NO.

Japan International Cooperation Agency(JICA)

Steering Committee of Study on Mining Sector Development Master Plan
of Government of the Republic of Armenia

Study on Mining Sector Development Master Plan
in
The Republic of Armenia

Final Report
(Summary)

October, 2003

Mitsui Mineral Development Engineering Co., Ltd.

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Preface

In response to a request from the Government of the Republic of Armenia, the Government of Japan decided to carry out the Study on Mining Sector Development Master Plan in the Republic of Armenia. The Japan International Cooperation Agency (JICA) implemented this study.

JICA sent a study team led by Mr. Masaharu Marutani of Mitsui Mineral Development Engineering Co., Ltd. The team consisted of the Mitsui Mineral Development Engineering Co., Ltd., Japan Association for Trade with Russian & Central-Eastern Europe, UNICO International Co., MESCO Inc. and PACRIM Resource Development Inc. There were five trips to Armenia from March 2002 to October 2003.

The study team held discussions with government officials related to the mining industry and conducted field surveys. After returning to Japan, the study team carried out further studies and compiled the final results in this report.

We hope this report will contribute to the promotion of the mining industry sector and make a more close relationship between both countries.

We also express our sincere appreciation to the Government of the Republic of Armenia and its officials related to the mining industry organizations for their cooperation throughout the study.

October 2003

Tadashi IZAWA
Vice President
Japan International Cooperation Agency

October 29, 2003

Mr. Tadashi IZAWA
Vice President
Japan International Cooperation Agency
Tokyo, Japan

Letter of Transmittal

We are pleased to submit the report of the Study on Mining Sector Development Master Plan in the Republic of Armenia to you.

This study was conducted by Mitsui Mineral Development Engineering Co., Ltd. with the Japan Association for Trade with Russian & Central-Eastern Europe, UNICO International Co., MESCO Inc. and PACRIM Resource Development Inc. under a contract with JICA during the period from March 2002 to October 2003. This report compiled and summarized the promotion and improvement measures for the basement fields of the mining sector and production field through the recent condition analysis and results of the case study for mining promotion in Armenia.

Improvement measures are positioned in the promotion Master Plan toward the recovery and growth of the economy by the mining sector. We hope that the Armenian government realizes this Master Plan as its highest priority subject based on the necessity of the development of society and economy for the whole country of Armenia by the recovery of the mining industry in the transition to a market economy and by the improvement of productivity, promotion of investment and introduction of foreign investment.

We would like to express our sincere gratitude to the officials of JICA, Ministry of Foreign Affairs and Ministry of Economy, Trade and Industry for their support and guidance in carrying out this project. We are grateful to the officials of the Steering Committee and Working Group for this study in Armenia, Embassy of Japan in Russia and JICA U.K. Office for their cooperation and assistance throughout our field study.

丸谷雅治

Masaharu MARUTANI
Leader
Study Team on Mining Sector Development
Master Plan in the Republic of Armenia

STUDY ON MINING SECTOR DEVELOPMENT MASTER PLAN IN THE REPUBLIC OF ARMENIA
SUMMARY OF FINAL REPORT

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CHAPTER 1 OUTLINE OF STUDY

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1. Background of Study

Since the independence in September 1991, the Armenia government started economic reforms by the introduction of a national currency (dram), tax regulation reform, privatization and implementation on the arrangement of law for the reconstruction of a free economic system. The World Bank and IMF have supported the promotion of the reform.

The mining industry in Armenia has recovered to almost the same production level as it had before independence, though some mines are in financial difficulties. The Armenia government has placed greater importance on the privatization of state owned mining companies, restructuring mines and smelting plant and new mining development, connecting the promotion of mining to the use of its vast metal resources as copper, molybdenum and gold in Armenia. The government has carried out the arrangement of the conditions for investment and has invited foreign capital participation.

2. Purpose of Study

The purpose of this study is to make a Master Plan for mining promotion in Armenia.

3. Target of Study

Target area for the study is the whole territory of Armenia. Target metals are mostly copper, molybdenum, gold and zinc.

4. Method of Study

In the investigation stage, the role of the mining sector in the mining policy and economic condition in Armenia was clarified. Mining administration and organization system, law and tax system, accounting standard, infrastructure and mineral potential, and present condition of mining, smelting and environment were studied. The extraction of issues and the analysis of hindered factors were attempted. Draft of the promotion of the mining sector master plan was concreted (Fig. 1-1).

The study was basically carried out by interviewing and collecting of data and documents from governmental and mining organizations and companies related to the mining industry. The utilization of a database on mineral resources and website was grasped. The basic designs of the mineral resource database and website to promote foreign investment were concreted. In addition, managements of the Kapan mine and Alaverdi copper smelter were studied as mining facilities of a case study and their issues were extracted. Economic evaluation was performed on the basis of an improvement plan. The technical transfer has been attempted through discussion to realize the action program and Master Plan. Also, the technical transfer was done through software training during the design of the database and GIS (Geographic Information System).

At the Master Plan formulation stage, each draft of the Master Plan (10-year strategy and development policy), action program (5-year development plan) and policy proposal based on materials and data, which were gathered and analyzed in the investigation stage, were implemented. Moreover the website was strengthened. After the drafts were discussed with the Armenian side,

the Master Plan has been settled. Investment seminar and mining seminar were held and the summary of the study was explained

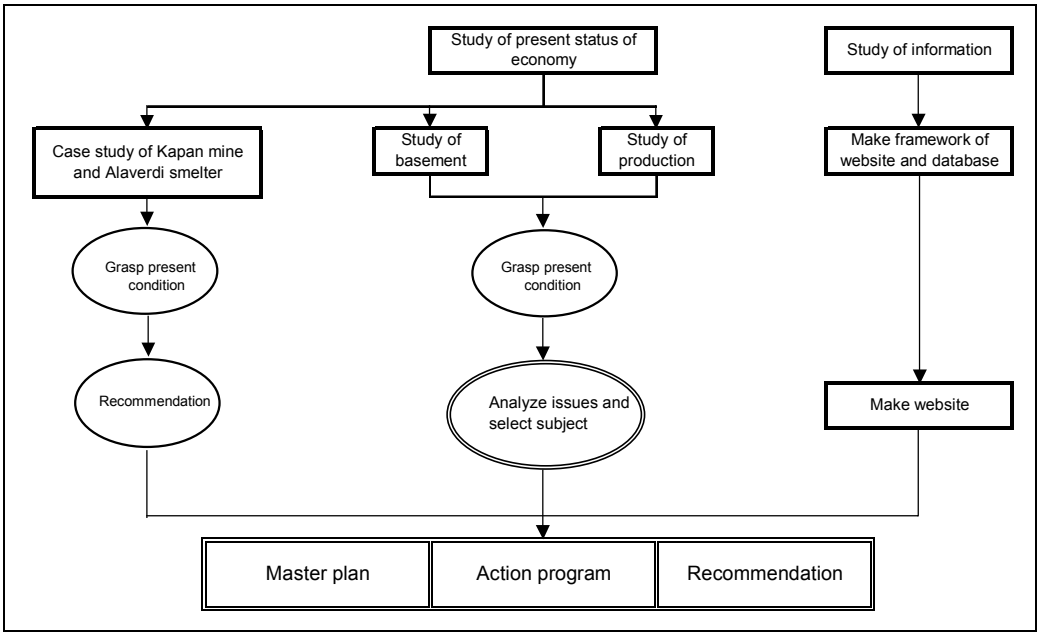

Fig. 1-1 Flow Sheet of the Survey

5. Implementation of Site Study

The Prime Ministerial Decree to establish the Steering Committee was issued in Armenia. The role of the Steering Committee was to supervise activities of the Joint Working Group and provide policy and strategic directions for the Joint Working Group activities, as well as consider possible ways of necessary support for Japanese study team activities.

The members of the Steering Committee are as follows:

Mr. K. Chshmarityan	Minister of Trade and Economic Development of the Republic of Armenia (RA) (Chairman of the Committee)
Mr. G. Sanoyan	Deputy Minister of Nature Protection of the RA
Mr. M. Mikaelyan	Deputy Minister of Finance and Economy of the RA
Mr. A. Ashughyan	Director of Mining Industry Department, MTED of the RA
Mr. T. Sukiasyan	Head of Investment Policy Department, MTED of the RA
Mr. R. Karapetyan	Director of Asian, Pacific and African Department, Ministry of Foreign Affairs of the RA
Mr. A. Matevosyan	Head of Mineral Resources Department, MNP of the RA

The Armenian members of the Joint Working Group are as follows:

Mr. T. Sukiasyan	Head of Investment Policy Department, MTED of the RA

	(Head of Joint Working Group)
Ms. J. Ghlichyan	Head of Normative Methodical Department, MNP of the RA
Mr. G. Shekhyan	Director of "Geoeconomics" Scientific Center
Mr. S. Hovakimyan	Chief of Mining and Construction Materials Section, MTED of the RA
Mr. T. Petrosyan	Chief Specialist of Legislation Department, MTED of the RA
Ms. M Vardanyan	Leading Specialist of Mining and Construction Materials Department, MTED of the RA
Mr. S. Tsaturyan	Leading Specialist of Mining and Construction Materials Department, MTED of the RA

The site study in Armenia was carried out at five times in 2002 and 2003. The Japanese study team was composed of the following 11 members taking part in the implementation of the study and making the report. The responsibility of each member was as follows:

Mr. Masaharu Marutani	Team leader
Mr. Yuji Nishikawa	Mining industry promotion plan
Dr. Allen Clark	Mining related legislation and organization
Mr. Kunio Okada	Macroeconomics
Mr. Hiroshi Hasegawa	Mining enterprise accounting and management diagnosis
(Mr. H. Masuda until September 2002)	
Mr. Kazuki Shingu	Mining and processing technology
Mr. Shinichiro Muto	Metallurgical technology
Mr. Morio Hashimoto	Geology
(Mr. H. Harada until September 2002)	
Dr. Takashi Ohya	Environment
Dr. Kazushige Wada	Database Design
Mr. Choshin Haneji	Coordinator
(Mr. M. Saito until March 2003)	

The Japanese study team was invited to participate in four sessions of the Steering Committee and agreed contents and confirmed the minutes.

The Japanese study team procured equipment in Yerevan by an order from JICA and installed the equipment at the study team's office in MTED of the Republic of Armenia.

Mining investment seminar in Caucasus sponsored by JICA was held at City Club at a session of the Association of Mining Analysts in London, United Kingdom on 26 September 2003. Mining seminar sponsored by JICA and MTED was held at the Queen Erato room at the Armenia Hotel in Yerevan on 1 October 2003. Presentation of the Mining website was carried out at the latter seminar.

CHAPTER 2 MINING INDUSTRY

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1. Outline of Mining Industry

1-1 Economic Conditions

In 2001, Armenia's GDP was 1,175 billion dram (some US$2.1 billion) and its growth rate was 9.6%. The 2001 GDP consists of agriculture (25.0%), industry (20.2%), commerce (9.8%), construction (10.7%) and transportation and communication (7.5%) (Statistical Year Book of South Caucasus 2002). No remarkable changes have been made since 1998. The growth of Armenia's GDP for 2002 was 12.9%. This was the highest growth rate after the independence of the country.

In 2002, Armenia's trade resulted in exports of US$457 million (increase by 33.6%) and imports of US$877 million (almost the same), totaling US$1,334 million (increase by 9.4%) as compared with the results of the preceding year. Thus, the trade deficit decreased to US$420 million from US$531.5 million in the preceding year.

According to the Central Bank of Armenia, the inflow of direct foreign investments for 2001 fell to US$76 million from US$104 million for 2000. It is undeniable, because of the delay of credits and loans from IMF and other organizations, the total amount of investment also had been decreased.

The reform of the financial system is still progressing, and the systems of loans and credits to the industries, one of the most important functions of banks, is still immature. As companies become joint-stock companies and the stock transactions on the market became more active, practically, domestic funds can be capitalized. However, the amount expected at present is extremely limited.

A number of international organizations including IMF, the World Bank, USAID, EBRD and UNDP provide Armenia with many kinds of supports. Beginning with the guidance of the financial policy provided by IMF, their supports include improvement of the environment for investment, reform of financial systems, corporate restructuring and promotion of privatization. The amount of foreign debts was a little more than US$900 million as of the end of 2001. Most of the foreign debts represent the supports of international organizations. In this sense, their supports are indispensable to Armenia.

1-2 National Budget

(1) National Development Plan

In 2002, the revenues were 228.3 billion drams, the expenditures were 263.8 billion drams and GDP budget deficit rate was 2.6 %. The 2003 budget sets revenues at 287 billion drams and expenditures at 334.2 billion drams. Under the present circumstances, it will be impossible for the national economy of Armenia to be free from the existing deficits. As for the expenditures, its social foundations may be maintained at the most, but its investment for the economic growth may not be proceeded.

1-3 Economic Policy

A reduction of budget deficit through an increase of revenue is one of the most important economic policies. With respect to this matter, a certain result was obtained during these years. To

make underground transactions open, tax police was newly established. It is also necessary to facilitate the reform of the public sector that includes the electricity and water supply businesses and decrease the liabilities of the national budget by intensifying the efficiency of management. The general reform of enterprises is also one of the important problems. However, the solution to the problem made little progress since the introduction of foreign capital remains unsuccessful.

1-4 Privatization

Since 1995, approximately 7,000 small-scale companies and more than 1,500 medium- and large-scale companies were privatized in Armenia. Many of these companies were privatized in the initial stage of the privatization project. Since the companies were sold to inexperienced individuals, the transfer of the latest management techniques and promotion of the equipment renewal were not attempted as had been expected of their privatization. After all, corporate reforms did not make progress in many cases. In 2001, a list of more than 900 companies subject to the final privatization was prepared to ensure further promotion of the intended privatization and approved by the Parliament. This program will include strategically important state enterprises related to mining, metal and energy and so on.

1-5 Present Situation of Mining Industry

Armenia does not produce energy resources such as coal, oil and natural gas. All the energy resources are imported from Russia and Turkmenistan of the CIS countries. Armenia produces gold, silver, copper, molybdenum, lead, zinc and rhenium. The important metals among within them are copper molybdenum and gold. Molybdenum is produced from accompanied minerals with copper ore. Armenia had supplied one-third of the molybdenum in FSU.

In Armenia, seven enterprises manage nine facilities of mines, plants and smelter (Table 2-1). Within those mines, the Kajaran copper-molybdenum mine was the largest molybdenum mine in FSU time. The mine has been managed by the Zangezur Complex State owned CJSC. Financing of the company has been increasing due to the sale of copper and molybdenum concentrates. In 2001, the mine produced 8 million tons of crude ore, and it corresponded to a 90 percent of 1989 production.

The Ararat Gold Recovery Company (AGRC) manages two gold mines: Zod and Megradzor. Moreover, the company recovers low-grade gold (1.0 g/t Au) from slime in the tailing dam near the Ararat gold processing plant. The annual gold production ranges from 2 to 3 tons.

Armenia Copper Programme (ACP) manages the Alaverdi smelter. In 1989, facilities and equipments of the smelter were destroyed under the pretext of environment issues. In 1998, ACP (at that time Manes & Vallex Co.) reconstructed the facilities and equipments of the smelter and resumed production. In 2001, it produced 7,000 tons of crude copper. The present operation rate is 40 percent of the capacity because of the shortage of copper concentrates. This productivity is very low as compared with 40 thousand tons of electric copper and 180 thousand tons of sulfuric acid in 1980. Copper, molybdenum and gold are imported to Europe and Iran. There are no domestic markets in Armenia such as processing and manufacturing industries to use these metals at the present time.

Table 2-1 List of Mines and Smelter in Armenia

Mine/ Smelter	Company Combinat	State/ private	Final product	Production(t) 2002	Market
Shamloukh	Metal Prince (Akhtala Combinat)	Private (Foreign)	Cu metal in Cu-concentrate	300-600	ACP
Alaverdi	Armenia Copper Programme (ACP)	Private (Foreign)	(Cu metal in Cu-concentrate) Cu blister	(2,400) 7,000	Germany
Kajaran	Zangezur CJSC	State	Mo concentrate Mo Trioxide Cu metal in Cu-concentrate	5,400 650 12,000	Pure Iron, Comsup Commodity Glencore, ACP
Agarak	Agarak CJSC	State	Mo concentrate Cu metal in Cu-concentrate	450 4,000	Pure Iron Glencore
Kapan	Kapan CJSC	Private (Foreign)	Cu metal in Cu-concentrate Zn metal in Zn-concentrate	1,000 700	Iran non
Zod Megradzor Ararat tailing	Ararat Gold Recovery Co. (AGRC)	Private (Foreign)	Au-Ag Dore Au	kg 2,800	UK
Yerevan plant	Pure Iron	Private (Domestic)	Ferro Molybdenum	2,000	Europe

The mines and smelters have polluted the river by heavy metals and still continue to pollute the air and soil. Research on scope of environmental pollution and influence to environment have been partly carried out and grasped by universities and institutes. The government has not grasped the actual situation of environmental pollution such as wastewater and dust from mining industry. The above situation is the result from superannuated analyzing equipment in the national supervisory organization and the decline of analytical facilities. The government and enterprise have recognized the importance of environmental issues, but do not carry out the countermeasures against the pollution and prevention activity because of a lack of finance.

1-6 Position of Mining Industry in the Macro-economic System

The GDP of 2001 was composed of agriculture 25.0%, industry 20.2%, trading 9.8%, construction 10.7%, and transportation & communication 7.5%. Metal mining and base metal production accounted for 6.1% and 7.3% of the total industrial production, respectively (Table 2-2). Armenian metal mining includes almost no iron ore mining and includes aluminum only in a small percentage. Therefore the Armenian metal mining seems to handle mostly nonferrous metals only. It is estimated, consequently, that so-called nonferrous metal mining accounted for 2.7% of the GDP in 2001.

Table 2-2 Mining Industries in GDP

	Number of Employee (thousand)			Number of Employee (ratio)			Production (current price: million US$)			Production (ratio)			Production increase (compared to previous year)		
	1999	2000	2001	1999	2000	2001	1999	2000	2001	1999	2000	2001	1999	2000	2001
Industry	195.2	179.7	…	100	100	100	529.7	557.1	552.3	100	100	100	5.3	6.4	3.8
Mining	5.7	6.2	…	2.9	3.5	…	20.6	29.8	36.4	3.9	5.3	6.6	16.2	24.7	19.7
Metal mining	…	…	…	…	…	…	18.0	27.1	33.6	3.4	4.9	6.1	13.7	28.5	20.9
Poduction	170.7	155.7	…	87.5	86.6	…	339.8	359.2	358.0	64.1	64.5	64.8	10.5	6.9	7.5
Base metal production	…	…	…	…	…	…	14.5	33.0	40.5	2.7	5.9	7.3	51.3	110.2	43.8

1-7 Situations of Mining Industries in the Neighboring Countries

Mining industry in Georgia is composed of energy and fuel resources of coal and

petroleum, steel, non-ferrous metals, industrial materials and building materials. As introduction of market economy, the production has reduced drastically. State-owned enterprise of the Madneuli mine (copper and gold) has operated steadily. In 2001, the Madneuli mine produced 1.4 million tons of copper crude ore and 57 thousand tons of copper concentrates. At present, joint venture between State Department of Geology of Georgia and an Australian mining enterprise has been prospecting copper and gold resources in the Bolnisi mining region of the southern Georgia.

Iran is blessed with vast petroleum and gas. While, mineral resources in Iran are comprised of coal, iron ore, non-ferrous metals, construction materials and industrial materials. Chief non-ferrous metal resources consist of copper, lead, zinc, chromium and manganese. Compared with energy resources, mining industry has not developed well. Rate of mining industry in GDP correspond to 1 % in 2001. Porphyry copper-molybdenum deposits embedded in the southern Armenia extends to the southeast, and they make Iran a worldwide copper production zone. Proved reserves of copper metal account over 3 billion tons. Operating mines and smelters are of the Sungun copper mine, which locates in 120 km from the border of Armenia, and the Ser Cheshmeh copper smelter in the southern Iran. The Sungun mine produces 180 thousand tons of copper concentrate annually, and the Ser Cheshmeh smelting plant produces 160 thousand of copper metal yearly.

2. Mining Administration, Organization and System

2-1 International Best Practices in Mineral Sector Institutional Organization

Although the overall structure of mining sector institutions may differ in detail and complexity from country to country it is important to recognize that the institutional, organizational and functional components of the mining sector institutions are not country dependent and should be the same in virtually every nation.

The functions of a public mineral sector institution responsible for the mineral sector of a nation can be summarized in terms of; (a) policy formulation; (b) granting of mineral rights; (c) environmental and social permitting; (d) monitoring, regulation and enforcement and (e) geological infrastructure development. As a result of these functional responsibilities the essential institutional building blocks would be as shown in the Fig. 2-1 that would have the following responsibilities:

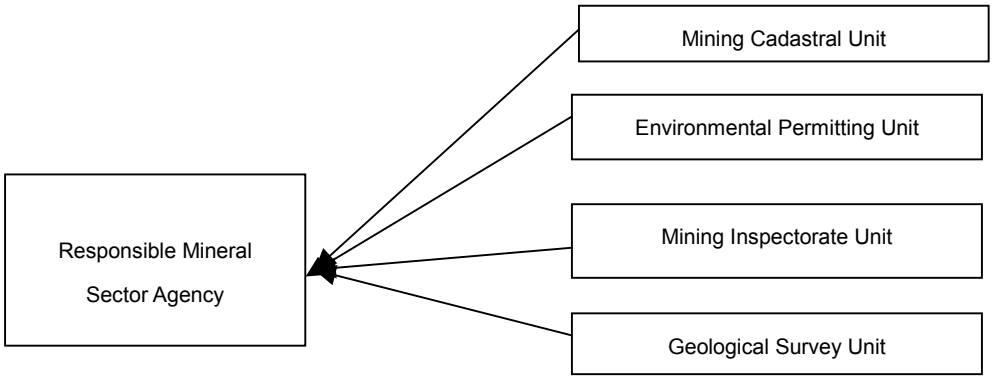


Fig. 2-1. Basic Framework of a National Responsible Mineral Sector Agency

2-2 Institutional Organization of the Mineral Sector of Armenia

In total there are over 20 individual Agencies/Commissions/Departments, in 8 Ministries, as well as the National and Local Governments, that have a role in mineral sector development in Armenia. Over 10 institutions have line responsibilities in terms of providing necessary approvals for the granting of licenses and contracts. This myriad of involved institutions, many with overlapping, duplicative or poorly defined mandates, was largely responsible for the low level of domestic and international interest in investment in the mineral sector.

Main purpose of new laws, the "Law on Subsurface of 2002" and the "Concession Law of 2002" is to solve complicated procedure in present mining sector. Although it is widely recognized with the Government of Armenia that there is a need for a central Authorized Body, and recent legislation provides for the creation of a single Authorized Body, subsequent decisions within the Government of Armenia have resulted in the creation of two Authorized Bodies (Fig. 2-2): i.e. an Authorized Body for Exploration located within the Ministry of Nature Protection and an Authorized Body for Exploitation to be located within the Ministry of Trade and Economic development.

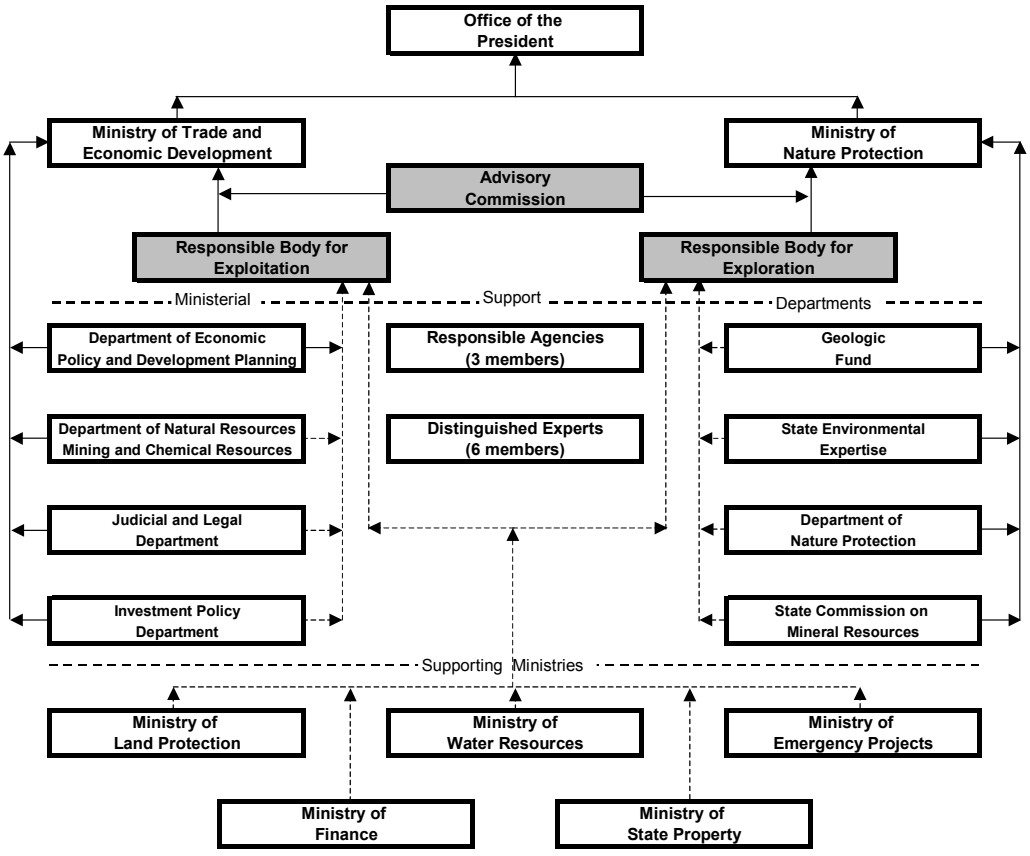


Fig. 2-2 Organizational Structure of the Responsible Body for Exploration and the Responsible Body for Exploitation

The creation of two Authorized Bodies, each within a separate Ministry, and with differing responsibilities appears largely to reflect the political difficulties inherent in restructuring traditional ministerial responsibilities.

3. Law and Taxation

3-1 Law

Detailed critiques of the key legislation pertaining to the mineral sector of Armenia are:

- Subsurface Law {Law on Subsurface of the Republic of Armenia (December 27, 2002)}
- Concession Law {Concession of Deposits for Purposes of Prospecting and Mining of Minerals of the Republic of Armenia (July 2, 2002)}.

and were enforced in April, 2003. The enactment of the Concession Law and Subsurface law potentially provides a basis for dramatically improving access to exploration and mining rights (Table 2-3). Notwithstanding recent legislation, the administrative process is still quite complex and provides for several layers of Government approval for both exploration rights.

Table 2-3 Comparison of Access to Exploration and Mining Rights in Armenia Compared to International Practice

ISSUE	ARMENIA PRACTICE	INTERNATIONAL BEST PRACTICE
1. Availability of areas	The potential investor defines the area/deposit of interest. Provides for a publicly available mining cadastre.	All areas that are not designated by law as off limits and are not already taken are available. The information is shown on maps of the mining cadastre, open for public consultation.
2. Application procedure	Application for either a "regular" or "Special" prospecting or mining license (Standard form not determined). Open tender or closed tender, as decided by the Government.	Generally, by standard form application to the registrar of mining titles. Tenders only in rare cases of disposition of known valuable properties extensively explored by the state.
3. Grant criteria	First eligible applicant for the area provided that there is no overlap of existing licensed areas. Extensive evaluation.	First eligible applicant for the area provided that there is no overlap of existing licensed areas. Limited evaluation of financial or technical background.
4. Form of mining rights	Negotiated contract, based on Model Contract.	License, permit, lease or concession, containing standard terms fixed by statute.
5. Time required	Weeks to months	Hours, days or weeks.

Armenia's requirement that exploration and/or production contractors reimburse the State for historic geological exploration costs is contrary to international practice and is not competitive. Other well-endowed mining countries provide extensive geological information to potential investors for free or at nominal cost in order to promote investment in the development of their resources.

Issues and recommendations concerning Law are as follows;

1. Pending mineral sector legislation (Mining Code and Concession Law) need to be rationalized to ensure consistency between the two laws.
2. Government needs to rationalize existing legislation within the mining sector with that of ancillary sectors (environment, forestry, land, water)
3. The issue of State "ownership" versus "stewardship", as defined in the Constitution of the Republic of Armenia need to be clarified by decree.
4. Existing legislation should be modified to provide, which it presently does not, security of tenure by addressing:
    a. Ambiguity in existing legislation as to whether mining rights are property rights or contract rights should be clarified, by defining and treating such rights as property rights;
    b. Grounds for termination of Subsurface Utilization Rights should be restricted to the

provisions of the Constitution i.e. Confiscation of property for the needs of society and the state may occur only in exceptional cases with prior full compensation on the basis of the law.

5. Transfers of mining rights should be permitted generally according to the procedure specified for pledges, except that existing policy should be modified to state, "Approval of transfers may not be unreasonably withheld by the Government".
6. Environmental permitting should be treated as a separate condition for operating after an exploration right has been granted and the proposed permitting process should be streamlined.
7. Restrictions on operating and marketing freedom – particularly requirements on reserve evaluation, production levels and use of local providers – are not competitive and should be eliminated or dramatically modified.
8. Stability of terms and conditions should be maintained as currently in effect under the Concession Law, except that the existing payment/refund system for VAT should be modified to allow for exclusions before payment.
9. A comprehensive mine closure plan, with appropriate funding, should be added as a component of a Concession Contract.
10. Mineral sector legislation should explicitly provide for direct and indirect Government funding of the Authorized Body and associated mineral sector institutions.
11. Environmental legislation of the Republic of Armenia should be dramatically revised and modernized both in general and as it applies to the mining sector specifically.

3-2 Mineral Sector Taxation

Although the tax regime of the republic of Armenia, as it applies to the mining sector is quite similar to other tax regimes internationally it differs significantly with respect to two major issues i.e. the VAT and the proposed Additional Profits Royalty.

Issues concerning VAT are as follows;

- Tax revenues in Armenia account for approximately 15% of GDP.
- Approximately 40-45% of tax revenues come from VAT.
- Approximately 10-20% of tax revenues come from Income Tax.
  The level of VAT in Armenia is very high (20%)**.**
- The mining sector receives a full rebate on all VAT paid to the Government.
- The rebate to the mining sector is approximately 20% of total VAT.

Although the mining industry receives a full rebate of VAT paid there are still two major, and inter-related problems for industry .

- Industry is neither exempted nor zero-based from the payment of VAT and as a result there is an initial capital outlay required by the Company.
- Because industry must pay the VAT there always remains the time-consuming, costly and often contentious issue of valuing the resource in order to assess the VAT.
- The refund of the VAT is a complex and often time-consuming activity which delays the VAT refund, results in economic costs in terms of lost interest and opportunity costs of

non-utilization of capital.

In essence the VAT in Armenia is a distorting tax that meets none of the internationally accepted best practice principles of neutrality, efficiency and equity. As such the process should be radically streamlined and modified.

Additional Profits Royalty in the Concession Law is as follows;

- Royalty at the rate of one per cent of the aggregate net back value of sales of metallic minerals (see comment on Article 44.1 re precious mineral), and
- An additional royalty at the rate of 0.1% for each 0.8% by which the profitability index exceeds 25%.

The linkage of royalties to the profitability of the licensee is used in a limited number of countries. The setting of the threshold value at 25%, when average mine profitability ranges between 14-18%, assures that only the most profitable mines would pay the additional royalty and then at a modest rate that would not result in an effective royalty rate higher than the international average of approximately 2.0%. However, the additional profits royalty may well act as a disincentive to foreign investment

4. Information of Mineral Resources

All the information and reports on the exploration for mineral resources are kept and managed by the Geological Fund of the Department of Mineral Resources of MNP. There are about 20,000 reports kept at the Geological Fund. Most reports are the results of geological exploration. The reports should be compiled and digitized.

Information of state owned mines on production planning, ore reserves and environment is at MNP. Data on production planning and industrial safety is at the State Committee on Inspection. The information is not disclosed. It is difficult to obtain information to fully understand the mine.

Recently some database systems have been utilized in Armenia using the ArcView, one of the most popular desktop GIS and mapping system, in various fields; construction, environment, airport control and so forth. The usage is also expanding in research fields: in Scientific Academy, Yerevan State University and American University of Armenia.

In mineral resources fields the Geoeconomic Scientific Center under the Ministry of Natural Protection is constructing a geological database for the northern Armenian area using the ACP's ArcView system. The Geoeconomic Scientific Center is also producing digital geological maps using drawing software (CorelDraw), which can be utilized for the GIS database construction for near future.

5. Privatizations of Enterprises Related to Mining Industry

The Government of Armenia, under the "National Privatization plan for the period 2001-2003" called for the privatization of 12 major state owned enterprises of which four are in the mining sector: the Zangezur copper-molybdenum complex, Agarak copper-molybdenum complex, Kapan complex and Akhtala copper complex. The Akhtala complex was bought and privatized by Metal Prince Co. (Switzerland) in July 2002. And the Kapan complex was sold to the Deno Co. (Switzerland) in November 2002.

5-1 Status of Privatization in the Mining Sector

Since 1999 to date no privatization tenders have been put forward: indeed tendering efforts are not scheduled until the time period March 2003 to January 2004. The reasons for the delay in privatization in the mining sector have been the following:

- Mineral Resources are a National Endowment
- Mining Enterprises and National Debt
- Establishment of an Appropriate Legislative Regime
- Resources and National Security

5-2 Key Issues to Be Resolved

(1) Debt of Privatized Enterprises

Overall the debt burden of the various mining enterprises to be privatized Kajaran and Agarak) or recently privatized (Kapan) is/was quite high, considering the nature of the enterprises. At present the debt structure of the major enterprises is:

- Kajaran – No debt
- Kapan – Approximately $8-9 million
- Agarak – Approximately $4-5 million

(2) Valuation of Mining Enterprises

The Privatization Law requires that the responsible Ministry specifically prepare a valuation of individual enterprises, prior to tendering, consisting of (a) a financial-economic audit of the company and (b) a re-evaluation of the assets and liabilities of the company.

The problem of valuation of enterprises to be privatized in the mining sector represents a particular challenge to the Government of Armenia and to the MTED, nevertheless, it is a requirement that have to be met if the privatization of mining sector enterprises is to move forward.

5-3 Privatization Options for the Mining Sector

- Privatization by tender
- Privatization by Concession Contract
- Privatization by Bankruptcy and Acquisition
- Privatization by Combination Concession Contract and Tender/Management Contract
- Privatization by Capitalization

5-4 Conclusions and Recommendation

The main reasons for the slowdown of the privatization rates and decrease in revenues of state budget are:

- High price of enterprises to be privatized compared with market prices of similar enterprises;
- Presence of many policy, legislative, financial and organizational obstacles and difficulties during privatization;
- Absence of actual programs aimed at improving the financial situation of privatized

enterprises;

- Large accumulated debts, which cannot be paid back by the enterprises and unsatisfactory technical and physical condition of capital assets;
- Unsatisfactory levels of efficiency during pre-privatization preparation of enterprises.

It is recommended that the Government of Armenia consider the following in the privatization of mining enterprises:

1. Introduction of a clear and defined approach to the privatization of state-owned mining enterprises Kajaran and Agarak.
2. Consideration of the removal of debt, for existing mining enterprises that are no longer economically viable, from the national debt balance.
3. Undertaking of a comprehensive valuation of Kajaran and Agarak under market economy, as required by the Privatization Law of 1999.
4. The Government should seek technical and financial assistance for the conducting of the valuations above through the international organizations.

6. Accounting Standard

Accounting standards of Republic of Armenia (ASRA) is developed based on IAS, published by IASC. Accounting Standards of Republic of Armenia (ASRA) were developed in line with the IAS and were approved by the orders of the Ministry of Finance and Economy RA in 1999 and 2000.

The ASRA is expected to be introduced in the mining sector in 2006. In the new accounting standards, there is a major issue related to companies in the mining sector, which is now pending. It is concerned with research and development costs incurred in the exploration and commercial exploitation stage. According to the IAS, companies in the non-mining sector are required to report costs and expenses classified in "research" – as part of up-front investment (self-created intangible asset) – as non-recurring expenses, not as a fixed asset. On the other hand, those classified in "development" can be reported as an intangible asset and amortized over a specific period.

6-7 However, the IAS clearly exempts the mining sector from the above rules, including oil and gas development costs. MFE is now developing new standards. MFE intends to continue establishment of international standards regulating book- keeping in mining industry and then based on it develop state standards. Many companies in the mining sector want to treat a broad range of up-front investment costs incurred in the development stage as intangible assets in order to spread financial burdens and conceive various accounting methods.

In Armenia, efforts have been made to develop a new accounting system since 1997 as part of the transition to a market economy. While the new system and its framework has been built up, however, individual companies lack human resources to operate the accounting system according to the new accounting standards, making their education and training an urgent task.

7. Infrastructure

Infrastructure factors that may hinder mineral resources development in Armenia are transportation (railways and roads) and electric power.

transportation of copper and molybdenum concentrates produced at complex in the southern part of Armenia cannot presently utilize the railway network via Naxcivan because of political reasons. Mineral concentrates and other products are transported by truck for 300 km from individual plants to the Ararat Station, 40 km south of Yerevan, and then reloaded on railroad cars and transported to Yerevan, Alaverdi, and/or Poti port on the Black Sea coast in Georgia. Therefore all the mines and smelter pay additional expenses. Armenia has a disadvantage in terms of international competition with other countries because it is a landlocked continental country requiring additional transportation cost for mining products. Repairing and revamping trucks and freight trains are indispensable. At the, same time railway, road, and shipping facilities should be reorganized in near future.

Although electricity supply is stable currently, the raw materials for both thermal and nuclear power generation, which supplies 80% of electric energy, are imported from Russia and other foreign countries. Electric power in Armenia is costly because the country depends on raw material imports. In order to secure a stable power supply, friendly political relations with neighboring countries must be maintained. Some international support should be positively utilized for improvement and reorganization of power generation facilities. Electric power in Armenian mining enterprises accounts for about 30 % of all the production cost. Accordingly, the Kajaran Complex and Alaverdi Smelter have hydroelectric power plants of their own because of the reduction of costs. They are reducing more electric power costs through increasing the number and improvement of the plants.

8. Human Resources Development

It is important for Armenia to secure and train capable, hard-working people with a high standard of education. The country has many serious problems in education.

After independence, the mining education budget was reduced to 35%, and the education level was difficult to maintain because of the deterioration of education facilities, a shortage of teaching material, the aging of the teaching staff and a decrease of salary for the teaching staff. The number of students enrolled in mining-related courses is decreasing because the demand for mining engineers has fallen, and it is difficult for graduates to find a job in mining-related companies. With the aging of the teaching staff (the average age of the teaching staff is 60); its quality has fallen because of bad working conditions (a low salary). Young, excellent students tend to go abroad and gain employment instead of staying at their universities. Therefore, no one wants to be a teacher.

It is also difficult to maintain and renew the mining education facilities because of a shortage of funds. In this IT-oriented world, there is a serious shortage of computers, which affects the education in data processing and automation system in the Department of Mining and Metallurgy so this situation must be improved urgently. It is desirable that not only mining engineers but also talented persons familiar with mining economy and mining law will be nurtured so the related lectures in the university are improved.

9. Present Situations of Exploration Works

Since independence, the Department on Entrails and Mineral Resources Protection and related state owned exploration companies are in charge of the prospecting organizations of the government. Governmental exploration activity has stopped because of a lack of finance, reduction of personnel and decrepit machinery and equipment. State owned exploration companies have hardly grown. No prospecting program is progressing except around the operating mines to obtain additional ore reserves so some supports and assistance for exploration activity are needed.

MNP expects that geological survey and exploration will be advanced by foreign investors. But exploration by foreign investment is making slow progress because the geological information is in Russian or Armenian that are very difficult for the Western companies to gain easy understanding. New global information on exploration technique is limited because there are not so many geologists who understand English. Investment environment for the Western companies must be improved by translating Russian information into English. And the same time, possibility of foreign governmental cooperation works in exploration should be studied.

10. Evaluation of Mineral Potential

10-1 Characteristics of Mineral Deposits and their Distribution

Caucasus region is divided into Greater Caucasus, Transcaucasus and Lesser Caucasus from north to south. Northern Caucasus corresponds to the Scythian Platform of the southern end of the Eurasia plate, and Southern Caucasus corresponds to the northern end of the Arabian Plate. Caucasus occupies the adjacent zone of both plates. Each zone develops faults. The whole area of Caucasus is shown to be a tectonic zone. Many kinds of metals are deposited with relation to volcanic activity and intrusive rocks.

The Greater Caucasus is composed of basement rocks of Baikalian and Hercynian ages, and the Mesozoic group covers the basement. The Mesozoic group consists of slate, sandstone and tholeiite basalt of Jurassic age. Mineral deposits are composed of volcanogenic sedimentary copper deposits related to submarine volcanic activity in Devonian age, polymetallic deposits related to tholeiite basalt of earlier Jurassic age. The Transcaucasus is composed of crystalline schist of Hercynian age, basalt and calc-alkaline volcanic rocks of early and middle Alpine age and sedimentary rocks of late Alpine age. Mineral deposits consists of sedimentary manganese-iron deposits of Jurassic to Cretaceous age, volcanogenic massive sulfide deposits related to calc-alkaline volcanic rocks of Cretaceous, and gold and silver vein type deposits. The Lesser Caucasus is divided into northern and southern part by the Sevan-Akera ophiolite zone. The northern part is mainly composed of marine sediments of Jurassic to Cretaceous, and the southern part mostly consists of volcanic to intrusive bodies of Cretaceous to Tertiary and overlain volcanic rocks of Neogene and Quaternary (Fig. 2-3). Armenia is mainly composed of the Lesser Caucasus. Mineral resources are chiefly copper, molybdenum, gold, silver, lead and zinc. There are approximately 300 ore occurrences and manifestations of including iron and aluminum in Armenia. There are also 500 non-metallic occurrences of building materials, facing slabs of tuff, marble and gabbro, and mineral water.

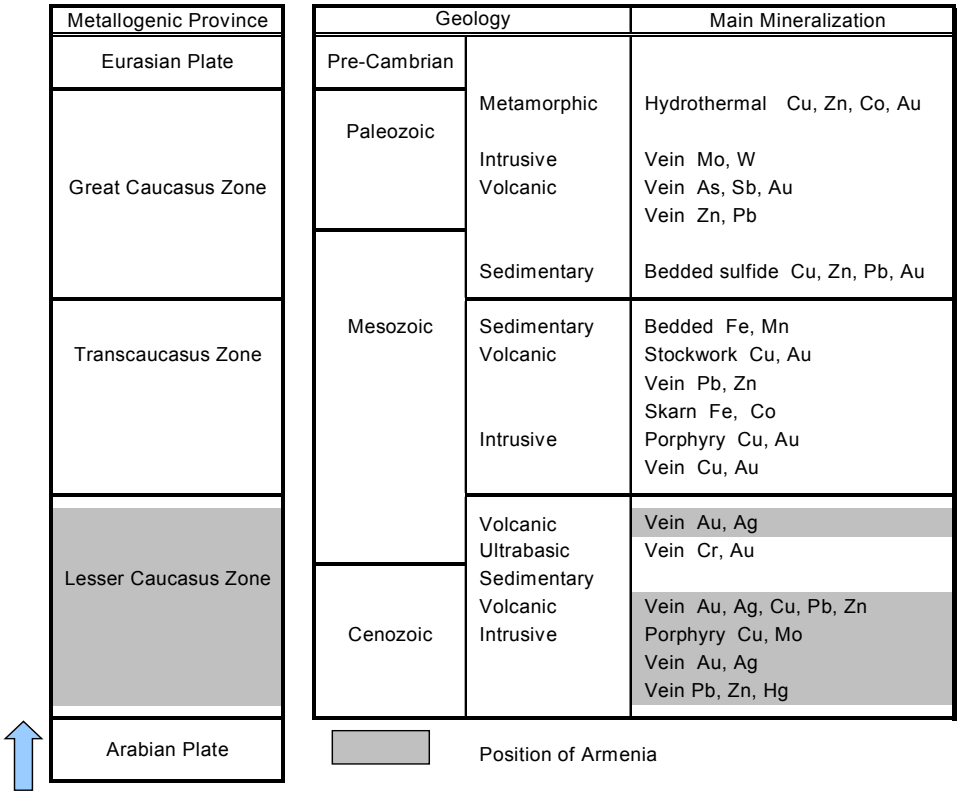


Fig. 2-3 Geology and Main Mineralization in the Caucasus

10-2 Characteristics and Potentials of Copper Deposits

The Armenian copper deposits, consisting of porphyry copper-molybdenum deposit, copper-pyrite vein-type deposit and polymetallic vein-type deposit, are distributed mostly in the Alaverdi area of the Lori district and the Kapan-Kajaran area of the Siunik district (Appendix 1).

According to the information of MNP, the copper reserve metal content of porphyry copper deposits is 6,870 thousand tons, 540 thousand tons from copper-pyrite deposits and 290 thousand tons from polymetallic deposits for a total amount estimated at about 7,700 thousand tons. The metal content and grade of copper reserves of the principal deposits are as follows: Kajaran (4,355 thousand tons, 0.25% Cu), Agarak (203 thousand tons, 0.46% Cu), Kapan (209 thousand tons, 3.19% Cu) and Tekhut (1,630 thousand tons, 0.35% Cu). The Kajaran deposit makes up 60% of the copper reserves in Armenia. From a regional point of view, the metal content of copper reserves is 2,120 thousand tons (27 %) in the northern district and 5,580 thousand tons (73 %) in the southern district respectively.

Total amount of molybdenum metal content is assumed to be 860 thousand tons. The metal content and grade of molybdenum reserves of the main deposits are as follows: Kajaran (677 thousand tons, 0.055% Mo), Agarak (12 thousand tons, 0.027% Mo) and Tekhut (99 thousand tons, 0.022% Mo). The Kajaran deposit makes up 80% of the molybdenum reserves in Armenia.

Compared to porphyry copper-molybdenum deposits in the world, the Kajaran deposit is a large-scale molybdenum deposit and has a rather high molybdenum grade despite a slightly low copper grade. (Appendix 2). The Tekhut deposit will be high potential area because Shevut deposit

of porphyry copper type and gold-copper vein and stockwork manifestations are found around there.

10-3 Characteristics and Potentials of Gold Deposits

Over several hundred Armenian gold deposits are known. However, only 20 principal deposits are known. They are separated mainly into two types as follows: Gold (-silver) quartz vein-type deposit and gold bearing polymetallic deposit (Appendix 3).

According to the information of MNP, most gold deposits are small, except the Zod deposits. The metal content of gold reserves of gold-silver quartz vein type deposits is 201 tons (163 tons in A to C2 category, 38 tons of P category) and 117 tons (110 tons in A to C2 category, 7 tons of P category) from polymetallic deposits for a total amount estimated at about 318 tons (273 tons in A to C2 category, 45 tons of P category). In addition there is about 72 tons of metal as a by-product from porphyry copper deposits so the total amount of gold content in Armenia is assumed to be 390 tons. The metal content and grade of gold reserves of the principal deposits are as follows: Zod (122 tons, 8 g/t Au), Megradzor (25 tons, 15.9 g/t Au), Shahumyan (40 tons, 2.5 g/t Au) and Lichkvaz-tey (16 tons, 5.61 g/t Au).

The possibility of an epithermal deposit associated with acidic volcanic activity during late Neogene to early Quaternary especially a high sulfidation type deposit amenable to open pit mining is very low. In the case of low sulfidation gold (- silver) deposits, it is not said this type deposit had been explored sufficiently, but a large amount of reserves is unexpected. High gold potential region are only around the Zod and Megradzor deposits (Appendix 4). In the case of polymetallic deposits, even if the gold grade is slightly low, other metals are valuable to be developed. The Marjian and Verin Vardanadzor deposits that have potentials for reserves are priority targets. The both deposits will be expected to increase reserves to a large degree.

11. Present Situation of Mining Activity

11-1 Outline of Mining Activity in Armenia

The total Armenian mining sales including smelting as of 2001 is 32 billion AMD (US$58 million) listed on Table 2-4. The Armenian mining industry stays at the material exporting level, because the up-stream sector from mining to mineral processing is 82.9%, and the down-stream sector from concentrate to smelting is only 17.1%.

Table 2-4 Mining Activities in Armenia

Company Type	No.	Name	Sales (×1000 AMD)	Remarks
National	4	Kajaran	14,579,220	Mo, Cu
		Agarak	2,908,491	Mo, Cu
Private	4	Kapan	928,862	Au, Ag, Cu, etc.
		Akhtala	14,000	Cu
		Ararat	8,332,748	Au
		Alaverdi	5,526,384	Cu smelting
Total	6		32,289,705	

There are historically old three mines: the Kajaran Mine, Kapan Mine and Agarak Mine which are located in the southern district where the most advanced area in mining is. Their operational summary is specifically reported here as the present situation of Armenian mining activity.

Production results since 1990 for three main mines are shown in Table 2-5.

Table 2-5 Annual Production Results of Three Main Mines (unit: t)

Year	Kajaran Mine	Agarak Mine	Kapan Mine
1990	7,950,000	2,445,000	392,298
1991	5,1100,000	1,548,000	358,577
1992	1,100,000	727,000	307,092
1993	500,000	275,000	311,964
1994	15,119,000	220,000	312,336
1995	2,721,000	970,000	399,202
1996	3,460,000	872,000	341,563
1997	3,819,000	69,000	224,956
1998	5,418,000	372,000	233,340
1999	6,325,000	359,000	186,557
2000	7,351,000	1,112,000	136,601
2001	8,067,000	1,855,000	268,544

11-2 Present Operational Situation and their Issues

These three mines produced a great deal of crude ore during FSU time, and the adopted mining methods are reasonable to mass production. The Kajaran Mine and Agarak Mine are operated by open pit. The Kapan Mine is operated by open pit and underground mining which used by shrinkage and sublevel stoping. All mining machines in each mine are made by FSU so seem to have been used for a long time.

The Kajaran Mine has about 1.7 billion tons of ore reserve, and possibility to scale up. It is probable to decrease mining cost by mass production effect with introduction of large mining machines to improve profitability. To scale up Kajaran, construction of a new tailings dam and new waste damp needs to be investigated.

The Agarak Mine has treated the stockpile low-grade ore since May 2002 to make up for a shortage of ore to the processing plant by a lack of the mining machines.

The Kapan Mine adopts the shrinkage and sublevel stoping methods in underground that are familiar in Armenia. The shrinkage and sublevel stoping are, however, generally adapted to a simpler shaped orebody like a massive deposit.

One issue in the mining operation is considered to be dilution. The mining method suitable to mass production for veins or stockworks does not seem to attain a good control of dilution because they are not massive and complicated in shape.

Capacities and treated result of processing plants in the mines are as follows:

Table 2-6 Mineral Processing Capacities

Mine	Minerals	Capacity (t)	Result (t)	Utilization rate(%)
Kajaran	Copper	9,100,000	8,067,000	88.6
Agarak	Copper	3,200,000	1,855,000	58.0
Kapan	Total	1,300,000	264,620	20.4
	Copper	1,000,000	181,441	18.1
	Polymetallic	300,000	83,179	27.7

The table show as follows: it is understandable that the operation of the Kajaran Mine looks to have recovered to almost a normal level but that the Kapan Mine and Agarak Mine have a great shortage of crude ore.

The result of processing recovery of 1999 is shown in Table 2-7. Each mine has generally stable recovery in spite of very old equipment. The Kapan Mine and Agarak Mine are especially making remarkable result in spite of the low utilization rates.

Table 2-7 Processing Recovery of Three Mines

Mine	Circuit	Metal	Recovery (%)
Kajaran	Copper	Cu	83.0
		Mo	72.2
Agarak	Copper	Cu	78.5
		Mo	76.0
Kapan	Copper	Cu	94.9
	Polymetallic	Cu	70.0
		Zn	83.0
		Au	85.0
		Ag	79.0

11-3 Conclusions and Recommendations

The Kajaran Mine has recovered to a reasonable production level corresponding to almost its own capacity and looks to have the most stable management. Some selling negotiation with foreign investors is at present proceeding on the assumption of privatization. If a large fund was invested for the scale up and renovation of old equipment, it could be changed to a profitable mine.

The Agarak Mine seems to have been under deficit operation for more than 10 years, but escaped from the worst period and is recovering rapidly by the support of the Kajaran Mine. It seems to take more time to recover its operation to normal level, but its mass production system might recover easily to the former profitable level depending on the prices of copper and molybdenum. A subject for the management of the Agarak Mine is to find out a reasonable buyer of the concentrate for the long-term apart from the Kajaran Mine and to assure capital money to renovate the old equipment and machines and construct an ore haulage facility underground.

The management of the Kapan Mine seems to be very serious and is considered to have suffered from a deficit. Mass production is impossible in case of the Kapan Mine like other mines. There is no other way but increasing production of more valuable concentrate in order to improve the management of the mine. The mine recognizes the actual situation and is making effort to increase the polymetallic ore bearing gold and silver. A long-term management strategy of the mine needs to be fixed to make it profitable, including some modifications of its own “Business Plan”.

The most serious issue common to the three mines is reportedly to undertake the unprofitable sales contracts of concentrate owing to a lack of marketing experience. The mine’s financial accounting is much more influenced by the sales contract than technical improvement in production and the profit of the mine depends on it. Accordingly some action must be done.

12. Present Status of Smelter

12-1 Copper Smelting and Refining

(1) Present Status of Copper Industry in Armenia

The Alaverdi Copper Smelter is the only one copper smelter in Armenia, which produced 7,056 tons of blister in 2001. Out of this, 4,955 tons were produced from copper concentrate of the Kajaran Mine and the remaining 2,101 tons were produced from scrap such as wire scrap.

According to import and export statistics, copper and copper product import into Armenia is only 550 tons in 2000. Copper demand is not large. Of the exports 11,590 tons, 7,231 tons are blister from Alaverdi. The remaining seems to be scraps. The import of electrolytic copper and sulfuric acid were 20 tons and 216 tons in 2001, respectively. The use of the sulfuric acid is for

thermal power plant (demineralized water production) and irrigation (sterilization). Judging from the present import status in Armenia, there is almost no industry using electrolytic copper and sulfuric acid, which are products from a copper smelter.

(2) Hydrometallurgy (SXEW)

A possibility of sulfuric acid consumption in Armenia is hydrometallurgy, which is a process to leach copper directly from the ore using sulfuric acid. Using this leaching process, the recovery of copper from copper oxide that used to be stockpiled as waste at the mine site became common. Possible ore for leaching (oxide ore) given from the Armenian side were the following deposits:

- Tekhut deposit: Undeveloped porphyry copper deposit (about 12 million tons of oxide ore)
- Aygedzor deposit: Undeveloped porphyry copper deposit (about 35 million tons of oxide ore)

(3) Operating Cost and Income/Expenditure Balance at the Alaverdi Smelter

In the production stage, the plant is making profit but the overhead and transportation fees are high resulting in deficit totally. Particularly, the transportation fee is as much as 85% compared with the production cost. The result of dividing into smelting and scrap treatments shows smelting shows a little profit at the production stage. The issue of little profit may be the low market price of copper and low operating efficiency. At the same time, if they cannot purchase scrap at a profitable price, they will continue to increase their deficit. It means that the business of blister production in the Alaverdi smelter is in a difficult situation. There is no merit unless electrolytic copper is produced from the scrap. When considering the profitability, the production of electrolytic copper should be started as soon as possible.

(4) Problems in Constructing a Copper Smelter in Armenia

Generally speaking, the bigger the smelter capacity the lower the smelting cost so a bigger smelter is more advantageous in the overall view. Today, if a new (pyrometallurgy) smelter and a new refinery would be built, it is said that the minimum feasible capacity is 200,000 tons per year.

Issues regarding Armenian copper smelting industry are listed as follows (Appendix 2-33):

- Necessity of Production of Electric Copper
- Market or Consumption of Sulfuric acid
- Domestic copper industry

12-2 Molybdenum Roasting

Molybdenum concentrate (MoS_2) production in 2001 amounted to approximately 7,000 tons. Molybdenum is traded as molybdenum concentrate, but also as molybdenum trioxide, which is produced from the concentrate by roasting. Molybdenum roasting is done at two plants of the Kajaran mine and Pure Iron Co. in Yerevan. Furthermore, a variety of products are made from this molybdenum trioxide, and a typical product is ferro-molybdenum.

In the molybdenum concentrate, rhenium (Re) is contained with a content of 200 to 400 ppm, though rhenium is not commercially evaluated at concentrate sales.

At the Kajaran mine, there is no recovery of rhenium, but research work has been carried out at a research center in Yerevan. On the other hand, rhenium recovery is done at the Pure Iron Co. The company sells the product as $KReO_4$ with a recovery ratio ranging from 55% to 60 %.

13. Environment

13-1 Current Status of Environmental Administration

The MNP is a core ministry to make and administrate environmental policy. It is responsible for effective utilization of environment and natural resources and preservation of environment in the ROA. The structure of MNP is reformed. The new organization consists of two major groups, which are structural units and detached units. Agency of Hydrometeorology and Environmental Monitoring (AHEM), one of the newly created detached units of MNP, is responsible to monitor environment of the country. Department of Hydrometeorology of the AHEM monitors quantity of surface water and Environmental Monitoring Center of the AHEM is responsible to monitor quality of surface water, atmospheric air and soil. There is no provision governing the liability of the state for past environmental damage, or no provision for liability in the existing privatization law. State budget for MNP is only 0.13 to 0.26 per cent of the entire state budget and has decreased in last five years.

13-2 Current Status of Monitoring and Public Awareness of Environment

The Environmental Monitoring Center of the AHEM collects samples and analyzes quality of ambient air, water and soil, and publicizes results. The Environmental Monitoring Center consists of the main office in Yerevan and five regional offices. Instruments and equipments of the main chemical laboratory are old and not well maintained. Sampling and analysis capacity of its personnel is required improvement.

There is no branch laboratory of the Environmental Monitoring Center in the Southern Region of the country where several major metal mines are. No samples of surface water, atmospheric air or soil were collected in the southern region by the Environmental Monitoring Center since 1991.

State Environmental Inspection of MNP is responsible for inspecting and enforcing environmental performance of industrial activities, including mining. It has regional offices in the principal cities of all Martzs. It inspects industrial establishments once every year. State Environmental Inspection has its own independent analytical laboratories. Capacity of its laboratories are worse than of Environmental Monitoring Center, so that State Environmental Inspection faces difficulty of indicting irregularities on discharges from industries based on their own analytical data.

Because of such history of destruction at industrial production facilities under the name of environmental protection, Armenian citizens are hesitant about moving against general trend of putting environmental issues behind of production in industry especially under the circumstance of economical development for overcoming recession. In the most FSU countries law-abiding awareness is very poor under confusion of transition from centrally controlled economy to free market economy. The same tendency is among environment issues.

CHAPTER 3 CASE STUDY

CAPTER 3. CASE STUDY

1. Target Selection

1-1 Target Mine and Smelter

The Kajaran, Agarak and Kapan mines were the possible targets nominated by the Armenia counterpart as state owned enterprises for the case study (as of July 2003). A mining complex was selected among these three mines for the case study based on the selection criteria on the following page.

On the other hand, the Alaverdi Smelter, the only copper smelter in Armenia, was already privatized. As above described, it is necessary to point out the issues regarding the Alaverdi smelter clearly and make a clear solution of the issues. If it were impossible to make this point clear, the promotion program for copper industry in Armenia would be not examined concretely. Therefore, the Alaverdi smelter is also selected as a case study facility related to the mining industry. At the same time, possibility of copper production in Armenia is discussed and an action program is proposed.

1-2 Selection Criteria and its Result

Before the preliminary field survey, the selection items were discussed and established with the Armenian side. The items are the criteria to select a state owned mining enterprise among three mining complexes for the target of the case study. As the basic items of the national mines, management policy, business strategy, long–term plan, finance analysis, sales strategy, market, ore deposit and reserves, mining method, productivity, break-even cost, investment in plant and equipment, environment protection and investment in ecology were selected, showing in Table 3-2-1. Efforts were made to collect the statistics for the criteria items. A target mine was selected on the basis of the statistic evaluation. The Kapan Mining Complex had the lowest evaluation. Therefore, the Kapan Mine was selected as the case study mine from the following viewpoints.

1) The complex is operating in deficit. Without radical restructuring, the complex will not be privatized and the development of the mining business cannot be expected.
2) The Kapan deposit is a small to middle scale deposit. It is a typical deposit in Armenia. The mine is operated mainly by underground with comparatively old equipment and machinery, and same in the processing plant. The productivity of the entire mine is very low. Reconstruction of the mine must be considered by some rationalization.
3) Prospective area for gold, silver and copper seems to exist around the polymetallic deposit in the Kapan Mine. The future more exploration may attain a long-term stable supply of nonferrous metal material to the Armenian mining industry.

2. Kapan Mining Complex

2-1 Introduction

The Kapan Mining Complex is located around the border of Azerbaijan by the Voghchi River and some 320 km by road from the capital, Yerevan. The Kapan ore deposit was discovered at the beginning of the nineteenth century, and the Kapan Mining Complex has continued operating for

about 150 years. There are two deposits under operation. They are the Central copper deposit and the Shahumian polymetallic deposit containing copper, zinc, lead, gold and silver. The Central Mine is operated by both methods of underground and open pit, and the Shahumian Mine by underground. The Kapan Mining Complex has a maximum yearly capacity of one million tons of copper crude ore treatment and 300 thousand tons of polymetallic crude ore treatment. The Mine produces pure copper concentrate, and copper and zinc concentrate containing gold and silver. All concentrate is exported to Iran through an agency of the Ural International Incorporated of Switzerland and sold FOB at the border. There are 798 personnel at the complex as of the end of 2001.

2-2 Geology and Mineralogy

The Kapan deposits are of vein type and stockwork type deposits hosted in Middle Jurassic volcanic rocks and minor sedimentary rocks. Ore bodies are overlain by a gypsum-rich stratabound horizon and the reason that the horizon is reported to contain breccia-like rounded fragments of sulphide mineralization, there is information which considers the Kapan deposits as Kuroko-type deposits. Nevertheless no significant associated stratiform massive sulphide has yet been discovered. In the Kapan Area two mines exist. They are the Central Mine with siliceous copper veins and stockworks, and the Shahumian Mine with polymetallic copper-lead-zinc-gold-silver veins.

2-3 Mining Operation

As for profitability at the Kapan Mining Complex, the current largest contributor is the Shahumian Mine with polymetallic type copper ore containing gold and silver. It will be quantitatively proved later in an economic evaluation. On the other hand, the largest contributor in production is the Open Pit. But there are too many departments without direct relation to production. The organization should be simplified with additional departments absorbed into the Engineering Department.

Decreasing dilution is a serious and important theme. A detailed indication seems to be needed for the Open Pit to control dilution. There are some limitations from the mining method in case of underground dilution. It is impossible to eliminate waste inside of the deposit in the adopted methods, sublevel and shrinkage stoping, but it is possible to control waste in the hanging wall or footwall by detailed instruction at the site. Under this circumstance, a quality control department is recommended to be prepared in the organization to decrease dilution effectively.

The engineer at the Kapan Mining Complex says the Kadzor Mine with a grade of 2% copper was discovered north of the Kavart vein, which is now being exploited by open pit. Some preparations for production like track road and ore pass raise were finished. The production from the Kadzor Mine with a much higher ore grade should be taken into consideration after economic evaluation.

In the underground mine, the delay of the development for preparation of mining blocks is serious owing to a lack of machines and spare parts caused by a shortage of funds. Production from the underground might be insufficient in the near future. At first, economic profitability must be

understood, and new mining blocks should be prepared urgently by the provision of funds, if profitable. A delay of the development especially in the Shahumian Mine will give a very serious impact to maintain the total operation of the Kapan Mining Complex. Therefore some countermeasures should be taken as soon as possible.

In the long-term view, introduction of a new mining system like “cut and fill” and “highly mechanized trackless” should be studied to obtain a much higher efficiency, considering the improvement of dilution control as well as future increase of workers’ wage.

2-4 Processing Operation

The additional departments except production in the organization of the Processing Plant are too many and complicated is just the same as Mining. It should be simplified with additional departments absorbed into the Engineering Department.

The current flow sheet for polymetallic ore is thought to have improved based on the past operation, but it seems to be a little more complicated than the international standard level. The process should be simplified to obtain a better production control.

An important point of polymetallic processing is to recover valuable metals as much as possible for a higher profit. In reality, lead is contained in the copper concentrate, but it is a possible penalty rather than a bonus. The Mine purchased some equipment except a steam producer to increase the pulp temperature for lead separation. The lead separation process seems to be constructed easily. The Mine must also study the profitability of the recovery of sulfide iron.

The present situation of tailings, which are discharged into the river, is not permitted environmentally. Tailings contain valuable metals like unrecovered gold and silver, which may be recovered economically and technically in future.

From long-term viewpoint, the introduction of the column flotation system to improve processing result and conserve electricity as well as autogenous grinding system to decrease operation cost should be studied.

2-5 Management

(1) Present Management

The Kapan Mining Complex fell into deficit in 1996 and has managed the very severe situation with total debt of US$7 million for six years. Table 3-1 shows the profit and loss statement. Operating cost was reduced 60% between 1996 and 2000, but production also decreased in the same proportion so an improvement in profitability was not recognized.

(2) Cost Analysis

According to the production and unit costs for the Kapan Mining Complex, mining and processing unit costs of the Shahumian Mine have generally decreased, and much effort seems to have been made for it. But unit costs for the Central underground are a little worse by reason of the sharp drop in production. On the contrary, the unit cost of the Open Pit is very small, one-fifth of underground, and is the lowest.

Table 3-1 Profit and Loss Statement

Year	1996	1997	1998	1999	2000	2001
Exchande rate(AMD/$)	415.09	490.55	504.7	536.16	539.67	555.09
Copper price(LME $/t)	2295	2277	1654	1573	1814	1578
Gold price(London $/toz)	388	331	294	279	279	271
Sales (×1000 US$)	2,892	1,796	1,469	1,155	1,255	1,673
Central U/G mining cost	2,128	1,226	853	660	304	455
Central O/P mining cost	0	0	0	3	118	218
Shahumian mining cost	371	361	258	470	379	489
Copper processing cost	816	518	519	309	288	486
Polymetal processing cost	378	392	314	363	370	474
Processing miscellaneous cost	504	338	150	206	228	260
Indirect cost	23	20	19	215	12	5
Total cost	4,220	2,855	2,113	2,226	1,699	2,387
P/L	−1,328	−1,059	−644	−1,071	−444	−714

Let us compare the production unit cost with one of the international mines. For instance, the Erdenet Mine in Mongolia prides itself on US$ 5 per ton of treated ore or US$ 880 per ton of copper metal in 2001. The Madneuli Mine in Georgia has a production unit cost of about US$ 9 per ton of treated ore or US$ 1,250 per ton of copper metal in 2001. The production unit cost of the Erdenet Mine is about half of the Kapan Mine based on treated ore and one-third for a metal base because it produces 24 million tons yearly so the economy effect of scale is very large. On the other hand, the Madneuli Mine is a small open pit with an annual production of 1.5 million tons. Its production unit cost is almost the same as the Kapan Mine based on treated ore, but half on a metal base. The reason is a better crude ore grade. The operation unit cost of the Chilean El Teniente Mine and Los Pelambres Mine, which operate an open pit as well as underground mine just the same as the Kapan Mine is about US$ 1,700 on a metal base as of 1997. Kapan is much worse than them.

2-6 Economic Evaluations

(1) Cash Flow Analysis for Current Mining Operation

The profitability of the current production system as well as the Kadzor Open Pit, which has already finished some preparation for production, is proved under the condition that the current production facility works normally. There are four combinations of production system as follows:

1) Central Mine－copper process circuit
2) Central Open Pit－copper process circuit
3) Kadzor Open Pit－copper process circuit
4) Shahumian Mine－polymetallic process circuit

1) Metal Prices

Metal prices used for the economic simulation are in Table 3-2.

Table 3-2 Metal Price used in Cash Flow (as of Aug. 2002)

Metal	Price	Note
Copper	$1,479.6/t	LME
Zinc	$747.6/t	LME
Gold	$310.3/toz	London price
Silver	$456.2/toz	USA, HH

2) Assumed Sales Condition

The sales contract of the Kapan Complex is secret. So general sales conditions are assumed as in Table 3-3.

Table 3-3 Assumptions for Concentrate Sales Condition

Mine	Conc.	Metal	Payment condition	T/C	R/C	Penalty
Central	Cu	Cu	Unit deduction 1% From concentrate	$80/t	6.5 ¢ /t	Deduct $2.5/0.1% more than 0.2% As, no penalty less than 0.1% Sb.
		Au	N/A	—	—	
		Ag	N/A	—	—	
Shahumian	Cu	Cu	Unit deduction 1% From concentrate	$80/t	6.5 ¢ /t	Deduct $2.5/0.1% more than 0.2% As, no penalty less than 0.1% Sb and 20g/t Hg.
		Au	Unit deduction 1g/t 90% evaluation	—	$6.0/toz	
		Ag	Unit deduction 30g/t 90% evaluation	—	$0.4/toz	
	Zn	Zn	85% of concentrate	$175/t	None	No penalty less than 0.3%As, 0.3% Sb, 50g/t Hg and 3%SiO_2.
		Au	Unit deduction 2g/t 60% evaluation	—	$6.0/toz	
		Ag	Unit deduction 50g/t 60% evaluation	—	$0.4/toz	

(2) Summary of Cash Flow Analyses

Results of cash flow analyses for all cases are summarized in Table 3-4 with a production of 100,000 t by the current operation system. The Central Mine underground and open pit operations are unprofitable and must be stopped.

Table 3-4 Summary of Cash Flow Analyses (US$)

Item	Central U/G	Central O/P	Kadzor O/P	Shahumian Mine
Sales	596,000	249,000	814,000	1,438,000
Expense	1,082,000	537,000	537,000	1,229,000
P/L	-486,000	-289,000	276,000	210,000

The most profitable case is the Kadzor Open Pit, which is worth watching with keen interest. The key to success for solving the present difficulty of the Kapan Mining Complex is in the Kadzor deposit. Preparation and increase of production by open pit are much easier than ones by underground. Machines and its production system can be settled quickly by shifting machines and workers from the current Central Open Pit.

Only the Shahumian Mine is presently the profitable mine in the Kapan Complex. Consequently shifting machines and workers from the Central Underground should strengthen the production system of the Shahumian Mine.

Dilution control is also ascertained to be very important in daily production. The profit of the Shahumian Mine will be improved very much by adequate protection against dilution because it contains gold and silver of very high prices.

(3) 10-Year Production Plan including Some Rationalization

A new production plan is devised for the Kapan Complex to survive, taking into account the simulation results. Mainframe in the plan is as follows.

1) The Central underground and open pit stops their all operations.
2) The workers and machines in the Central underground are moved to the Shahumian Mine. New mining machines are purchased to prepare stopes and increase production up to 150,000 t in four years and finally 300,000 t, its capacity, eight years later.
3) The workers and machines in the Central open pit are moved to the Kadzor Open Pit. New machines are increased to produce 200,000 t in three years and 500,000 t, half of its

capacity, five years later.

4) The crude ore grades of both the Shahumian Mine and Kadzor Open Pit are improved by strengthening dilution control.
5) The organization of the Kapan Complex and allocation of workers are changed to be more effective and functional. For that purpose, administrative persons and supplementary workers are reduced.
6) Office works are computerized to obtain immediate and exact data and advance management quantitative control and administrative persons use computers.

The 10-year production plan for the Kadzor Open Pit and Shahumian Mine is in Table 3-5 and 3-6 respectively.

Table 3-5 Production Plan of the Kadzor Open Pit

Item	Unit	Year									
		1	2	3	4	5	6	7	8	9	10
Treated ore	1000 t	50	100	200	350	500	500	500	500	500	500
Cu grade in ore	Cu %	1.44	1.48	1.52	1.56	1.60	1.60	1.60	1.60	1.60	1.60
Cu recovery	%	81.0	81.5	82.0	82.5	83.0	83.0	83.0	83.0	83.0	83.0
Cu grade in conc.	Cu %	23	23	23	23	25	25	25	25	25	25
Conc. production	1000 t	2.54	5.24	10.84	19.59	26.56	26.56	26.56	26.56	26.56	26.56
As grade in conc.	As %	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65
Moisture	%	12	11	10	10	10	10	10	10	10	10

Table 3-6 Production Plan of the Shahumian Mine

Unit	Year									
	1	2	3	4	5	6	7	8	9	10
1000 t	90	115	130	150	180	220	260	300	300	300
Cu %	0.30	0.31	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32
Zn %	1.30	1.40	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50
Au g/t	1.60	1.70	1.80	1.90	2.00	2.00	2.00	2.00	2.00	2.00
Ag g/t	27	28	30	32	33	33	33	33	33	33
%	70	71	72	73	73	73	73	73	73	73
Cu %	15.0	15.5	16.0	16.5	16.5	16.5	16.5	16.5	16.5	16.5
%	55	55	55	55	55	55	55	55	55	55
%	65	65	65	65	65	65	65	65	65	65
1000 t	1.26	1.63	1.87	2.12	2.55	3.12	3.68	4.25	4.25	4.25
%	15	14	13	12	11	10	10	10	10	10
As %	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
%	70	71	72	73	73	73	73	73	73	73
Zn %	55.0	55.5	56.0	56.0	56.0	56.0	56.0	56.0	56.0	56.0
%	18.5	19.0	19.5	20.0	20.0	20.0	20.0	20.0	20.0	20.0
%	19.0	19.5	20.0	20.5	21.0	21.0	21.0	21.0	21.0	21.0
1000 t	1.49	2.06	2.51	2.93	3.52	4.30	5.08	5.87	5.87	5.87
%	13	12	11	10	9	9	9	9	9	9
Cd g/t	4100	4100	4100	4100	4100	4100	4100	4100	4100	4100

Table 3-7 shows the investments that can secure increasing production.

Table 3-7 Investments for Increasing Production

Item	Investment (US$1000)				
	1st year	2nd year	3th year	5th year	8th year
Mining machines	200	200	200	300	300
Ore transporting machines	200	0	0	200	200
Mining machines for the Kadzor Mine	200	200	200	500	500
Processing machines	0	200	500	500	500
Construction of the tailings dam	500	0	0	200	200
Zinc sulphate producer	100	0	0	0	0
Total Investment	1,200	600	900	1,700	1,700

Unit operating and indirect costs are settled in Table 3-8. The unit mining cost for the first year of the Kadzor Open Pit is assumed to be 50% more than the Central Open Pit in 2001, taking into account of some initial stripping waste. Considering increasing efficiency and production, the unit mining cost of the Kadzor Mine is estimated to decrease gradually by 13.3%, 20% and 26.7% respectively from the first year cost in the following years.

Table 3-8 Operation Cost Assumptions for the Production Plan

Item	Cost($/t)			
	1st year	3th year	5th year	7th year
Unit mining cost for the Kadzor Mine	2.55	2.21	2.04	1.87
Unit mining cost for the Shahumian Mine	10.5	8.40	7.35	6.30
Unit copper processing cost	2.68	2.41	2.14	2.01
Unit polymetal processing cost	5.70	5.13	4.56	4.28
Unit miscellaneous costs in processing	0.98	0.88	0.78	0.74
Indirect cost	5,320	4,256	3,724	2,660

The unit mining cost for the first year of the Shahumian Mine is increased largely compared with the current cost because workers and machines of the Central Mine are moved so the first year cost of the plan is the sum of both mines' costs. But it is estimated to decrease gradually 20%, 30% and 40% from the first year cost by same reason as the Kadzor Mine. On the other hand, the unit processing cost of the first year is assumed to be same as the current cost. After the second year, it is estimated to decrease 10%, 20% and 25% respectively from the first year cost, considering the economy of scale, renovation of equipment and producing their own zinc sulphate. The indirect cost is assumed to decrease 20%, 30% and 50% respectively from the first year cost, considering downsizing of the organization.

(4) Long-term Forecast of Metal Prices

Long-term metal prices are given in Table 3-9 forecasted by the above data and existing information;

Table 3-9 Forecast of Metal Prices

Metal	Price	Note
Copper	$1,750/t	LME
Zinc	$900/t	LME
Gold	$300/toz	London Free Market
Silver	$5.00/toz	USA H&H

(5) Economic Evaluation on the Production Rationalization Plan

The economic evaluation on the 10-year production plan is carried out based on the forecasted metal prices as above mentioned. Sales condition of the concentrate is assumed to be same as the first simulation. Results of the economic evaluation are in Table 3-10.

The table shows that it is profitable enough to give a 28% IRR for ten years with the first year's repayment of the current debt of US$ 7 million and accumulated investment of US$ 6.2 million to increase production. The first and second years give deficits, but they are smaller than the working capital so they do not seem to be a difficult matter.

3. Copper Smelter

3-1 Alaverdi Smelter

In this Case Study, the influence of LME price fluctuations to the management ACP with the full capacity production of Alaverdi Smelter is simulated as follows.

Table 3-10 Economic Evaluation for the Long-term Rationalized Plan

Item	Unit	1st. Year	2nd. Year	3rd. Year	4th. Year	5th. Year	6th. Year	7th. Year	8th. Year	9th. Year	10th. Year
Kadzor											
Ore treated	000't	50	100	200	350	500	500	500	500	500	500
Cu grade	Cu %	1.44	1.48	1.52	1.56	1.6	1.6	1.6	1.6	1.6	1.6
Shahumian											
Ore treated	000't	90	115	130	150	180	220	260	300	300	300
Cu grade	Cu %	0.3	0.31	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32
Au grade	Au g/t	1.6	1.7	1.8	1.9	2.0	2.0	2.0	2.0	2.0	2.0
Revenue	$000	2,028	3,176	4,858	7,331	10,458	11,281	12,103	12,924	12,924	12,924
Cost	$000	2,362	3,342	3,353	5,204	5,445	5,783	5,236	6,161	5,709	1,362
Net P/L	$000	−334	−166	1,505	2,127	5,013	5,498	6,867	6,763	7,215	11,562
Investment	$000	*8,200	600	900	0	1,700	0	0	1,700	0	0

N.B. P/L : Profit and Loss, * includes debt of $ 7 million IRR:28%

(1) Full Capacity Production

The yearly production capacity of the Alaverdi Smelter is 20,000 tons of blister production, 10,000 t from copper concentrate and 10,000 t from scrap. The production result of Alaverdi in 2001 was 7,056 tons. In 2001, the Kajaran Mine produced copper concentrate equivalent to 11,430 t copper, which was a sufficient supply to meet Alaverdi's production capacity. The simulation study using the blister production of 20,000 t/y, and present production capacity under the current metal price is shown in Table 3-11. The loss per ton is improved from the current US$ 314 to US$ 1 under full capacity production.

Table 3-11 Simulation Results of Profit and Loss of ACP

2001 result **Summary**
Blister A+B 7056 ton

	ADM x 1000	USD x 1000
Sales revenue	5,279,809	9,263
Material cost	3,814,866	6,693
Operating cost	758,092	1,330
Factory benefit	706,852	1,240
Over head	1,314,037	2,305
Transportation cost	657,310	1,153
Benefit	▲ 1,264,495	▲ 2,218

Unit loss US$ 314 /t

2001 result base Full operation **Summary**
Blister A+B 20000 ton

	ADM x 1000	USD x 1000
Sales revenue	14,921,693	26,178
Material cost	10,970,661	19,247
Operating cost	798,793	1,401
Factory benefit	3,152,239	5,530
Over head	1,314,037	2,305
Transportation cost	1,844,539	3,236
Benefit	▲ 6,337	▲ 11

Unit loss US$ 1/t

(2) P/L Changes Caused by LME Price

The influence of the LME price fluctuation on P/L of ACP was reviewed. The LME price fluctuates in wide range and P/L of the smelter is greatly influenced by this fluctuation. The case study is based on US$1,600/t, 2,100/t and 2,600/t.

The conditions for case study are as follows;

1) Full capacity production of blister in the same production system as the current conditions

2) Production of electrolytic copper from blister

In this case, two further cases of sales are assumed as follows depending on the purchaser.

2)-1 Export of electrolytic copper

2)-2 Domestic sale of electrolytic copper

(3) Result of the Case Study

The results of study are shown in Fig.3-1. ACP can make profit from the production of blister if the LME price is more than US$2,400/t.

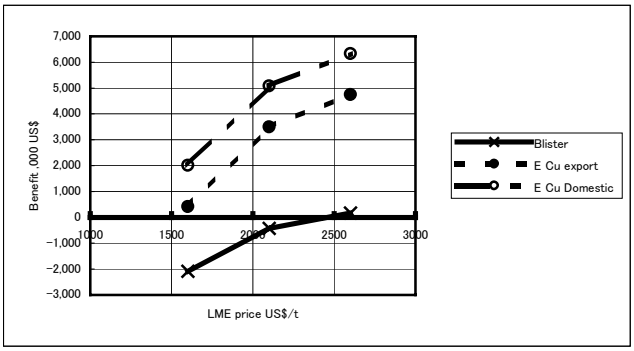


Fig. 3-1 Result of the Case Study

When produced electrolytic copper is exported, ACP can make profit if the LME price is more than US$1,600 /t. For this case, however, about US$20 million is required for the reconstruction of a tankhouse. The recovery period of the construction cost of the tankhouse is shown in Table 3-12.

Generally any project is considered as very good if the recovery period of construction cost is less than 3 years. In the LME price is 2,600 US$/ton, the case of domestic sale nearly corresponds to that.

Table 3-12 Return Period of the Construction Cost (years)

LME Price	Export	Domestic Sale
US$1,600/t	48.1	10.0
US$2,100/t	5.7	3.9
US$2,600/t	4.2	3.2

3-2 Copper Production in Armenia

As mentioned above, the current domestic consumption of copper is not large in Armenia so it is not practical to study the copper production considering only domestic consumption. But it is possible if the consumption area is expanded to the Caucasus because there is no copper production facility in this area.

Possibility of copper production in Armenia is discussed here from various points.

(1) Supply of the Copper Concentrate

The copper production in concentrate from Armenian mines in 2001 was 16,404 tons. In 2001, 10,000 t of copper was produced in Georgia so the total production is 26,404 t. The private mine, Alaverdi Mine, has a yearly production plan of 2,400 t copper from May 2002, and so the final total is estimated at 28,800 tons. The current yearly production of blister planned by ACP is 30,000 t so the total concentrate produced in the Caucasus almost meets to it.

1) Copper Consumption

The international relationship between copper consumption and GDP is attained by

plotting the table, shown as Fig. 3-2.

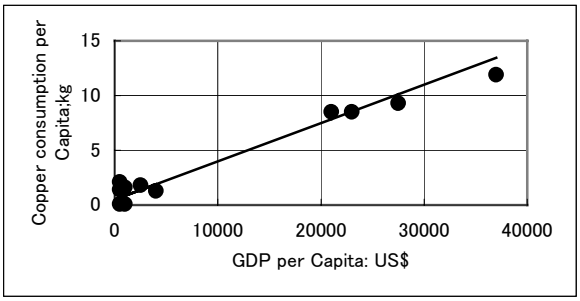


Fig. 3-2 Relationship between GDP and Copper Consumption

Copper consumption in Armenia, Georgia and Azerbaijan are estimated from the figure. In the Table 3-13, the copper consumptions 5 and 10 years later in Armenia, Georgia and Azerbaijan are estimated with 10%, 3% and 10% GDP growth rates. The maximum domestic consumption in Armenia will be about only 7,000 tons in 10 years, but the total consumption in the Caucasus will reach up to 26,000 tons.

Table 3-13 Estimated Copper Consumption in the Caucasus (as of 2000)

Country	GDP	Consumption	Population	Current	Copper Consumption in future		
	US$/capita	Kg/capita	Million	Consumption	Growth	In 5 yr.	In 10 yr.
Armenia	503	0.676	3.8	2,569 t	10 %	4,137 t	6,663 t
Georgia	555	0.694	5.1	3,541 t	3 %	4,105 t	4,758 t
Azerbaijan	507	0.677	8.1	5,487 t	10 %	8,837 t	14,233 t
Total	—	—	17.0	11,597 t	—	17,079 t	25,654 t

2) Current Mining Industries in the World

Copper business is not local, but global. Its current situation is explained in short as follows.

i) Global Copper Business Trend

Production in mines, smelters, refineries, SX-EW and fabricators in major countries in 1999 is shown in Appendix 3-20. All advanced industrialized countries are included in the table. If Armenia also wishes to have a long- term development of its industries, it should produce electrolytic copper and invite fabricating companies.

ii) International trade of copper concentrate and electrolytic copper

Regarding trade of copper, the concentrate and electrolytic copper are common, but the blister or anode is rare. Blister will not lead to the development of fabricating industry.

3-3 Possibility of Smelter Construction in Armenia

Copper mines are located mainly in the southern part of Armenia so transportation cost can be minimized if there is a smelter in this area. But the initial investment for construction of pyro-metallurgical smelter will be a vast amount. A rough estimate for a pyro-metallurgical plant with a pollution control facility will be approx. US$250 million for a yearly capacity of a 30,000 t electrolytic copper. A rough estimate for a hydrometallurgy plant using SX-EW with a yearly capacity of 30,000 t electrolytic copper will be approx. US$130 million which is lower than the pyro-metallurgical plant. However, a SX-EW plant has several limitations for construction. For example, the SX-EW plant treats not concentrate but crude ore directly so it must be located nearby

the mine. In the southern area, three plants will be required for three mines. But as mentioned above, chalcopyrite, which is common in Armenian mines, is still in research stage for economical recovery copper so it is impossible to adopt SX-EW immediately.

Infrastructures are already equipped at the Alaverdi Smelter so it can be modified to a pyro-metallurgical plant with a yearly production capacity of 30,000 t from the copper concentrate and the estimate cost will be US$ 43 million according to the Outokumpu estimate.

3-4 Conclusions and Recommendations

The issues of the Alaverdi Smelter are two points, the exhaust gas pollution and the fact that its final product, blister, is only an intermediate product of smelting.

At present, there is little domestic demand in Armenia for electrolytic copper and sulfuric acid produced from pollution control facility. Exporting sulfuric acid will not be profitable due to high transportation cost.

SX-EW is one of the solutions, but it still in the technical development stage in the world so its trend must be observed keenly. Much research on bio-leaching had been reportedly carried out during FSU time in Armenia. Further research and development must be continued utilizing fully the past basic research. If the research turns out successful and SX-EW is applied at the southern mines to produce electrolytic copper at a production cost of 50 ¢ /lb, the mines will be profitable at low a LME price of US$1,560/t (70 ¢ /lb).

An action program is proposed to solve the issues of the Alaverdi Smelter. The action program is divided to two stages, reconstruction and development stages. In the reconstruction stage, the electrolytic copper production and the construction or invitation of a copper manufacturing plant will be started. At the same time the sulfuric acid usage will be tested. In the development stage, the Alaverdi plant capacity will be increased with pollution control under consideration of the results of market research and test for electrolytic copper and sulfuric acid consumption in Armenia. At the same time, SX-EW plants will be constructed at mine site if the result of leaching test is good. The content of the action program is shown as follows:

1) Investment Cost (rough estimate)

Reconstruction stage

1)	20,000t/y tankhouse	US$ 20 million (include anode furnace and casting)
2)	De-dust equipment	US$ 1 million
	Total for Reconstruction stage	US$ 21 million

Development stage

3)	Additional 20,000t/y tankhouse	US$ 5 million
4)	Production expansion of smelter to 40,000 tons per year, and recovery of SO_2 gas as sulfuric acid	US$ 43 million (by Lurgi Proposal)
	Total for Development stage	US$ 48 million

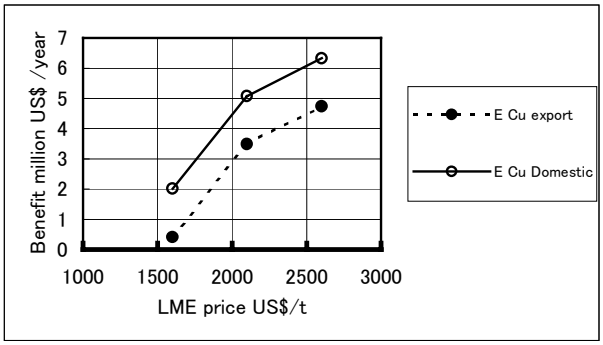
2) Reconstruction Stage

- 1) 20,000 t/y tankhouse
- 2) Improving the efficiency of exhaust gas dust collection at the smelter

The effect by the above 2 items is shown in Fig. 3-3

In case all produced copper is consumed in the domestic market and US$ 2,100 per ton of LME price, the operation profit (before depreciation, tax and interest) is about US$ 5 million per year and the investment cost of US$ 21 million is recovered in about 4 years. But if all copper is for the export market, the profit reduces to US$ 3.5 million per year and the recovery period will be 6 years.

Fig. 3-3 Investment of 21 million US$



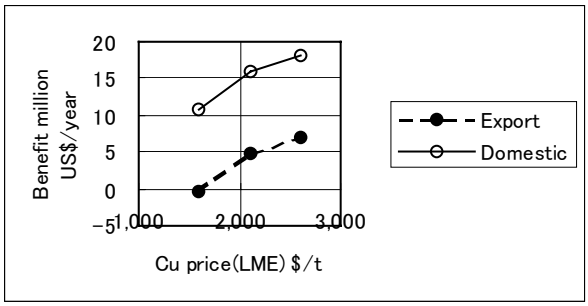
2) Development Stage (five years)

- 3) Expansion of tankhouse by 20,000 t/y capacity
- 4) Production expansion of smelter to 40,000t/y, recovery of SO_2 gas as sulfuric acid

The effect by the above 2 items is shown in Fig. 3-4.

In case all produced copper and sulfuric acid are consumed in domestic market, and US$ 2,100 per ton of LME price, the operation profit (before depreciation, tax and interest) is about US$ 16 million per year and the investment cost of US$ 68 million (including item 1) and 2)) is recovered in about 4 years. But in case all electrolytic copper and sulfuric acid are for the export market, the profit reduces to US$ 5 million per year and the recovery period will be 14 years.

Fig. 3-4 Investment of 68 million US$



4. Analysis of the Managerial Situation of Two Mining Enterprises using Key Indices

Managerial analysis was done for two mining enterprises, the Kapan Mine CJSC and Alaverdi Smelter (Armenia Copper Program - ACP CJSC).

This section reports the results of the business analysis of the two enterprises by

calculating key managerial indices from the financial data, namely the profitability, financial stability, utilization of assets and capital, growth potential and productivity.

4-1 Kapan Mine

(1) Overall Evaluation

Kapan CJSC reports a loss, holds large liabilities and excessive fixed assets, and is in a very unstable financial condition. Due to the limited working capital, it cannot always buy parts and consumables required for production. In fact, the shortage of materials and parts forced a production shutdown for a few months in FY2001 and FY2002. The company is behind payment of electrical charges and wages. Overall, it is in a critical condition and cannot recover from the situation by itself.

(2) General Direction for Improvement

It is imperative to develop a reconstruction plan and start restructuring efforts, such as disposal of fixed assets and significant reduction of workforce, which should be carried out urgently. In addition, as a loss is continuously generated with no prospect for improvement and large debts create the shortage of operating funds, the sales of the entire company to a foreign investor should be a feasible way to save the company and keep it going.

4-2 Alaverdi Smelter (ACP)

(1) Overall Evaluation

The managerial indices in FY2000 and FY2001 show deterioration. Profitability decreased significantly in FY2001. The gross profit to revenue became one-third that in FY2000, and the operating profit to revenue turned to negative. On the other hand, sales and administrative costs grew sharply partly due to the increase in the number of employees. In FY2001, while ACP increased its capital by 2.8 times, fixed assets were reevaluated to increase by 12.9 times, resulting in the excess asset value over the capital and making the financial condition less stable. Furthermore, current liabilities grew rapidly in FY2001 to decrease the short-term solvency. Finally, the rapid increases in assets and capital, coupled with the revenue decline caused their utilization and productivity to deteriorate significantly.

(2) General Direction for Improvement

To improve ACP's business condition, profitability should be given the first priority. For raising profitability, revenue should be increased and/or the production cost should be reduced to increase the gross profit to revenue. To increase the revenue under the present production system, market development and expansion is indispensable and efforts to reinforce marketing and sales capabilities are essential. Cost reduction is discussed in detail in another section. Revenue growth and cost reduction will raise profitability to allow ACP to reduce current liabilities and improve its solvency.

To stabilize the financial condition in the long term, it is imperative to dispose fixed assets that are not used or underutilized, while ensuring effective and efficient operation and utilization of fixed assets required for business activities.