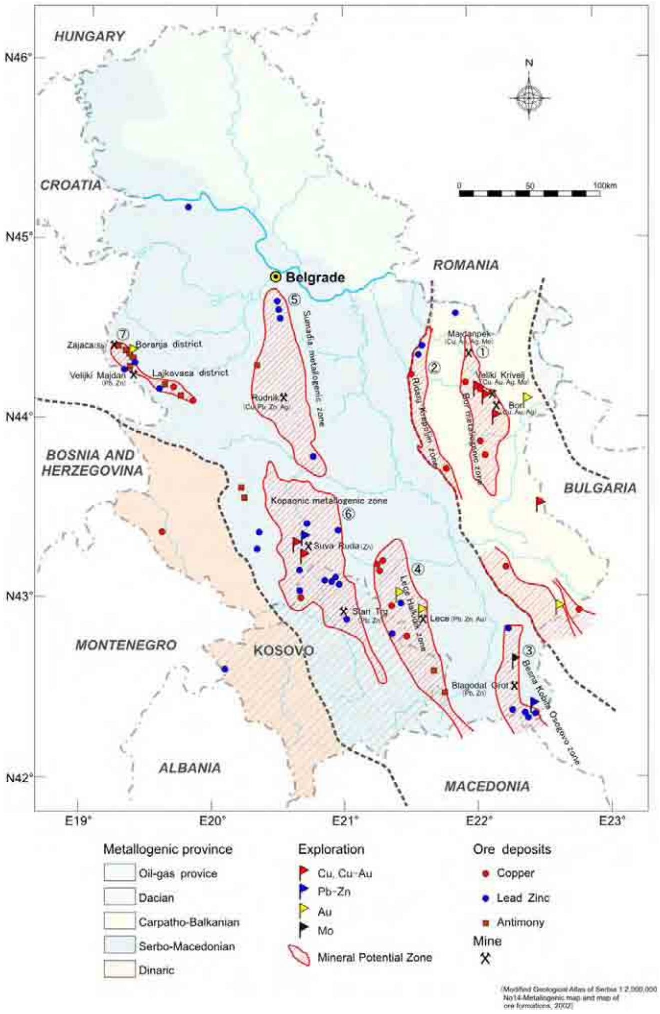


Fig.3.3 Mineral Potential and Explored Areas in Serbia

3.9 Current State and Tasks of Mining Activities

3.9.1 Geology of the Bor Metallogenic Zone

This zone is located in the Carpatho-Balkanian metallogenic province. The Timok magmatic complex of the Late Cretaceous period is widely distributed in this zone, and contains important Serbian copper deposits. The Timok magmatic complex covers an area of 80km from north to south and 20km from east to west. Ninety percent of the magmatic complex is composed of pyroclastic rocks, and two main volcanic events are recognized. In the Timok magmatic complex, porphyry copper deposits and massive replacement deposits occur along a mineralization zone covering an area of 50km from north to south and 5km from east to west. Mineralization is assumed to have occurred as volcanic dykes intruded along the rift. Ore deposits in the metallogenic zone are genetically related to faults oriented NNW-SSE, with post-mineralization faults trending E-W. The Bor segment of the major fault runs 30-40km toward the northwest. The Krivelj fault runs on the east side parallel to the Bor fault. The fault is a reverse fault, dipping 60° - 70° west. The

Majdanpek deposit of porphyry copper is situated along the northwest extension of these faults.

3.9.2 Ore Deposits

(1) Porphyry Copper Deposits

a) Veliki Krivelj

The deposit is located 7km north of Bor city. A porphyry copper deposit is situated in fracture-developed zones which trend NE-SW and NW-SE in andesite and quartz diorite porphyry. The deposit is distributed in an oval shape that has a NW-SE orientation. The scale of the deposit is 800m along the NW-SE axis, 400m along the NE-SW axis, with a vertical extension of 1,000m or more. Mineralization of 0.55% Cu until 492m below sea level has been confirmed by the deepest drill hole. The bottom of the orebody has not been confirmed.

Most of the copper grades 0.3-0.4%, with high-grade copper tending to occur in the central and peripheral parts. Hydrothermal alteration shows zoning of biotite, sericite, argillized, and silicified zones from the center to the periphery. Ore minerals are mainly chalcopyrite and pyrite.

b) Majdanpek

The ore deposit is located 60km north-northwest of Bor city. The deposit is situated in the northern end of the Timok magmatic complex. The deposit has high gold mineralization compared with other porphyry deposits in the complex.

The area is composed of metamorphic rocks-- mica schist, phyllite, gneiss and marble of the Paleozoic era-- and conglomerate, sandstone and limestone of the Jurassic era. These rocks are part of an intruded igneous complex that consists of andesite, tuff, dacite, diorite and quartz diorite. A porphyry copper deposit was formed in a fracture zone 300m to 600m wide, trending north-south, when andesite and quartz diorite intruded as stock in gneiss and schist.

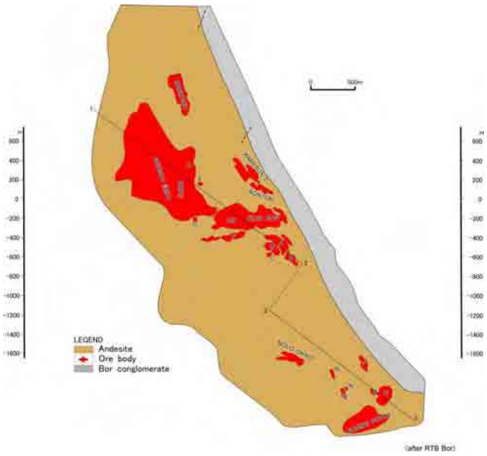
The deposit is divided into north and south pits. The south pit is oval shaped, running 2.5km north to south and 1.6km east to west. The top of the pit is 580m above sea level, and the bottom of the pit is 120m asl. The dimensions of the ore deposit are 800m north to south, 100-300m east to west, and 1,000m or more in vertical extension.

The north pit is also oval shaped, running 1.9km north to south and 1.1km east to west. The top of the pit is 670m above sea level, and the bottom of the pit is 360m asl. The dimensions of the ore deposit are 400m north to south, 60-70m east to west, and 1,000m or more in vertical extension. Drilling prospects have confirmed that mineralization continues at least 100m below sea level. Replacement polymetal deposits (Cu, Pb, Zn) of the Tenka I and Tenka II deposits and satellite deposits of the Dolovi I, Dolovi II, and S. Dusan deposits occur in the northwestern side of the north pit. Ore minerals are mainly composed of chalcopyrite with bornite, tetrahedrite and molybdenite.

(2) Massive Hydrothermal Deposit

a) Bor

Andesite and pyroclastic rocks of the Late Cretaceous to Tertiary eras cover the area around the deposit. Country rock in the deposit is porphyrytic andesite. The deposit occurs in an area 5km long by 1km wide. The Bor deposit is a volcanic massive copper sulfide deposit that occurs from the surface (about 400m asl) to 800m in depth, and changes into a porphyry copper deposit in the deeper part. By the Bor fault, the deposit is limited to the western side of the fault. Non-mineralized conglomerate is distributed on the eastern side of the fault, corresponding to the footwall side (Fig.3.4 and Fig.3.5).



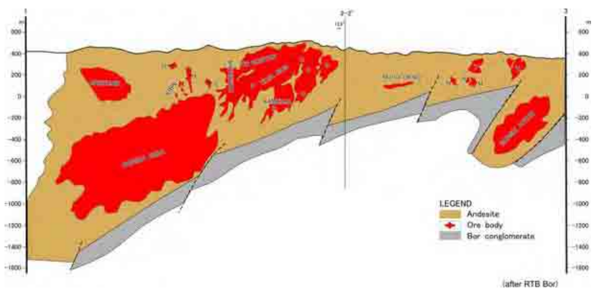


Fig.3.4 Geological Map of the Bor Deposits Fig.3.5Vertical Projection of the Bor Deposits

The deposit is divided into the northwestern, central, and southeastern bodies. The most important orebody was the central body, but it has already been mined out. The orebodies occur in andesite which has been subjected to intensely argillized alteration. Ore is commonly massive, and sections of ore are disseminated and stockwork. At one time there were 25 orebodies, but most of them have been mined. Currently orebodies occur in the Brezonik, Tilva Ros (lower part of the Bor open pit), and P2A areas. Ore minerals are dominantly composed of pyrite, with chalcopyrite, energite, bornite, chalcocite and covellite. The copper grade of the ore ranges from 1 to 2%.

3.9.3 Reserves

The Bor mine started operations in 1902; since then it has produced 200 million tons of copper ore with 1.5% Cu and 3.2g/t Au, and 3 million tons of copper metal. The Veliki Krivelj mine stared operation in 1982; since then, it has produced 150 million tons of copper ore with 0.3% Cu and 0.1g/t Au, and 450 thousand tons of copper metal. The Majdanpek mine started operation in 1961; since then, it has produced 359 million tons of copper ore with 0.44% Cu and 0.2g/t Au, 1.6 million tons of copper and 83 tons of gold. Table 3.5 summarizes the geological reserves[1] and exploitable reserves of each ore deposit collected from RTB Bor. The Veliki Krivelj deposit has 560 million tons of reserves, but reserves that can be exploited with the current pit design amount to 152 million tons. The Borska Reka deposit, which is the target for the next exploitation, has 556 million tons of reserves, but currently exploitable reserves amount to 142 million tons. Total ore reserves of RTB

[1] "Geological Reserves" in Serbian terminology corresponds to ore reserves.

Bor amount to 2.5 billion tons, but only about 397 million tons, or 15% of these, are exploitable reserves.

Table 3.5 List of Reserves in RTB Bor

Ore deposit	Orebody	Class	Category (Western)	Category (Serbian)	Ore thousand t	Cu grade %	Au grade g/t	Copper thousand t	Gold t	Cutoff % Cu
Veliki Krivelj		Geological reserves	Proven	A+B+C1	560,460	0.34	0.07	1,858	38.1	0.2
		Minable reserves	Proven	A+B+C1	465,150	0.34	0.07	1,512	31.6	0.2
		Exploitation reserves	Proven	A+B+C1	152,739	0.35	0.07	514	10.4	0.2
Bor Underground	Brezanik	Geological reserves	Proven	B	1,972	1.28	0.27	25	0.5	0.4
		Minable reserves	Proven	B	1,495	1.31	0.26	20	0.4	0.4
		Exploitation reserves	Proven	B	1,023	1.21	0.26	12	0.3	0.4
	Tilva Ros	Geological reserves	Proven	B	3,890	0.76	0.13	29	0.5	0.4
		Minable reserves	Proven	B	2,903	0.86	0.14	25	0.4	0.5
		Exploitation reserves	Proven	B	991	0.81	0.17	8	0.2	0.5
	P2A	Geological reserves	Proven	B	8,509	0.71	0.33	60	2.8	0.4
		Minable reserves	Proven	B	2,865	0.89	0.32	25	0.9	0.6
		Exploitation reserves	Proven	B	1,776	0.83	0.46	15	0.8	0.6
	Borska Reka	Geological reserves	Proven	A+B+C1	556,911	0.57	0.21	3,151	114.6	0.3
		Geological reserves	Probable	C2	450,922	0.49	0.11	2,223	49.4	0.3
		Minable reserves	Proven	A+B+C1	319,969	0.50	0.20	1,601	65.2	0.3
		Exploitation reserves	Proven	A+B+C1	142,159	0.53	0.23	752	32.6	0.3
Cerovo	Cementario 2	Geological reserves		?	26,580	0.31	0.07	82	1.9	?
	Cementario 3	Geological reserves		?	9,144	0.33	0.07	30	0.6	?
	Cementario 4	Geological reserves		?	4,028	0.28	0.07	11	0.3	?
	Cerovo Primami	Geological reserves		?	238,359	0.38	0.07	906	16.7	?
	Drenovo	Geological reserves		?	45,778	0.28	0.06	128	2.8	?
	Kraku Bukaresku	Geological reserves		?	1,600	0.62	0.62	10	1.0	?
	Total				325,489	0.36	0.07	1,168	23.3	
Majdanpek	South pit	Geological reserves	Proven	A+B+C1	409,171	0.34	0.18	1,344	72.2	0.2
		Minable reserves	Proven	A+B+C1	246,083	0.36	0.19	882	46.7	0.2
		Exploitation reserves	Proven	A+B+C1	98,757	0.40	0.23	391	22.5	0.2
	North pit	Geological reserves			210,658	0.32	0.25	678	52.9	?
Coka Marin		Geological reserves	Proven	B+C1	271	2.04	5.34	6	1.4	?
		Minable reserves	Proven	B+C1	221	2.16	5.91	5	1.3	?
Total		Geological reserves			2,527,982	0.42	0.14	10,537	354.3	
		Exploitation reserves			397,445	0.43	0.17	1,693	66.7	

(Source: RTB Bor)

3.9.4 Deposit Potential

To maintain a balance between ore reserves and exploitable reserves at the Veliki Krivelj deposit, 410 million tons will be the future target reserve after open pit mining. However, reserves will need to be recalculated in consideration of economic aspects. Satellite orebodies of polymetal occur around the north pit of the Majdanpek deposit. Combined with the central orebody, there are 210 million tons of ore reserves. In the north pit, exploitable reserves have not been calculated due to insufficient development. There should be more exploration around satellite orebodies. Drilling of the lower extension of the Borska Reka orebody has confirmed mineralization down to 900m below sea level. Therefore, ore reserves between -500m and -900m amount to 450 million tons with 0.49% Cu and 0.11g/t Au as Category C2 reserves. It is future issue whether there is the economic feasibility of deep mining or not.

3.9.5 Issues

As described in the section on reserves, the total ore reserves of RTB Bor amount to 2.5 billion tons, but there are only 397 million tons of exploitable reserves, which represents only 15 % of the total. It is not advisable to evaluate ore deposits based only on reserve figures.

3.10 Geology and Deposits of the Veliki Majdan Mine

3.10.1 Geology and Deposits

In this area, there are a number of lead and zinc deposits and important Serbian lead and zinc mines and smelters. Around the Veliki Majdan deposit, antimony and lead & zinc deposits occur widely in association with Tertiary granodiorite. One deposit is a small-scale lead and zinc deposit which formed in the boundaries between limestone and schist of the Triassic period, and andesite to dacite intrusives of the Tertiary period. Another deposit is a massive skarn type that occurs in pipe-like and irregular shapes. The deposit, which consists of small orebodies, is 10m to 15m long and 1m to 3m wide. The horizontal area of orebodies ranges from 20 m^2 to 200 m^2. Due to the skarn, the boundaries between deposits and country rock are clear. Ore grade shows 1 – 20% Pb and 1 – 20% Zn. Ore minerals are chiefly composed of pyrite, galena and sphalerite.

3.10.2 Reserves

The Veliki Majdan mine, which started operation in 1952, produced 1.8 million tons of crude ore consisting of 4.50% Pb and 3.71% Zn, which yielded 82,000 tons of lead and 67,000 tons of zinc (according to the mine data). Ore reserves in December 31, 1987, which is the latest data kept for the mine, amounted to 113,000 tons with 6.14% Pb, 4.64% Zn and 188g/t Ag in A+B+ C1 category. Probable resources are presumed to amount to between 65,000 and 70,000 tons.

3.10.3 Issues

Though there are underground maps, underground geological maps, and assay maps, there are no large-scale geological maps, so it is not possible to clarify the limits of mineralization and to analyze the formation of deposits. Therefore, the potential of reserves cannot be determined. The density of underground drilling prospects is quite high, but there is enough in only 30 % to 50 % of the total length of prospects. The mine has implemented drilling work because the interval of drilling prospects is regulated due to the Serbian reserve calculation. Although the lower parts, under 280asl, of the Rudevac orebody in the east and the Lipnik orebody in the west have not been explored, potential areas are indicated due to the lack of geological maps. There is no clear basis for calculating presumed resources.

3.11 Geology and Deposits of the Zajaca Mine

3.11.1 Geology and Deposits

The Zajaca mine is located in the Boranja ore field. Important antimony deposits are distributed in this district, including at Zajaca, covering an area 15 – 20km from east to west and 4 – 5km from north to south. A great deal of antimony was produced in this district during the former Yugoslavia era. The Boranja ore field is composed of schist, sandstone, limestone of the Late Paleozoic era (Carboniferous to Permian period), and schist and limestone of the Triassic to Jurassic periods of the Mesozoic era. Boranja granodiorite, andesite, and dacite of the Tertiary are intruded (Fig.3.6).

Mineral deposits in the Boranja ore field are distributed in zones around the Boranja granodiorite and are composed of skarn-type iron deposits, skarn-type lead-zinc deposits, hydrothermal lead-zinc deposits, hydrothermal antimony, and metasomatic fluorite deposits (Fig. 3.7).

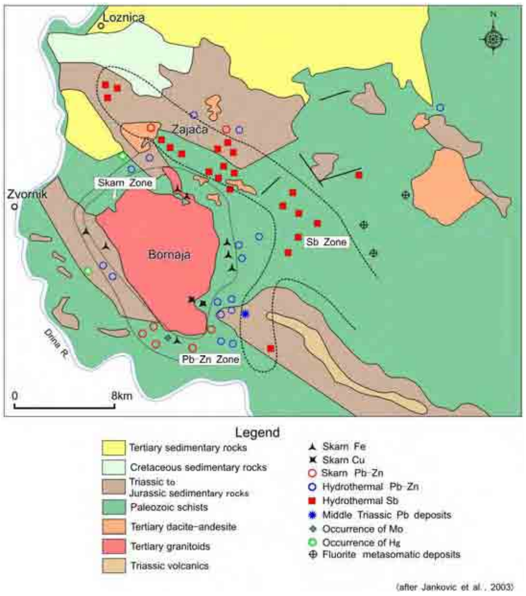


Fig 3.6 Geological Map of the Boranja Ore Field

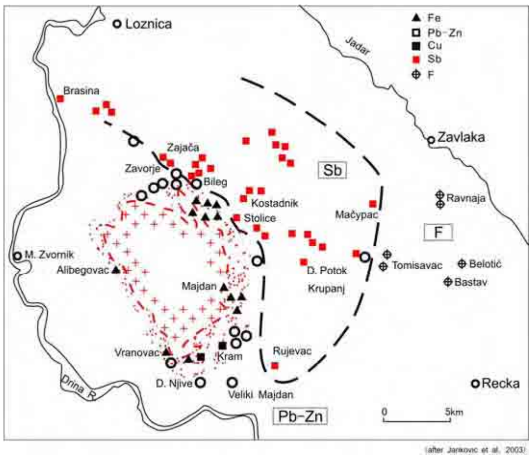


Fig 3.7 Zones of Mineral Deposits of the Boranja Ore Field

The Zajaca deposit is a stratiform and lenticular antimony disseminated orebody (sulfide and oxide ores) which formed along the boundaries between limestone and schist of the Carboniferous period (Fig.3.8). The deposits are associated with a stratiform epithermal antimony vein, in which the country rock is jasperoid.

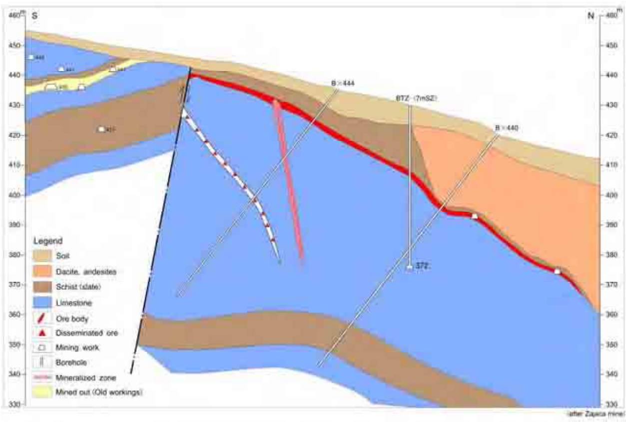


Fig.3.8 Geological Profile of the Turin Orebody at Zavorje Mine

Main ore minerals are composed of stibnite and pyrite, and observed valentinite (Sb_2O_3) and senarmontite (Sb_2O_3) that the stibunite is oxidized to. It is associated with chalcopyrite and galena. Calcite consists mainly of gangue minerals with quartz. Quartz veinlets and silicification and carbonatization occur in footwall limestone. Empirical evidence shows that antimony ore occurs around those alterations.

3.11.2 Prospecting

Prospecting was implemented in basic order of surface drilling, underground tunnel (adit, drift and sub-level drift). Surface drilling was carried out in dense intervals ranging from 20m to 60m, due to the small ore body size. Currently, preparations are being made to reopen an adit, and to do a drift exploration by scraper, because the Turin orebody at the Zavorje deposit is currently an object of exploration.

3.11.3 Reserves

The Zajaca mine started operation in 1890. Over the next 100 years, it produced 90,000 tons of antimony metal with average grade of 2.5% Sb.

According to data from the mine, the total proven reserves of categories A+B+C amount to 967,000 tons with 1.55% Sb, and mineral resources (Category C2) amount to 700,000 tons with 0.97% Sb (Tables 3.6 and 3.7). Within the total proven reserves of 967,000 tons, 51 percent (500,000 tons) is Category C1, so drift exploration will be needed to confirm exploitation of the Category C1 ore.

Table 3.6 Reserves at the Zajaca Mine

Ore deposit	Class	Category (Western)	Category (Serbian)	Reserves t	Sb grade %	Sb t
Zavorje	Geological reserves	Proven	A	−	−	−
	Geological reserves	Proven	B	1,590	3.75	60
	Geological reserves	Proven	C1	57,910	1.49	863
			A+B+C1	59,500	1.55	922
Štira	Geological reserves	Proven	A	−	−	−
	Geological reserves	Proven	B	2,517	2.28	57
	Geological reserves	Proven	C1	21,372	1.82	389
			A+B+C1	23,889	1.87	446
Brasina	Geological reserves	Proven	A	4,628	2.89	134
	Geological reserves	Proven	B	−	−	−
	Geological reserves	Proven	C1	23,083	1.22	282
			A+B+C1	27,711	1.50	415
Kik	Geological reserves	Proven	A	3,725	1.90	71
	Geological reserves	Proven	B	13,715	2.85	391
	Geological reserves	Proven	C1	37,925	1.70	645
			A+B+C1	55,365	2.00	1,106
Dolic	Geological reserves	Proven	A	−	−	−
	Geological reserves	Proven	B	4,510	2.82	127
	Geological reserves	Proven	C1	19,087	2.44	466
			A+B+C1	23,597	2.51	593
Kolicina	Geological reserves	Proven	A	112,396	2.33	2,619
	Geological reserves	Proven	B	325,179	2.00	6,504
	Geological reserves	Proven	C1	337,781	0.71	2,398
			A+B+C1	775,356	1.49	11,521
Stolice	Geological reserves	Proven	A	−	−	−
	Geological reserves	Proven	B	1,063	2.24	24
	Geological reserves	Proven	C1	1,296	1.20	16
			A+B+C1	2,359	1.67	39
Total	Geological reserves	Proven	A	120,749	2.34	2,823
	Geological reserves	Proven	B	348,574	2.05	7,162
	Geological reserves	Proven	C1	498,454	1.01	5,058
			A+B+C1	967,777	1.55	15,044

(Source: Zajaca mine)

Table 3.7 Mineral Resources at the Zajaca Mine

Area	Category (Western)	Category (Serbian)	Resources t	Sb grade %	Sb t
Zavorje	Probable	C2	140,140	0.81	1,135
Štira	Probable	C2	28,275	0.81	229
Brasina	Probable	C2	60,512	0.80	484
Kik	Probable	C2	93,385	1.80	1,681
Dolic	Probable	C2	–	–	–
Kolicina	Probable	C2	387,620	0.87	3,372
Stolice	Probable	C2	–	–	–
Total			709,932	0.97	6,901

(Source: Zajaca mine)

3.11.4 Issues

Among the mining geologists there is only one senior geologist. There is insufficient exploration planning and maintenance of documents due to lax organization. Moreover, there are insufficient underground maps and underground geological maps, and no underground assay maps. Also, there is no basic document showing ore reserve calculations. So, these calculations are not reliable. When redeveloping a mine, one has to reconfirm the highest priority ore assay using analytical equipment and techniques. Exploration to determine the above-mentioned mineral resources in Table 3.7 has been insufficient for map preparation.

According to recent geochemical surveys of steam sediments and soil conducted by a private exploration company near the Zajaca mine, geochemical gold anomalies are distributed around antimony mineralization fields. Jelenkovic and Obrenovic (2005) detected gold anomalies of greater than 0.1ppm Au in seven districts. It is thought that these geochemical gold anomalies could reflect a Carlin-type gold mineralization that has replaced carbonate rocks and calcareous shale. This means there is a high possibility that epithermal gold deposits exist.

Investigation targeting gold has not been implemented at the Zajaca mine. Therefore, to re-open this mine, it will be very important to 1) collect ore samples from old adits and drifts, 2) collect surface samples of ores and rocks, 3) undertake RC (reverse circulation) drilling, and 4) analyze the existing gold and antimony.

3.12 Geology and Deposits of the Rudnik Mine

3.12.1. Geology and Mineral Deposits

Cretaceous limestone, sandstone and breccia are distributed around the Rudnik mine. The strata have developed a folding structure having a NW-SE axis with a plunge of 20° toward the SE. Dacite intrusives of Cretaceous to Tertiary occur with the chief direction of NE to SW in the Cretaceous system around the mines

Deposits are skarn-type that formed between the limestone and dacite. Main skarn minerals are clinopyroxene, garnet and epidote, and pre minerals are galena, sphalerite, chalcopyrite and pyrrhotite. The mineralized area is 2.5km long trending NW-SE, and 1.5km wide trending NE-SW. Nearly 90 orebodies occur in a $5km^2$ area.

3.12.2. Reserves

Cut-off grades in the Rudnik mine are 1.2% Pb, 1.2% Zn, 0.25% Cu and 60g/t Ag. As of 31 December, 2006, ore reserves amounted to 2 million tonnes with 1.8% Pb, 1.8% Zn, 0.525 Cu and 92g/t Ag. The ratios of category B and C1 in reserves are 14% and 86%. There are 26 orebodies with calculated ore reserves, with an average reserve of 80,000 tonnes.

3.12.3. Exploration Personnel

There is a total of seven staff. Their chief tasks are as follows:

1) Exploration in currently exploited sections and new prospecting zones

2) Grade control of mined ore from mining to mineral processing.

3.12.4. Exploration

Exploration in 2007 is divided into exploration in currently exploited sections and exploration in newly-prospecting zones. In the exploited sections, a total of 200m of drift prospecting and underground drilling of 10,000m are planned to confirm a C1 category reserve. The lengths of drill holes range from 150m to 200m. The mine has five drilling machines, comprised of two old ones and three new ones. Maximum drilling length is 600m. Exploration in newly-prospecting zone is done by surface drilling survey in the 7km to 8km east zone of the mine. A total drilling length of 1,200m (400m x 3 holes) is planned in 2007.

3.12.5. Issues

Dilution at the working face is high, ranging from 20 % to 30%. Because the average grade of mined ore is a low 3% Pb+Zn, the reduction of dilution will help operations directly. It is important to improve each shining hour from a moving to working faces on foot to a car-transportation. The latest geological report was prepared by the staff of the Rudnik mine. A lot of time has been spent on it. Reports to the government increase the burden on the business. The introduction of IT skills including the use of scanners and digitizers will be necessary for geological investigations.

3.13 Activities of Serbian Non-Ferrous Mines

Serbian non-ferrous mines have historically operated against a backdrop of rich mineral resources. There were many production mines such as RTB Bor. However, in recent years all mines have suffered considerably from political impacts such as the United Nations Sanctions Resolution and the economic sanctions imposed by Western European countries, and they have not returned to normal production yet..As there are no data on past production in Serbia at the Ministry of Energy and Mines (MEM), non-ferrous crude ore production after 1990 in Serbia-Montenegro is shown from USGS reports, as following figures.

These two figures show 2 sharp drops in production after 1990; the first was in 1993 and the second was in 1999. The former was caused by sanctions imposed by the United Nations in 1992, and the latter resulted from economic sanctions imposed by Western Europe, etc., in 1998. It is easy to understand how these and other actions had such a tremendous impact on Serbian mines. By 2004, production of copper ore had dropped to less than 20% of 1990 levels, and lead and zinc ore production had fallen to about 11% of 1990 levels.

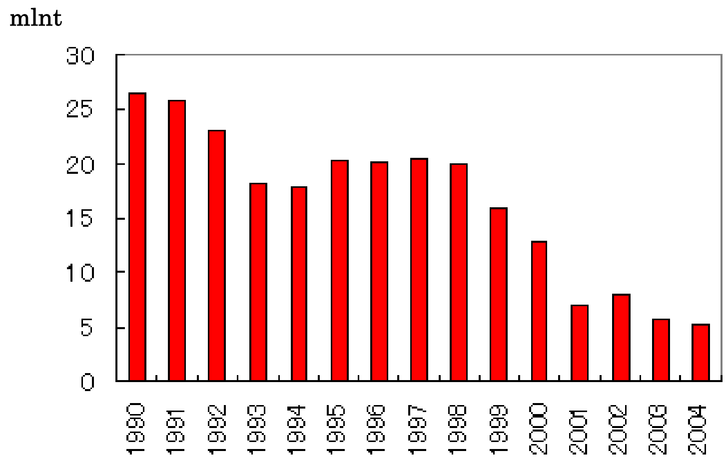


Fig.3.9 Production of Copper Ore in Serbia Montenegro (source: USGS)

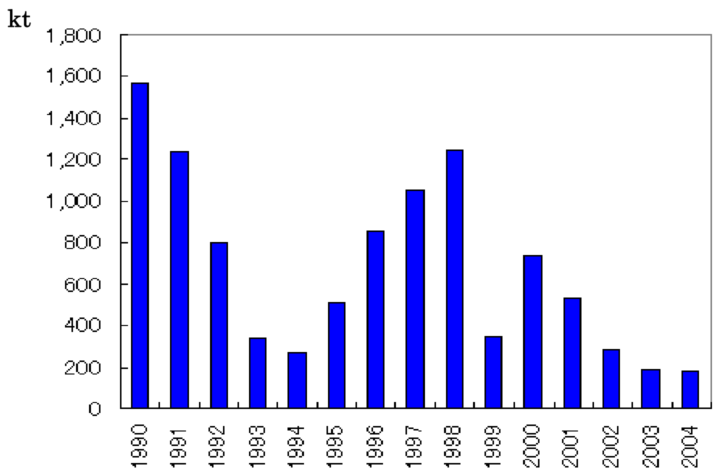


Fig.3.10 Production of Lead and Zinc Ore in Serbia and Montenegro (source: USGS)

Chapter 4 Current State and Tasks of Mining Activities

4.1 Activities of Large Mines owned by RTB Bor

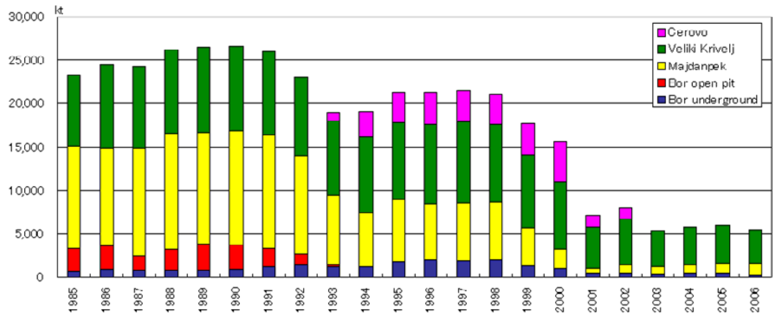


Fig.4.1 Production of the last 20 yrs at RTB Bor

RTB Bor is located in the Bor District which is about 230km by road to the southeast of Belgrade. RTB Bor consists of three mining complexes: the Bor Copper Mine (RBB), the Majdanpek Copper Mine (RBM) and the Copper Smelter (TIR). The RBM is located in Majdanpek City, but the other two complexes are in Bor City. Fig. 4.1 shows production trends at RTB Bor for the last 20 years. The main mine facilities of RTB Bor in Bor City are shown in Fig.4.2.

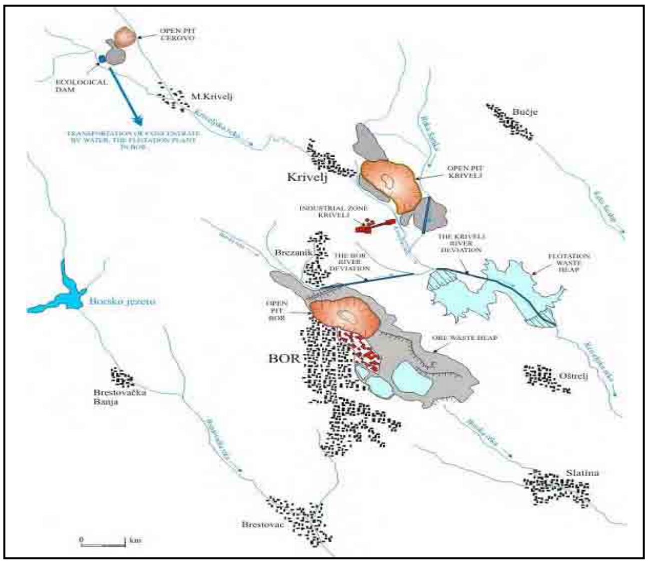


Fig.4.2 Layout of the Main Mine Facilities in Bor City

4.1.1 Bor Underground Mine

The history of the RTB Bor underground mine dates back to 1897 when first exploration was done in the Tilva Ros area by a French investor. The first production took place in 1904. In 1993, the Bor open pit stopped operation because mining targets (Tilva Ros and P2A) were too deep. Since then, these ore bodies have become the principal ore sources for the underground mine. Exploitation of

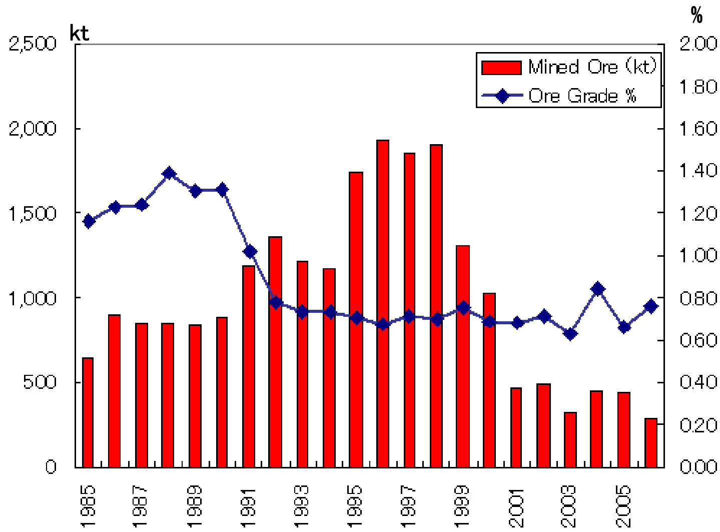


Fig.4.3 Production of the Bor Underground Mine

the Brezanik ore body, which is slightly distant from these two ore bodies, was begun in 1980. Peak production of the underground mine was 1.93 million tons in 1996, and remained at a level near that for the next 3 years. However, production began dropping in 1999, and by 2001 it had fallen to 470,000t. This was due to a shortage of parts for underground machines caused by economic sanctions. Fig.4.3 shows production of the underground since 1985. Sharp production declines in 1999 and 2001 are easily recognized. Fig.4.4 shows a schematic diagram of the current underground mine.

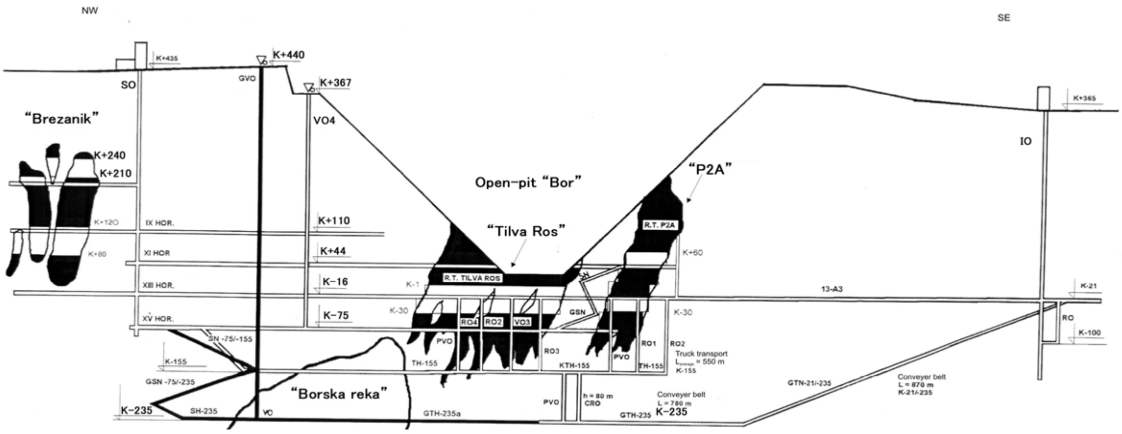


Fig.4.4 Schematic Diagram of the Bor Underground Mine (source: RTB

The Bor underground mine introduced trackless system in 2003, when the underground tracks were removed. Regarding mining methods, sublevel caving is used at Tilva Ros and P2A, and cut and fill is used at Brezanik.

Underground operation is finely managed using various production and cost data, the same as in Western countries. Table 4.1 shows a comparison of operation efficiency between 1996 (year of production peak) and 2003 (year of significantly reduced production).

Table 4.1 Comparison of Underground Operations in the Bor Mine in 1996 and 2003 (source: Bor)

Item		1996			2003		
		operation	workers	efficiency	operation	Workers	Efficiency
Mining	Brezanik	260,098t	22,896	11.36t/miner	29,111t	4,315	6.75t/miner
	Tilva & P2A	1,672,977t	18,960	88.24t/miner	294,674t	9,221	31.96t/miner
	total	1,933,075t	41,856	46.18t/miner	323,785t	13,536	23.92t/miner
Drifting		6,058m	12,900	0.47m/miner	1,464m	7,484	0.20m/miner
Investment		1,544m	9,694	0.16m/miner	1,559m	8,587	0.18m/miner
Transporting & crushing		1,933,075t	12,6446	152.88t/miner	323,785t	12,644	25.61t/miner
Grand total		1,933,075t	75,987	25.44t/miner	323,785t	42,251	7.66t/miner

According to this table, production in 2003 was only about one sixth of the 1996 level. This dramatic decrease was mainly due to the embargo on mining machine parts. Operation efficiency decreased in all areas, because of disruptions caused by inadequate machines. Painful situation of the mine operation can be easily understood. The amount of drifting also dropped, falling to one fourth because only a few machines could be used for production. Therefore, subsequent mining could be more difficult owing to the lack of mining preparation and exploration.

4.1.2 Development of the Borska Reka Ore body

The Borska Reka is a gigantic ore body located near the Bor underground and Veliki Krivelj open pit, but it lies beneath the Bor underground mining levels. A plan for mining the ore body was formulated at Belgrade University in 1999, and a mining consultant contracted by the World Bank reviewed and analyzed the contents of the plan in 2005.

4.1.3 Bor Open Pit Mine

The Bor Open Pit Mine was started in 1923. The grade of ore was somewhat higher, 7 to 4 %Cu, in those years. Production data for 1985 to 1993 are shown in Fig.4.5. All operational data are listed in the Appendix.

The total exploited rock mass from mine opening to closing was as follows:

Total ore 95,799,627t (Cu 1.4%), total waste 171,176,926t (stripping ratio: 1.40)

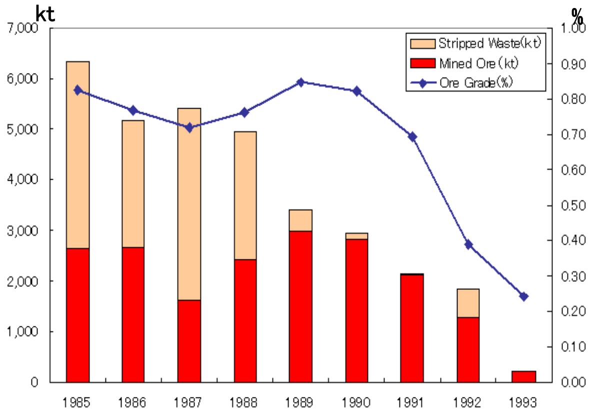


Fig.4.5 Operation Result of the Bor Open Pit


Fig.4.6 Geological Section of the Veliki Krivelj

4.1.4 Veliki Krivelj Open Pit Mine

The first waste stripping in this mine was started in 1979, and the first ore production was begun as the 4th mine of RTB Bor in 1983. Annual production reached 9.6 million t in the 4th year after first production, and had been maintained at nearly the same level until 1998, when the economic sanctions began. Since 1999, mine production has decreased; in 2006, it was less than 4 million tons, which was about 40% of the peak. Ore grade was 0.5% Cu at the beginning, but it had decreased over time to 0.28% Cu in 2006. However, today it plays the lead role in production, accounting for 70% of the ore produced at RTB Bor.

Fig.4.7 shows production data

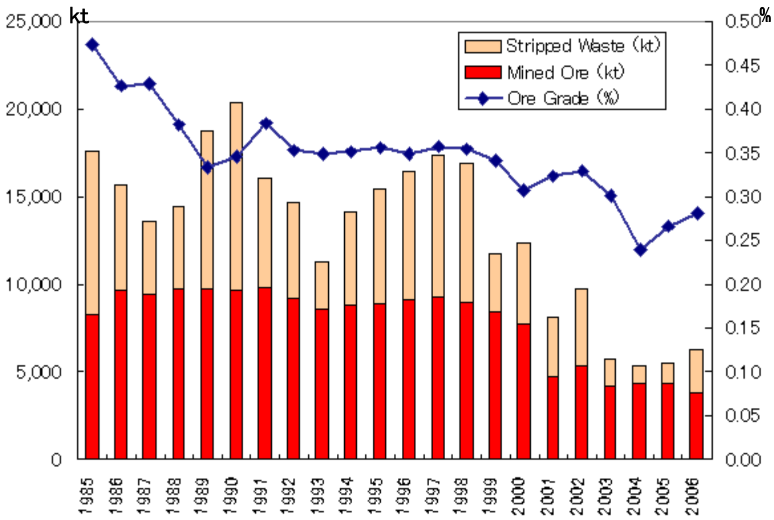


Fig.4.7 Operation Result of the Veliki Krivelj

from Veliki Krivelj since 1985. Table 4.2 shows a comparison of ore mass exploited from 1983 to 1992, and from 2003 to 2006. The earlier period (1983 to 1992) was a comparatively good period of operation, while the latter period (2003 to 2006) was far less favorable. Annual average of total mass removed declined to less than one third, and average stripped waste decreased to about one fifth. Accordingly, the stripping ratio decreased from 0.86 to 0.36. This indicates partially delayed stripping.

Table 4.2 Comparison of Exploited Mass in the Veliki Krivelj Open Pit

Period	Mined ore	Stripped waste	Total mass	Stripping ratio
1983 to 1992	84,852,005t	73,340,701t	158,192,706t	0.86
Annual average	8,485,201t	7,334,070t	15,819,271t	0.86
2003 to 2006	16,769,965t	6,080,445t	22,850,410t	0.36
Annual average	4,192,491t	1,520,111t	5,712,603t	0.36

4.1.5 Cerovo Open Pit Mine

The Cerovo open pit is located approximately 8 km to the north-east of the Veliki Krivelj Mine. The Cerovo Open Pit Mine began stripping the initial burden in 1991, and started production in 1993 when the Bor open pit stopped operation. The Cerovo 1 finished its reserve in 2002. Current remaining reserve may be up to 320 million tons with a grade of 0.3% Cu and 0.1g/tAu, which are the objective of privatization.

The Copper Mine Bor (RBB) was above described, and the RBB personnel was restructured according to the privatization strategy. Table 4.3 shows a comparison of personnel in January 2003, February 2007, and July 2007.

Table 4.3 Transition of RBB Personnel (source: RTB Bor)

Department	Jan. 2003	Feb. 2007	July 2007
Veliki Kreivelj Open Pit	516	405	396
Veliki Krivelj Plant	352	288	278
Cerovo Open Pit	124	11	13
Bor Underground	694	441	416
Bor Plant	342	230	225
Bor Repair Shop	128	87	87
Hydrometallurgy	48	29	34
Exploration	147	92	98
Administration	375	258	250
Zagradje Limestone	163	118	116
Bela Reka Silica Sand	72	67	66
Total	2,961	2026	1979

4.1.6 Slag Mining

Commercial metals from slag discharged from the Bor smelter have been recovered for the past several years by the TIR . Mining has been carried out by the TIR, but the RBB has taken the opportunity of stopped work in the underground operation of the Tilva Ros and P2A to study full open pit mining operation of slag. And a new operation plan for slag mining was submitted to the MEM. The total amount of slag is about 9 million tons with about 66,000t of copper metal, 2,600kg of gold, and 41,000kg of silver. Ore reserves for each bench are listed in Table 4.4.

Table 4.4 Slag to be Mined

Benches	Slag (t)	Cu (%)	Cu (t)	Au (g/t)	Au (kg)	Ag (g/t)	Ag (kg)
365/350	1,318,973	0.715	9,431	0.28	372.0	4.50	5,935.4
350/340	3,061,392	0.715	21,889	0.28	863.3	4.50	13,776.3
340/332	1,277,730	0.715	9,136	0.28	360.3	4.50	5,749.8
330/330	1,465,830	0.715	10,481	0.28	413.4	4.50	6,596.2
320/320	1,330,959	0.715	9,516	0.28	375.3	4.50	5,989.3
320/310	736,056	0.715	5,623	0.28	207.6	4.50	3,312.3
Total	9,190,940	0.715	65,715	0.28	2,591.8	4.50	41,359.2

Mined slag will be treated through a flotation process, as previous test operations have shown this to be the best recovery method. Full scale operation of copper slag flotation is estimated in Table 4.5. The total operating cost is estimated to be US$6.57/t, 1.77/t for mining costs and US$4.8/t for processing costs. It will be possible to recover the total investment of about US$ 10 million.

Table 4.5 Estimated Flotation Operation Values

Item	Estimated value
Annual amount to be treated	1,112,400 t
Cu grade in slag	0.715 %
Au grade in slag	0.282 g/t
Ag grade in slag	4.5 g/t
Concentrate	219,050 t
Cu grade in concentrate	15.0 %
Cu recovery	50.0 %
Cu in concentrate	32,857 t
Au grade in concentrate	5.072 g/t
Au recovery	50.0 %
Au in concentrate	1,296 kg
Ag in concentrate	64.748 g/t
Ag recovery	40.0 %
Ag in concentrate	16,544 kg

4.1.7 Majdanpek Open Pit Mine

The Majdanpek Mine (RBM) is located in the City of Majdanpeck which is 70km from Bor City. The RBM has two open pits, South Pit and North Pit, and a processing plant. The concentrate is transported to the Bor Smelter (TIR) by train. The central part of the city is located in a valley containing many homes. The main mine facilities are located along a line from the central city, to the North Pit, South Pit and the mineral processing plant. Furthermore, the waste dumps of the North and South pits and tailings pond are somewhat distant from the other facilities, which are fairly close together. The layout of the main facility of the RBM is

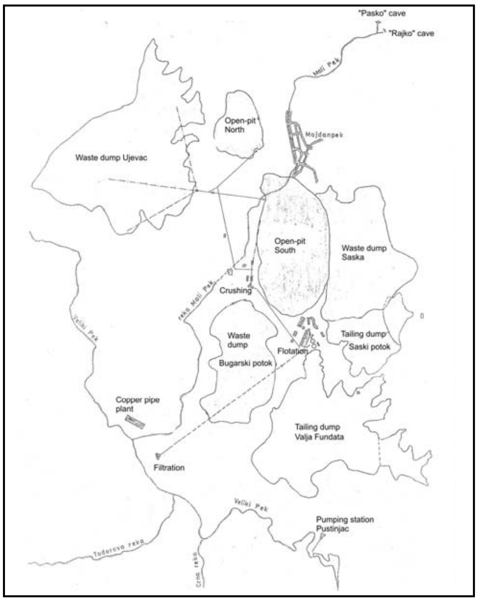


Fig.4.8 Layout of Main Facility of the RBM

shown in Fig.4.8.

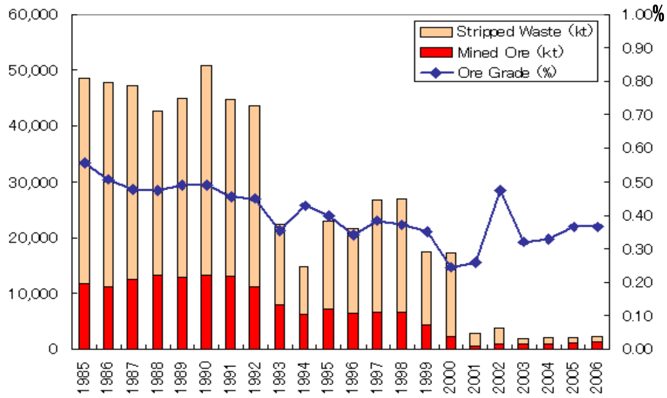


Fig.4.9 Operation Result of the Majdanpek Mine

The South Pit started stripping in 1959 and production in 1961. The ore processing plant was constructed by 1961 when the mine began to send the concentrate to the TIR. The Pit was expanded after that, and annual production reached 13 million tons in 1976, and remained at that level until 1989. The RBM had been a central player of RTB Bor, accounting for more than half of its total production since the year after its opening. In 1968, the mine accounted for more than 70% of total production, and maintained this share until 1982, when the Veliki Krivelj Open Pit was opened. The North Pit recorded the first production in 1989 after it had initiated stripping in 1977. In 1990, the pit started full production. Fig.4.9 shows the production results of the Majdanpek Mine. The number of RBM workers had decreased as production decreased, as shown in Fig.4.10. In 2002, the RBM carried out a drastic restructuring by laying off 1,370 workers, about half of the total workers. Despite this action, however, operating efficiency dropped considerably. For example, the mine has maintained its three-shift system, but the first shift is now working only in preparation, not in production.

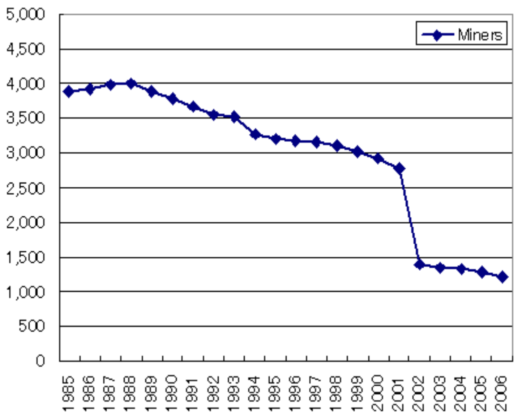


Fig.4.10 Miners in the Majdanpek

The main reason for decreased production is the superannuation of mining machines, just like at the Veliki Krivelj Mine. The current main mining machines are listed in Table 4.9. There are some very old machines and some machines are rarely used.

Table 4.6 shows a comparison of exploited mass from 1977 to 1989, and from 2003 to 2006 at the South Pit. The earlier years (1977 to 1989) were a comparatively good period of operation, while the later years (2003 to 2006) were considerably less favorable.

Table 4.6 Comparison of Exploited Mass in the South Pit

Period	Mined ore	Stripped waste	Total mass	Stripping ratio
1977 to 1989	164,933,812t	358,684,295t	523,618,107t	2.17
Annual average	12,687,216t	27,591,100t	40,278,316t	2.17
2003 to 2006	3,500,200t	2,667,000t	6,167,200t	0.76
Annual average	875,050t	666,750t	1,541,800t	0.76

Annual average of exploited mass fell approximately 76%, and average stripped waste decreased by about 98%. Accordingly, the stripping ratio decreased to about one third, from 2.76 to

0.76. This clearly indicates delayed stripping. Unlike the RBB, the RBM has not introduced IT, so the past operation data is not used efficiently. It is easy to understand the bad state of production merely by seeing the bad condition of the local roads.

Fig.4.11 Design and Current State of the South Pit

Table 4.7 shows a comparison of exploited mass from 1990-2000 and from 2003-2006 at the North Pit. The annual average of exploited mass decreased approximately 99%, as did average stripped waste. Accordingly, the stripping ratio decreased to less than half, from 3.13 to 1.55. This clearly indicates delayed stripping. If the RBM is to continue exploiting above the current water level, it will be necessary to reroute the national road and remove a large mass of waste (approximately 8 million tons), which will require a considerable amount of investment.

Table 4.7 Comparison of Exploited Mass in the North Pit

Period	Mined ore	Stripped waste	Total mass	Stripping ratio
1990 to 2000	31,609,186t	98,987,692t	130,596,878t	3.13
Annual average	2,873,562t	8,998,881t	11,872,443t	3.13
2003 to 2006	752,800t	1,166,000t	1,918,800t	1.55
Annual average	188,200t	291,500t	479,700t	1.55

4.2 Activities of Middle/Small-Scale Mines in Serbia

Many small/medium-scale mines used to mine lead-zinc, rare metals, and other ores in Serbia. However, they have been relatively inactive 1991 because of political uncertainty, so plans were made to privatize all national mines, and some mines have already been privatized. The study team visited three small/medium-scale mines (the Veliki Majdan, Rudnik and Zajaca mines) to investigate their current states. The Rudnik and Zajaca are privatized mines.

4.2.1 Veliki Majdan Lead and Zinc Mine

The headquarters of the Veliki Majdan Mine is located in Ljubovija City, in the Macva District, about 200km east of Belgrade. The city lies on the border with Croatia, which is 30m across the River Drina. It was opened as a modern mine in 1934 by an English company which established the Drina Mining Company for full exploration work with the first drift. After a period of inactivity, a national company, Zajaca, restarted exploration in 1940, and began production in 1954. Then it became independent as Veliki Majdan in 1972 but soon joined the Zorka Sabac Group to send the zinc and pyrite concentrate to Zorka and the lead concentrate to Trepca. Management was taken over by Trepca in 1996. The Veliki Majdan Mine became independent in 2003, then it was privatized in September 2006 and management was taken over by the Swiss company "Minero".

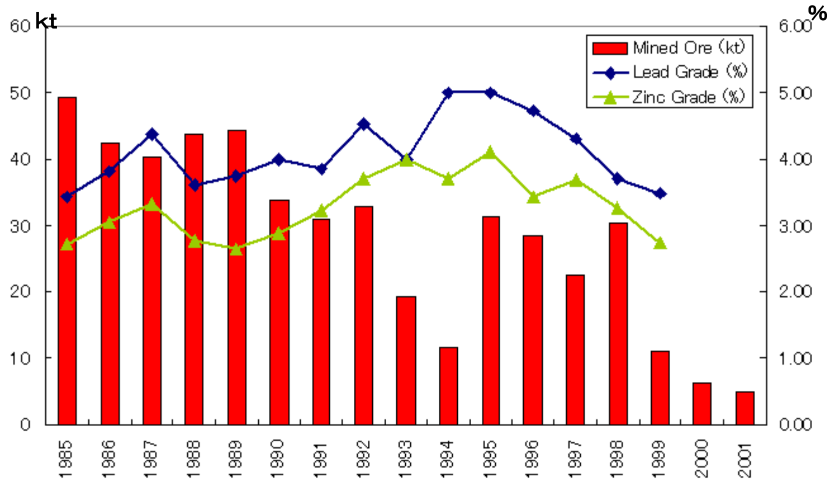


Fig.4.12 Production Result of the Veliki Majdan

Fig.4.12 shows production results from 1985 to 2001, and in 2001 the mine stopped production. The mine continued to operate under difficult conditions, but finally stopped operations in June 2001 when heavy rains ruptured its tailings dam. Furthermore, the mine could no longer keep pumping water up from the underground in 2003. After privatization in December 2006, the mine restarted dewatering. Trepca gave up management rights to the mine due to these and political issues.

Current issues associated with reopening the mine are a) pumping up water from the drifts 160m under water, b) restoring the damaged tailings dam, c) hiring experienced workers because all previous workers were fired, and d) repairing or replacing the many machines for mining and ore-processing that had been abandoned for a long time. The mine estimates that it will take one million euros to restart operation in September 2007. However, as of February 2007, no detailed plan had been formulated, and many problems still remain.

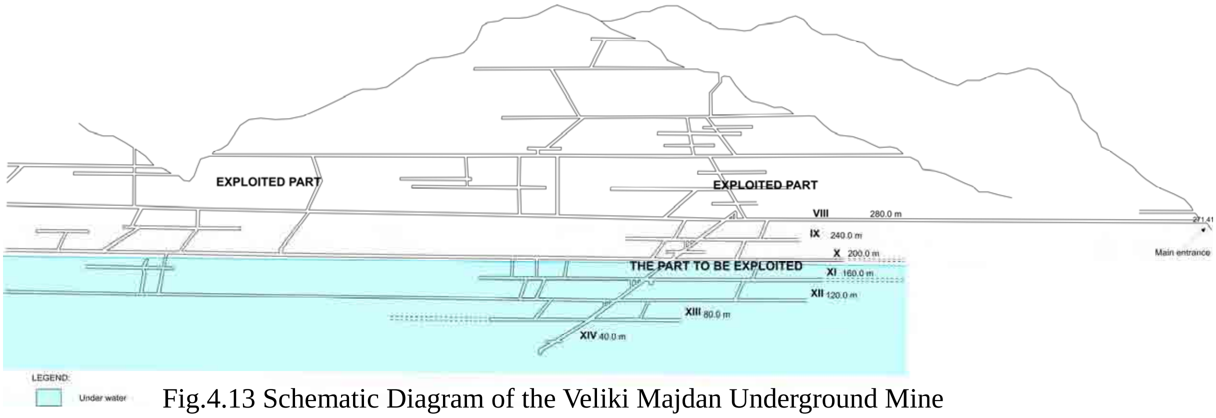


Fig.4.13 Schematic Diagram of the Veliki Majdan Underground Mine

4.2.2 Rudnik Poly-Metal Mine

The mine is located in Rudnik Village, Gornji Milanovac, Sumadija District, approximately 110 km south of Belgrade. This was the first privatized mine which was bought by Contango in a public auction held in September 2004. Contango bought 70% stock of the company, and the other 30% was given to workers of the company, who have already sold most stock to banks and investment companies. Currently there are more than 10 shareholders.

This mine was established in 1948 by Trepca, and ore production began in 1952. It produces lead, zinc and copper ore. The lead and zinc ore deposits are small massive skarn type while the copper deposits are mainly stock work type which are somewhat larger than the lead-zinc deposits. Mine production had been stable until 1992, when it fell sharply due to economic sanctions. In 1994, the mine could not produce ore. In 1995, the mine re-began production, but debt was accumulated owing to low production and low metal prices. Finally, the company was privatized in 2004. As this mine had been managed autonomously before privatization, a new owner had difficulties in labor management.2 former managers and 3 leaders of miners were fired to break with the old habits. After privatization, the mine became profitable (160 million Dinars) in 2006 due to high metal prices. Production dropped shortly after privatization, but it has recovered year by year, and will reach the peak level of the past in 2007 (Fig.4.14). From 1999-2002, zinc concentrate was sent to the Veles Smelter in Macedonia. Since then, it has been sent to the Plovdiv Smelter, same as with the lead concentrate. Copper concentrate

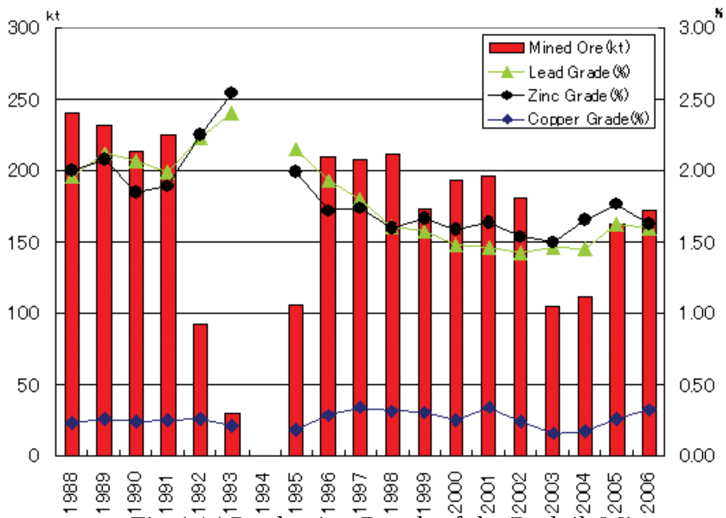


Fig.4.14 Production Result of the Rudnik Mine

has been treated in the Bor Smelter.

The mining method of the mine is descending “Room and Pillars”. Each small ore-body prepares one stope, but large ore-bodies are separated vertically into 2 or 3 portions. Each portion is mined from top down by “Room and Pillars”. Total amount of the sulfide orebody, P2, beneath the oxide ore is about 800,000t which lies near the surface. The oxide ore has been tested by the Ore Processing Department of the mine. However, the mine gave up exploitation of the oxide ore due to its low recovery rate. Currently, the mine is preparing the sulfide orebody just beneath this oxide ore by the underground method. Room and Pillar method, main mining method of the mine, is not applicable for this orebody, and Cut and Fill method may be adopted.

4.2.3 Zajaca Mine

The Farmakom Ltd. is located in Sabac City, Macva District, which is about 200 km west of Belgrade. The company was established about 20 years ago. Although the core business of the company is agriculture, it has been gradually expanding and diversifying its operations since its founding. Currently it is a large (200-million-euro) operation employing a total of 2,000 workers. The company deals in milk, agricultural products cultivated in greenhouses, and spare parts for cars, and also runs a metal foundry and a lead smelting business. It bought out the Zajaca Mining Co. Ltd. in March 2006 to acquire antimony mines

The Zajaca area is rich in metallic minerals with a metallogenic length of 25km (300 to 500m wide) in the NW-SE direction, and many mines have been developed in this area in the last 130 years. There are many nonferrous metal ore deposits such as lead, zinc, tin, and arsenic, as well as antimony in this area.Total production of antimony was 140,000t in metal base. Antimony production was begun after World War 2, and the average annual production was about 2,000t from 1945 to 1990. The production peak was during 1965 to 1977, when the average annual production was about 3,200t. The Zajaca Mining Co. Ltd. stopped producing antimony in 1991 due to decreased metal prices. After that, the company produced lead for car batteries from scrap lead using its smelting facility. Farmakon has studied reopening mines. They target lead, zinc, tin, rare earths such as CaF_2, and antimony.

4.3 Other Mining Activities

4.3.1 Kostolac Coal Mine

Currently, the Kostolac mine produces approximately 7 million tons of coal for 4 billion kWh/year with a 1,000 Mw facility. They plan to increase coal production to 9 million tons/year in the future to meet increased electrical demand. Fig. 4.15 shows mine

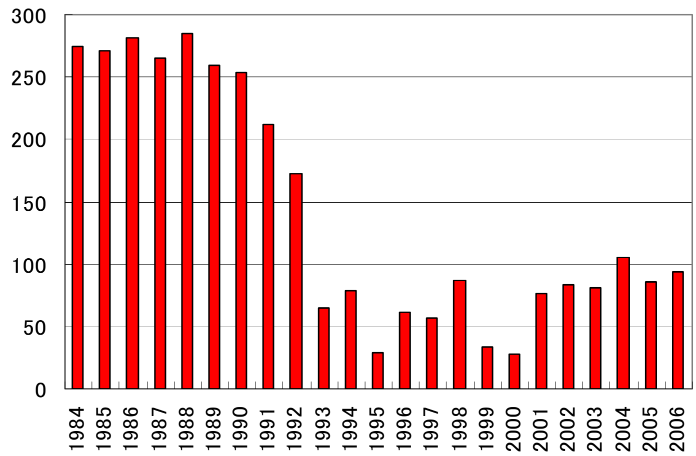


Fig. 4.15 Kostolac Mine Production in the Last 20

production for the last 20 years. The mine suffered less than metal mines under economic sanctions, because the Russian-made spare parts for mining machines were continuously available. It should be noted that the mine does not have a privatization plan, because its production is directly linked to the Serbian people's lives. The Thermal Power Plant and "Kostolac" Mine are located in Kostolac, Pozarevac Municipality in the Branicevo District about 100 km to the east of Belgrade. They are operated by the state-owned company, EPS. The mining cost is €7- 8 /t and the mine runs profitably.

Currently at the Kostolac Mine, there are 3 open pits, Drmno (mining area: 2.5 km × 5.0 km), Cirikovac (1.5 km × 2.0 km), and Klenovnik (0.8 km × 1.0 km). The pit bottom of Drmno Pit is located 50 to 80m under the water level of the Danube River, which is about 500m from the pit. Therefore, the pit continuously operates dewatering with 200 wells. Two tons of water must be dewatered for every 1 ton of coal. Additional wells are needed to facilitate pit moving in the future. They expect to drill 40 to 50 new wells for each 500m move of the pit. Another problem with Drmno Pit is avoiding the nearby Roman ruins known as "Viminacijum" on the coal layers. 20 million Dinars (about 250,000 Euros) per year will be needed to move most of the ruins to another location. However, as some ruins cannot be moved, approximately 40 million tons of coal will be remain unmined. 30 years have already passed since Cirikovac Pit was opened. There are 2 coal layers to be mined. However, mining has already encroached to within about 700m of a local villagers' residence area. Thus, it will be impossible to continue mining without changing the current mining method, so underground mining may be adopted. The current stripping ratio of this pit is about 7:1, but dewatering is unnecessary.

Klenovnik Pit produces about 150,000t per year with a stripping ratio of 7:1. Mining is done by dragline, and coal is transported 2km to the plants by train. The reserve is insufficient, and transportation costs are significant. So, the pit is scheduled to be closed 3 years from now.

4.3.2 Kovilovaca Limestone Quarry

The Kovilovaca Limestone Quarry is located in Pozarevac Municipality, Branicevo District, about 135km to the east of Belgrade. The current proven reserve is 21.65 million tons, but the quarry has a vast concession area, so quarry life is not an issue. Since the thickness of the overburden waste is about 0.5m, the mining condition is very good. Limestone is distributed according to purity and grain sizes. Annual production trends are shown in Fig.4.16 after privatization.Production has drastically increased since privatization through several management efforts, such as renovation of machines and introduction of an efficiency wage system. In 2007, production is expected to increase to 1.5

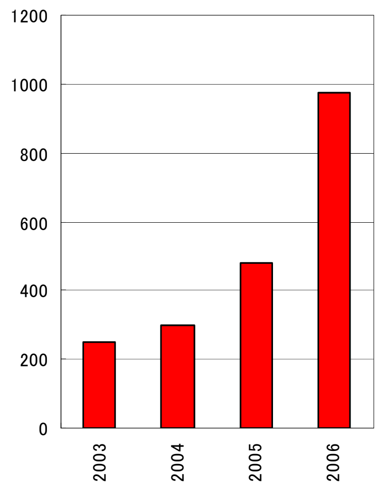


Fig. 4.16 Kovilovaca

million tons.

4.4 Smelting Activities

4.4.1 Overview of the Copper Industry in Serbia

(1) Import and Export of Copper (Statistical Yearbook of Serbia 2006)

tons/year

	Export			Import		
year	2,003	2,004	2,005	2,003	2,004	2,005
Total	39,319	37,788	59,723	20,812	47,897	41,747
Cyplus	1,673	3,809	19,015	824	4,564	19,386
Italy	2,526	4,164	7,416			
Gemany	4,054	6,040	5,821	950	493	376
USA	3,089	4,341	3,695			
Romania	1,333	1,746	3,111			
Bosnia	1,127	1,010	2,084			
Bulgalia				4,379	23,614	13,077
Russia				4,255	4,974	4,312
Austria				1,298	1,620	2,366
Others	25,517	16,678	18,581	9,106	12,632	2,230

(2) Production by TIR Bor

Year	2003	2004	2005
Cathode	14,000	12,000	31,000

In the 1980's, production of the Bor smelter reached 150,000 t/y and approximately 70% of this production was supplied to fabricators in Yugoslavia.

(3) Copper Industry in the Balkans

1) Copper Mines

Total copper concentrate quantity 11,129,000 tons. Assuming the copper content in concentrate to be 25%, the net copper quantity is 282,000 tons

2) Copper Smelters

In the Balkans, the total copper quantity is 282,000 tons, meaning that there is relatively little copper concentrate in this area.

Country	Location (Name)	Capacity x 1,000	Process Type (S); secondary
Albania	Kukes (Gjegian)	5	Reverberatory
	Lac	7	Blast Furnace
	Rubik	5	Reverberatory
Armenia	Alaverdi	7	Reverberatory
		3	Reverberatory (S)
Bulgaria	Eliseina	14	Blast Furnace (S)
	Pirdop	190	Outokumpu Flash
Hungary	Csepel	4	Reverberatory (S)
Italy	Porto Marghera	24	Reverberatory (S)
Poland	Glogow District (Glogow I)	220	Blast Furnace
	Glogow District (Glogow II)	205	Outokumpu Flash
	Wroclaw (Hutmen S.A.)	9	Blast Furnace (S)
	Legnica	93	Blast Furnace
Romania	Baia Mare	35	Outokumpu Flash
	Zlatna	10	Reverberatory (S)
	Zlatna	40	Outokumpu Flash
	Zlatna	13	Reverberatory
Serbia	Bor	170	Reverberatory
Slovakia	Krompachy	20	Reverberatory (S)
Turkey	Samsun	42	Outokumpu Flash

Total 1,032,000 tons

4.4.2 Operation at the TIR Bor

Features of the RTB Bor and TIR Bor are as follows;

1) Copper content in concentrate from RTB Bor is low and the concentrate cannot be sold in the international market when its copper content is 20% or less. Therefore, RTB Bor needs to have its own smelter.
2) The production at TIR Bor is essentially based on raw materials from Bor mines and imported concentrate is used to maintain the copper content in charged concentrate at 20% Cu. Although there is no problem with using up to 28% Cu at the smelter, operations are carried out with the minimum amount of imported concentrate.
3) Before economic sanctions were imposed in 1990, there were fabrication plants in Serbia that used electrolytic copper as a raw material and approximately 100,000 t/y electrolytic copper was consumed locally in Yugoslavia. At present, the domestic fabrication in Serbia is approximately 20,000 t/y, and all fabrication plants except RTB Bor are privatized.
4) Because purchases of imported concentrate and sales of electrolytic copper are entrusted to East Point Co., Ltd. of Cyprus, electrolytic copper produced by TIR Bor is not given priority for domestic sales.
5) The theoretically calculated copper recovery rate of TIR Bor is about 93%, which is lower than the contract recovery rate of 95%.
6) The cut-off grade (for trading) of gold and silver in copper concentrate is 1g/t gold and 30g/t silver and they, unlike copper, are producing a profit. However, RC (refining charges) are not taken into account.
7) The sales price of sulfuric acid is now 0.5 euros per ton, meaning the more that is produced, the less profit there will be. When fixing SO_2 as sulfuric acid for pollution prevention, it must be considered as a pollution control cost. (In the following study, it is not considered in the operating costs for copper production.)

Quality control is already registered for LME electrolytic copper, and some sections have acquired ISO 9001 (Quality Control). Also, Refinery, Blending control ISO 14000 (Environment Control) is scheduled after privatization.

Concerning accounting, financial reports are issued yearly and quarterly. A summary of financial reports for the 3 years is shown in the table below.

Table 4.8 Summary of Financial Reports

year	2004	2005	2006
On business			
Sales income	4,719,515,000	972,833,566	8,349,505,494
Raw material	2,131,885,563	416,129,030	4,636,136,492
Other direct cost	2,533,952,437	497,773,759	3,811,487,246
Profit and loss	53,677,000	58,930,777	-98,118,244
Financial cost			
Financial income	563,139,973	568	582,696,040
Financial outgoing	1,101,050,971	15,678,646	506,113,018
Profit and loss	-537,910,998	-15,678,078	76,583,022
Non-business profit/loss			
Other income	16,654,434	315,416	118,517,138
Other outgoing	131,990,056	3,443,512	67,889,965
Profit and loss	-115,335,622	-3,128,096	50,627,173
Accounts receivable			30,019,966
Grand total			
Profit Loss (Din)	-599,569,620	40,124,603	59,111,917
Profit Loss (US$)	-10,240,301	603,204	883,342
Din/US$	58.55	66.52	66.92
Electrolytic copper t/y	11,997	31,284	41,387
LME price US$/t	2,866	3,679	6,722

Because the profit and loss are settled each year, they cannot manage to have re-investment fund. The Smelter/Refinery of Bor started production in 1961 using one reverberatory furnace. In 1971, the plant began using 2 reverberatory furnaces and its capacity was expanded to 175,000 tons. The copper concentrate imported today is mainly from Bulgaria and is handled by East Point Co., Ltd. of Cyprus.

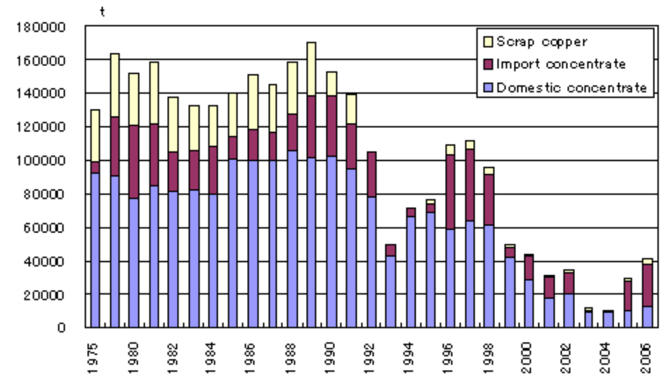


Fig.4.17 Past Production

The copper production capacity is 160,000 tons but in recent years, the production has only been 10 to 20% of this capacity. Because of this, the operating costs are becoming high. We estimated the operating costs based on past operation results. We received basic data on operating costs from 1991 to 2006 and calculated operating costs versus production. Fig.4.32 shows the calculated operating costs (cents/lb) by production amount. At 165,000 t/y production, the direct operating cost is 6.9¢/lb. The minimum production to have a profit under current concentrate purchase price of 31.75 ¢/lb is 19,500 t/y. However, this is on a direct cost basis and this minimum production quantity will increase when indirect costs are included. For example, when a desulfurization plant and wastewater treatment facilities are installed for pollution control, approx. 1.5 ¢/lb has to be added to this operating cost. Total 8.4 ¢/lb.

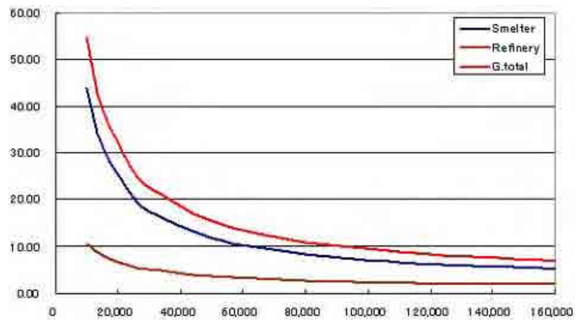


Fig.4.18 Operating Cost by production

The graph below shows the average operating costs of smelters in the world, comparing operating cost of the Bor. The operating costs of Bor will be the cheapest in the world if the plant is operated at full capacity. These costs are low compared to international level and will likely increases the economy grows. Thus, operating costs will likely rise in the future.

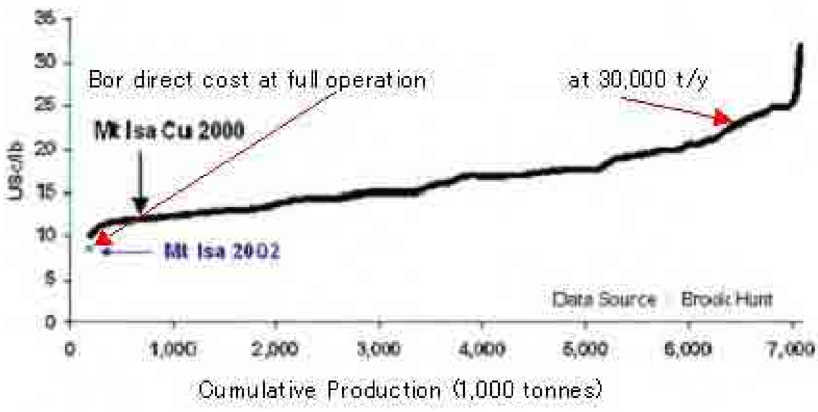


Fig.4.19 Operating Cost for Smelting and Refining

Smelter operation is based on the quantity of concentrate. A large portion of cost derives from the quantity of the concentrate. When the copper content in this concentrate is low, the production cost based on copper quantity becomes high. The quality of concentrate used at RTB Bor is quite low compared to the average world concentrate of 28%. Copper, silver and gold content in concentrate from the mines of RTB Bor is as tabulated below.

BOR	10～12 % Cu	12～18g/t Au	150～350 g/t Ag
Veliki Krivelj	16～22 % Cu	50～200g/t Au	600～1500 g/t Ag
Majdanpek	10～16 % Cu	4～7g/t Au	30～60 g/t Ag

The copper content in blended concentrate is adjusted to 20 to 22% Cu by blending with imported concentrate having a higher copper content. However, since 2000, the quality of imported copper has dropped down to approx. 15%. However, there is some sign of recovery in 2005 with the use of imported concentrate. Matte grade is within the range of 35% to 45%. Slag is kept at around the 0.5% level. The figure below shows copper content in copper concentrate, in matte and in slag.

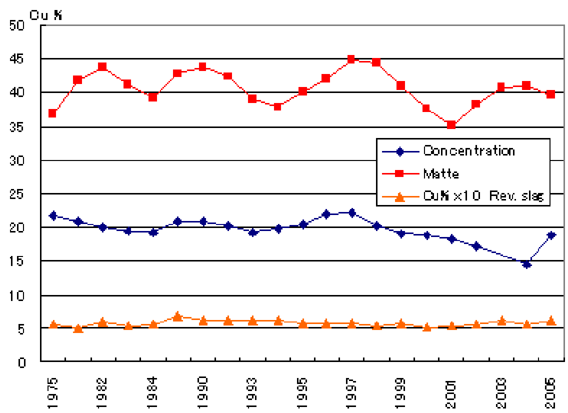


Fig.4.20 Cu Grade Trend of Concentrate, Matte and Slag

4.4.3 Copper Smelting/Refining Business

TC/RC is a processing cost which is borne by the smelter/refinery. Therefore, in order to have a profit, the total operating costs should be lower than TC/RC.

TC is a unit cost per quantity of concentrate and is expressed as ¢/lb of copper quantity. Therefore, it varies depending on the copper content in concentrate. The following table shows conversion values for various concentrations. For example, at TC70$/t, the TC will be 11.8¢/lb with copper content of 28% but when it is 10%, TC will become 35.3¢/lb as a copper base. Profit is indicated as (TC/RC – production cost). Fig.4.21 shows both TC and TC/RC together, along with operating costs.

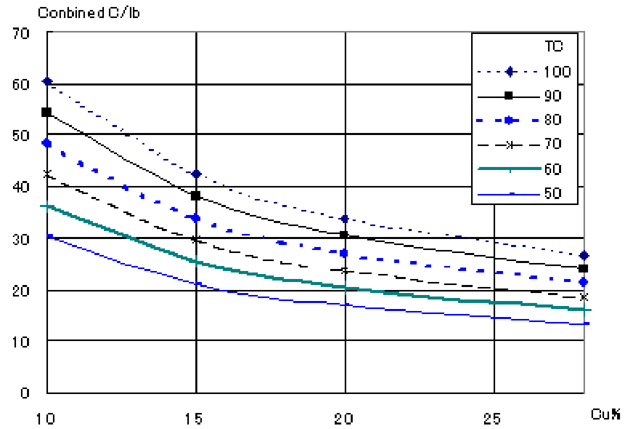


Fig.4.21 Relation between TC/RC and Operating Cost

Past trends in TC/RC are shown in Fig.4.22. The standard for copper content in concentrate is 28% Cu. According to this figure, TC/RC is changed by LMC prices. TC/RC in the RTB Bor is unknown, but sale and cost should be managed according to the international standard. There is no specific relationship because it is determined by the supply and demand conditions of concentrate and the relation between the seller (mining side) and the buyer (smelter side). However, the maximum was something like 35¢/lb (TC/RC=130/13) and the minimum was 10¢/lb (TC/RC=40/4). Also other sources of smelter profit are described as follows..

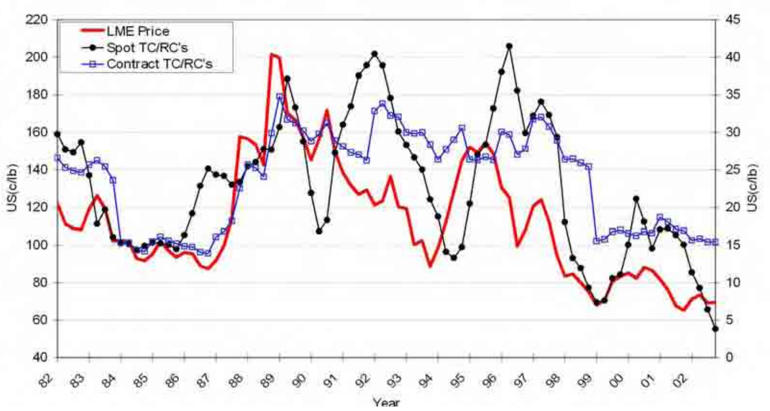


Fig.4.22 Trend of LME Copper Price and TC/RC (US /lb in 2002)

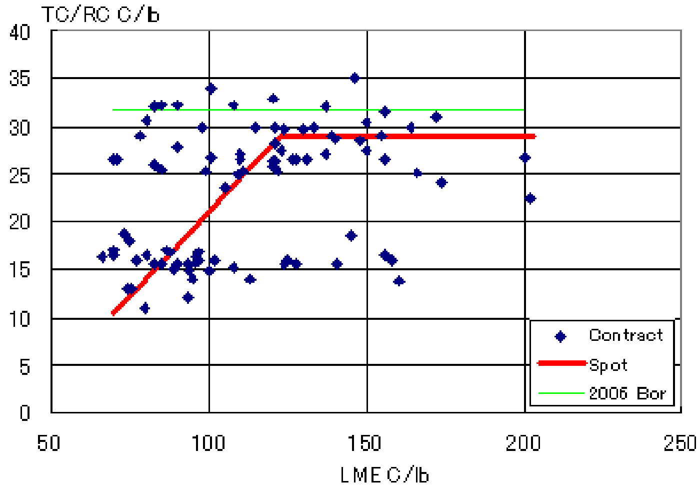


Fig. 4.23 Relation between LME Price and TC/RC

Transactions in copper concentrate are based on the copper content minus 1%. In other words, if the actual recovery is higher than that, there will be a profit. Copper recovery rate at TIR Bor is shown below.

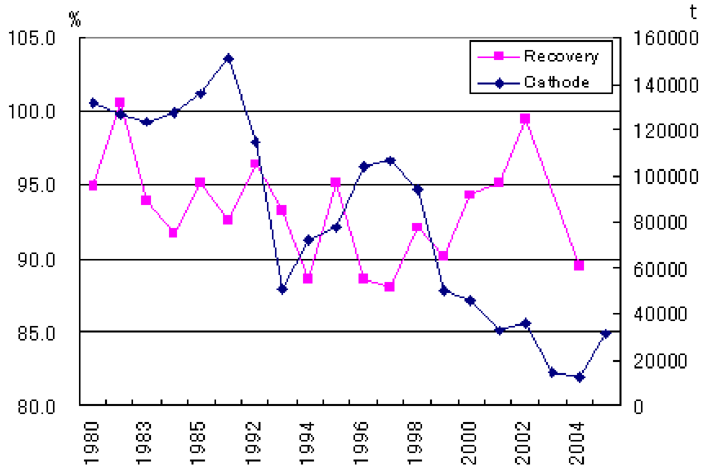


Fig.4.24 Copper Recovery Trend of the TIR Bor

Sulfuric acid is produced from sulfur in the copper concentrate but sulfur is not included in the concentrate price. If it can be sold at a price higher than the operating cost, it will produce a profit. However, sulfuric acid has been in over-supply recently and it is difficult to sell it under favorable conditions. At present, the operating cost is 20 euros per ton of sulfuric acid while the sales price is 0.5 euros per ton, meaning the loss is increased when more is produced. Therefore, it is needed to use sulfuric acid.

The average grades of Au and Ag in concentrate in the past were 5.5g/t and 36.7g/t, respectively. Assuming that the cut-off is 1g/t Au and 30g/t Ag, the contract recovery rate will become 82% Au and 18% Ag. The actual recovery rate is approximately 95% Au and 88% Ag, meaning there is a profit from this difference in recovery. It is linked with improvement of management to manage this profit/loss from gold and silver recovery.

4.4.4 Modification of the BOR Smelter

(1) Reverbertory Furnace Process

1) the production capacity is to remain at the present 160,000 t/y, incorporating pollution control measures into present facilities.

The present reverberatory furnace process has low operating cost and when the production is increased, the operating cost can be reduced further. At present, the operation is only to treat the copper concentrate from the Bor Mine, but it may be possible to increase profits by increasing the production and minimizing the operating cost.

The operation results up to 1990 show actual production of 165,000t/y. It is possible to continue operations by conducting maintenance which had been neglected and by implementing the pollution control measures.

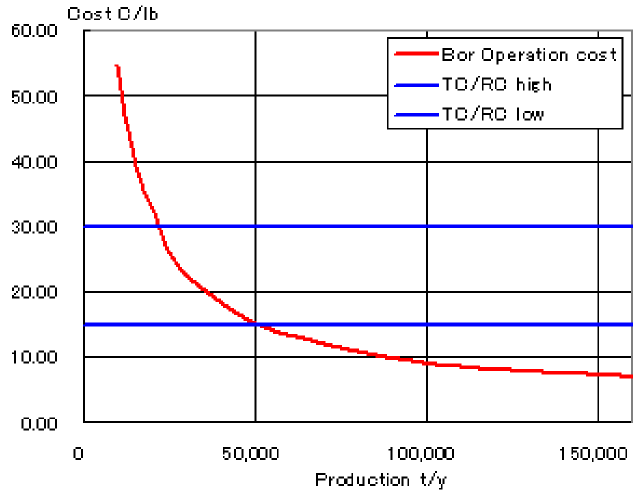


Fig.4.25 Minimum Profitable Level of Production

As shown in Fig.4.25, if the upper limit of TC/RC in the past was 30¢/lb, profit could be expected at a production level of 20,000t/y or higher and if the low limit of TC/TC was 15¢/lb, a profit could be expected at production of 45,000t/y or higher. Thus, TIR Bor should have a minimum production of 45,000 t/y. Prerequisite is shown as follows;

- Desulfurization system

The specifications of desulfurization system for 160,000 t/y production are estimated in the following table.

	Nm3/hr	SO2 %	SO2 Nm3/h
Reverberatory gas	140,872	0.75	1057
Sulfuric acid exhaust gas	278,650	0.32	900
Total	419,522	0.47	1957

- Construction cost (Lime/Gypsum process) US$30 million

- Operating cost US$ 2.1 million /y including indirect costs

0.59 ¢/lb as 160,000 t/y copper production

(These are very rough figures.)

- Wastewater treatment system

At present, there is 440m3/day waste water discharge and that at full capacity operation is assumed to be 530m3/day.

Construction cost (Neutralization + iron coprecipitation process) US$3.5 million

Operating cost US$ 3 million /y including indirect costs

0.85¢/lb as 160,000 t/y copper production

- Grand total for pollution control measures

Construction cost US$33.5 million

Operating cost 1.44 ¢/lb

(2) Smelting Process

The copper smelting has a long history, and there are many processes developed. Basically, the process is divided to two steps, which are primary smelting and converting. Many types of furnaces are used for primary smelting, but currently in most cases PS converter is used for converting.

(3) Implementing a New Copper Smelting Process

Table 4.9 shows a comparison of operating costs among smelting processes. The areas are divided because the labor cost and energy cost are different in each area.

The smelting cost of reverbertory furnaces is the second highest in all areas following blast furnaces. At Bor, there is a special situation in that the smelting cost is low because of the low unit costs of energy and manpower, but as internationalization progresses, there is a likelihood that smelting costs will increase.

Table 4.9 Comparison of Operating Costs by Smelting Process (direct cost)

Smelting cost C/lb 1993

	Africa	Asia	Australia	W Europe	Latan America	N.America
Reverberatory	8.8	25.1		28.2	10	16.6
OKO Flash		17.8	5.7	16.4		11.3
Inco flash						12.6
Noranda						13.6
MI		20.1				9.9
ISASMELT			12.4			12.6
Blast	27.6				39.8	
Electric	7.6	10.6		23.4		
Noranda			12.6			
CMT					9.7	

1) New Smelting Process

In the new smelting process, the functions of the roasting furnace and reverbertory furnace of the Bor will be performed by only one furnace. This will eliminate production of low-concentration SO_2 gas from the reverbertory furnace and will allow the use of a double contact system sulfuric acid plant that requires rich SO_2 gas. In this double contact system sulfuric acid plant, the conversion rate to sulfuric acid can be improved by a single contact system from the present 95% to approximately 99.5%, thus eliminating the need for a separate desulfurization plant. The mainstream smelting process has been transitioning from Flash -> MI-> CMT->ISASMELT or AUSMEL (Fig.4.26).

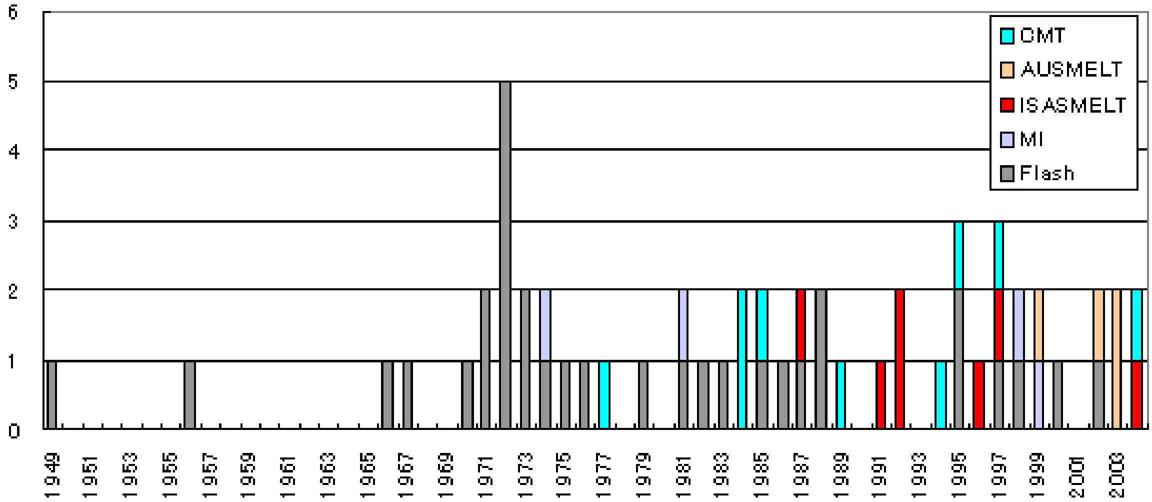


Fig.4.26 Trends in the Use of the New Smelting Process

The TIR Bor was planning to convert to the new process in 1979, 1990 and 1998, but it still has not been materialized.

4.4.6 Plan for Improving the Program

Assuming privatization, tentative improving program and scheduling is shown as follows;

(1) Countermeasure against Pollution

1) Air Pollution

As a first step, the priority should be given to re-starting of existing sulfuric acid plants that have been shut down due to lack of spare parts. The air antipollution measure should be given priority to in terms of time, and it is necessary therefore to return to the original design capacity of the existing facilities, and to settle the deficiency of the existing facilities ability.

As a second stage, it is necessary to reduce the SO2 discharge from the smelting facilities in operation. In the first stage, the lack of capacity of existing facilities should be determined and decide the remodeling specifications.

In the third stage, the establishment of the SO2 removal facilities matched with remodeling of smelting process is necessary. A long construction period may become necessary in order to make a decision of the plant capacity, the choice of smelting process, preparation of a large amount of investment. So, it is desirable to carry out this stage in two steps.

2) Effluent

An existing plant has only wastewater treatment facilities for #3 sulfuric acid plant. It is necessary to expedite the decision on the quantity and the quality of wastewater of sulfuric acid plants, refinery and others, and it is necessary to start the construction of wastewater treatment facilities immediately.

(2) Plan for Improving Schedule

a. 2007 Selection of desulfurization process — Cu production 40,000 t/y
Order for wastewater treatment facility

b. 2008 Order for desulfurization plant, construction — Cu production 40,000 t/y
Completion of the wastewater treatment facility
Ameliorate poor maintenance including restoration of acid plant

c. 2009 Completion of the desulfurization plant — Cu production 40,000 t/y
Start operation of the wastewater treatment facility
Ameliorate poor maintenance including restoration of acid plant

d. 2010 Start operation of the desulfurization plant
Production expansion by reverb. furnace — Cu production 160,000 t/y
When concentrate from Bor mine is not enough, imported concentrate is used.

e. 2011 Start research on the introduction of a new smelting process
Determine production capacity, select smelting process, execute feasibility study, etc.

f. 2013 Place order for new smelting process

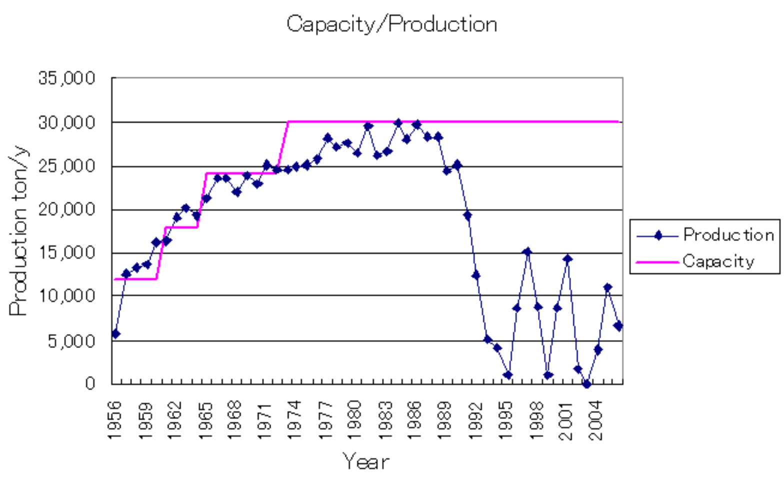
g. 2017 Start operation of new smelting process plant

4.4.7 The Zorka Zinc Smelter/Refinery

(1) Production Trend

Similar to the Bor Smelter, the Zorka Zinc Smelter/Refinery had been steadily increasing production. However, production dropped sharply because of the outbreak of the war in 1990 and the subsequent economic sanctions by EU countries. In 2006, production was 6,000 tons compared with an annual production capacity of 30,000 tons.

Fig.4.27 Production of Zinc in the Zorka Smelter



The residue treatment system is a jarosite process. The factory cannot procure concentrate and 10% of zinc remains in residue and the zinc recovery rate is 87%

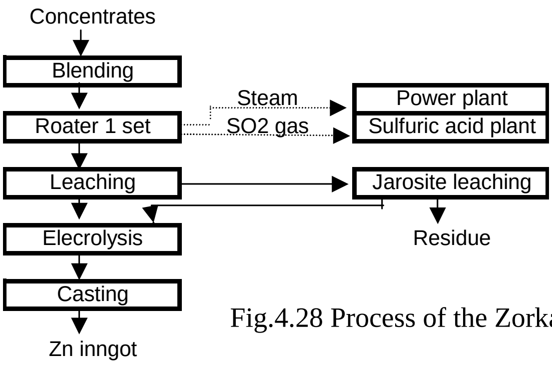


Fig.4.28 Process of the Zorka Smelter

4.4.8 Current State and Task of Metallurgical Education

In Serbia, metallurgical education is provided at the Faculty of Metallurgy in the University of Beograd and at Technical Faculty of the University of Beograd in Bor. Recently, there has been much more interest in popular courses like management and there are only a few students in metallurgy. Thinking of the Bor Smelter in the future, improvement shown in 4.4.6 should be implemented to recover production, and it would be linked with employment of students and fosterage of successors.