2-1-2 JSC "Balkhashmed"

(1) General

The city of Balkhash is located at the latitude of 46° 52′ N and the longitude of 74° 59′ E, on the northern shores of Lake Balkhash, in the province of Zhezkazgan. The city was founded primarily for processing of ores from the Kounrad Mine when its exploitation started in the late 1930's and includes the Combine's head office and plants such as a concentrator, a smelter, a refinery and a metal fabrication factory. The Kounrad open pit mine is located about 12 km north of the city, while another mine, the Sayak, is some 200 km east of the city. The ores of both mines are transported by rail to the Balkhash concentrator for dressing. Many raw materials are obtained from foreign sources such as Erdenet in Mongolia, Chuquicamata in Chile and others.

There is an airport about 5 km north of the city, where commercial flight services are available four times a week from Almaty. International flights from Moscow, Russia, also stop over twice a week en route to Almaty. A railway along the northern shores of Lake Balkhash connects Balkhash city to the town of Moiinti, about 130 km to the west, and to the town of Aktogay, about 380 km to the east. Both these towns are connected by rail to the capital city, Almaty to the south.

The topography of the general area is characterized by featureless peneplain, ranging from about 400 to 600 m above mean sea level. There are no notable rivers in the area and surface water, mostly infiltrating to form underflow, is very poor all the year round. Lake Balkhash is one of the major lakes in the world and occupies an area of 18,430 km^2.

The Balkhash district belongs to a climatic zone of dry feather-grass steppe with generally low precipitation. The difference between the maximum and the minimum temperatures is considerable, with a monthly mean of 24.1 ℃ in July and -14.8 ℃ in January. Monthly precipitation ranges from 5 to 15mm and indicates no significant fluctuation by season. The climatic records are shown in Table 2-1-2(1).

Table 2-1-2(1) Climatic Record of Balkhash Area

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Av. Record /Total	
Temperature (℃)														
Monthly Av.(Mean)	-14.8	-13.6	-5.5	7.5	16.0	21.8	24.1	21.6	15.2	5.9	-3.8	-10.5	5.4	1951-1980
Precipitation (mm)														
Monthly	7.9	9.2	9.7	13.7	7.2	15.3	12.3	12.6	5.3	9.2	10.3	14.9	126.5	1951-196

(2) Geology and Ore Resources

The Kounrad deposit is a porphyry copper deposit, associated with a granodiorite porphyry intrusion. The Middle Carboniferous granodiorite porphyry stock, measuring 2 km by 3 km in horizontal dimension, intrudes Lower Carboniferous volcanics composed of rhyolite lava and acidic pyroclastics, and is intruded by diorite and diabase. The ellipse shaped copper mineralization occurs in an area that is 1,350 m in its long axis, 950 m in its short axis, and at least 500 m in the vertical dimension. The orebody is in the granodiorite porphyry stock with

strong silicification and sericitization. The main ore minerals are chalcopyrite, chalcocite, molybdenite, bornite, pyrite, and small quantities of gold and silver. The ore being mined at present is nearly all secondary and consists of chalcocite.

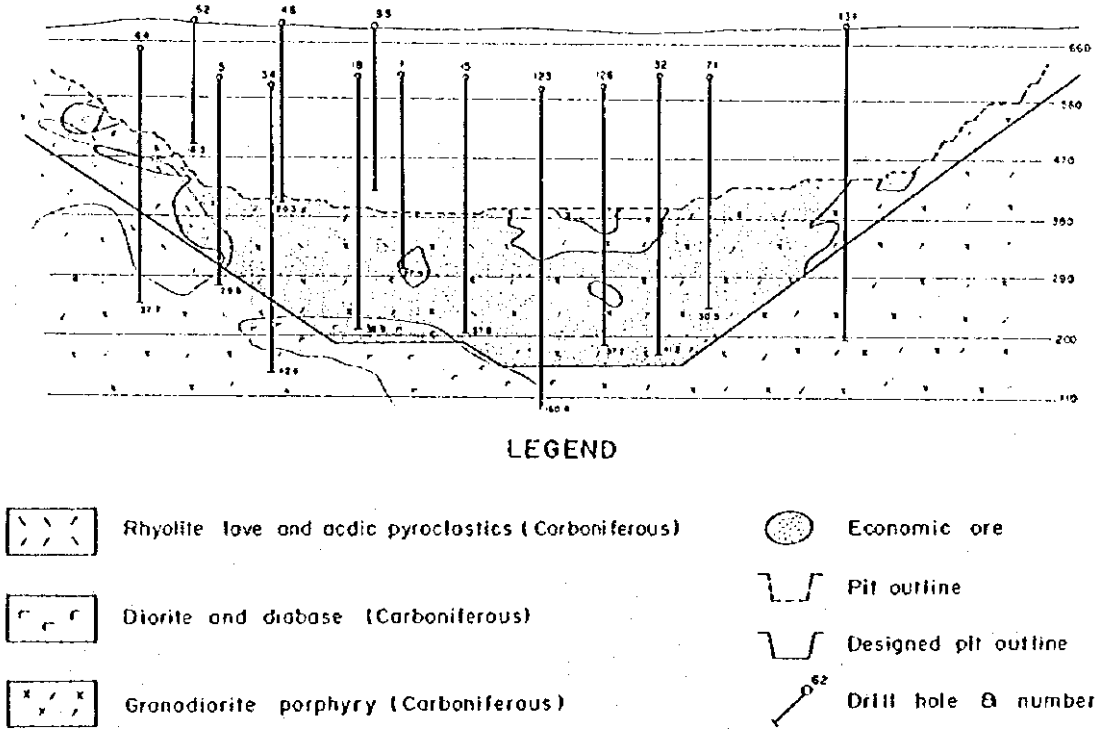


Fig.2-1-2(1) Section of the Kounrad Pit, JSC "Balkhashmed"(1995)

At Kounrad Mine, the expansion of an open pit was justified by a reserve of 217 million tonnes with an average grade of 0.33 % copper, 0.005 % molybdenum, 0.015 g/t gold and 0.62 g/t silver indicating a 39 year mine life.

The Sayak-1 deposit, one of six deposits located in the Sayak mining district, is skarn formed at the contact between limestone and granitic intrusions. Present operations are confined to the Sayak-1 Pit where about 2 million tonnes of ore averaging 0.64 % copper is mined per year. Orebodies occur in a sequence of Middle Carboniferous sedimentary rocks which lie in contact with granitic rocks of Permian age. In the contact zones the limestone is metamorphosed to marble with associated iron and copper mineralization. The mineralization, about 2.5 km long and 700-800 m wide, is chiefly chalcopyrite, magnetite, molybdenite and bornite. Ore zones are often steeply dipping and ore grades are usually 0.6 % copper.

The remaining ore reserves at the beginning of 1996 were 8.4 million tonnes grading 1.16 % copper, 0.004 % molybdenum, 0.4 g/t gold and 6.0 g/t silver. This indicates a three year mine life.

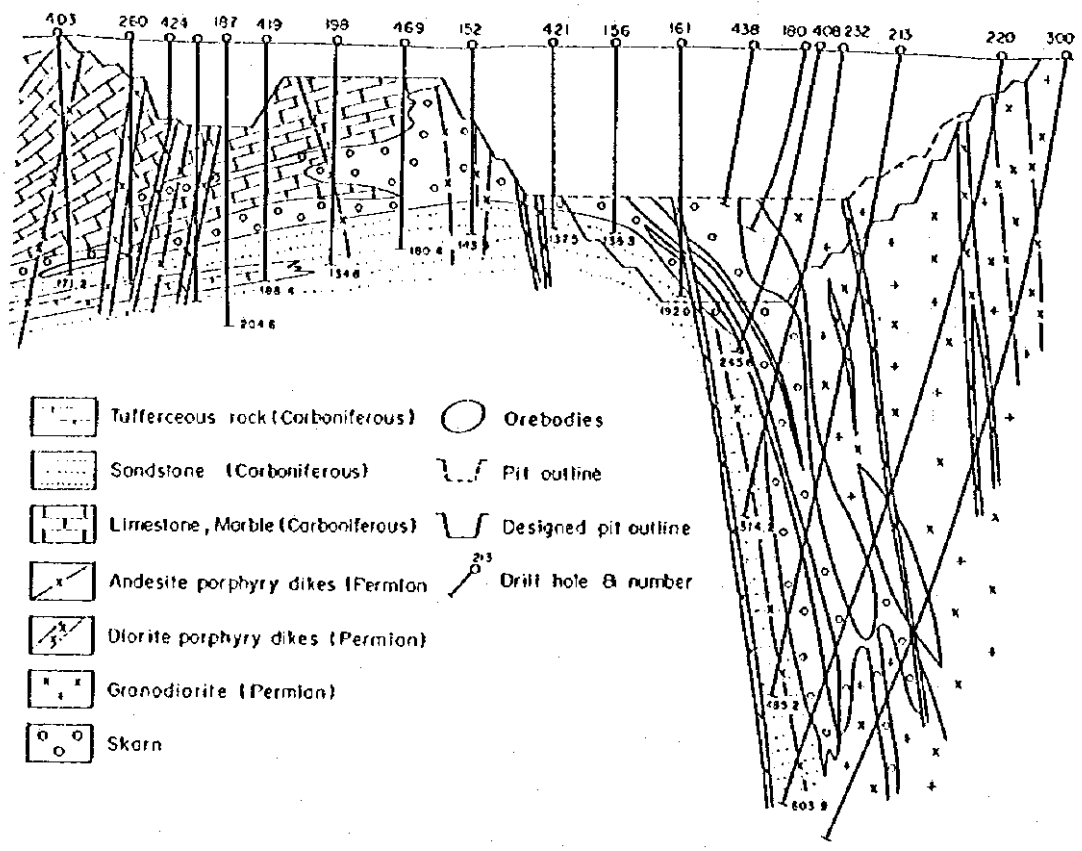


Fig.2-1-2(2) Section of the Sayak Deposit, Balkhashmed(1995)

(3) Mining

The JSC "Balkhashmed" has two mines in operation, namely the Kounrad and Sayak Mines. As Sayak Mine is scheduled to be mined out in 2001.

The Sayak Mine has produced ore constantly. On the contrary, production from the Kounrad Mine has decreased steeply since 1994, and it can now produce 8 million tonnes of ore per year with a waste-to-ore ratio of 3. It is believed that the concentrator will not treat as much ore as planned because the ore from the Kounrad Mine is low in grade, and the concentrator is in poor condition due to a lack of spare parts and a shortage of power supply.

The production records are shown in Table 2-1-2(2).

Table 2-1-2(2) Production Record

Year	Kounrad			Sayak		
	Ore 1,000ton	Cu %	Waste 1,000m^3	Ore 1,000ton	Cu %	Waste 1,000m^3
1991	--	--	--	2,171	0.66	3,389
1992	--	--	--	2,268	0.66	3,189
1993	7,470	0.38	5,580	2,231	0.61	3,387
1994	5,370	0.38	6,060	2,001	0.64	2,810
1995	5,200	0.38	5,477	2,127	0.65	1,472
1996(plan)	7,800	0.34	6,500	2,200	0.61	3,769

Source: Data from JSC "Balkhashmed"

1) Kounrad

Development of the Kounrad Mine commenced in 1935 and production started in 1938. It is 12 km north of the JSC "Balkhashmed". The open-pit covers an area 1,980 m by 1,640 m with a depth of 435 m from the surface(Fig.2-1-2(3)). The final pit will be 610 m deep. The bench height is 15-20 m and the final pit slope is 36 degrees on average. The Gyprotsvetmet Research Institute completed a review of the final pit in August 1995, which led to a significant waste reduction. The final pit is being revealed near the surface, so that the pit will be mined downwards from now on. The mining activities at the present pit bottom will be completed in 1999, after which the pit will be expanded and deepened. At that time the production rate will be decreased to 3 million to 5 million tonnes per year for ten years because of the high waste-to-ore ratio.

The mining method is bench-cut utilizing rotary drills(hole diameter: 244.5mm), electric excavators (bucket capacity: 5m^3, 8m^3, 10m^3), railcars(load capacity: 105t) and dumptrucks(load capacity: 40t, 105t). The railway is extended to the pit bottom, where blasted ore is loaded onto railcars by an excavator to be transported to Balkhash for ore processing. There is a standard for drill and blast, which is based on the Protodiakonov index. Blast holes are drilled on 7.5m by 7.5m centers and are 18m long. Tri-cone bits are used for drilling, with an average consumption rate of 0.05 pieces per one thousand m^3. The performance of drilling is 95 meters per machine-shift. 70 % of the explosives used is granulite which consists of ammonium nitrate and TNT with a powder factor of 0.37kg/m^3. The secondary breakage rate is 5 % of total ore blasted. An excavator can load 3,200 tonnes per machine-shift. A four-railcar train can haul 1,600 tonnes per shift. Power consumption is 5.7 kWh per tonne of material. Ore losses are 3% while dilution is 7%.

There is a maintenance system to keep equipment working properly. Table 2-1-2(3) shows high availability and low utilization in general. It indicates that machines are well maintained and less utilized in accordance with the low production rate. Dumptrucks are obsolete, so that their availability is very low.

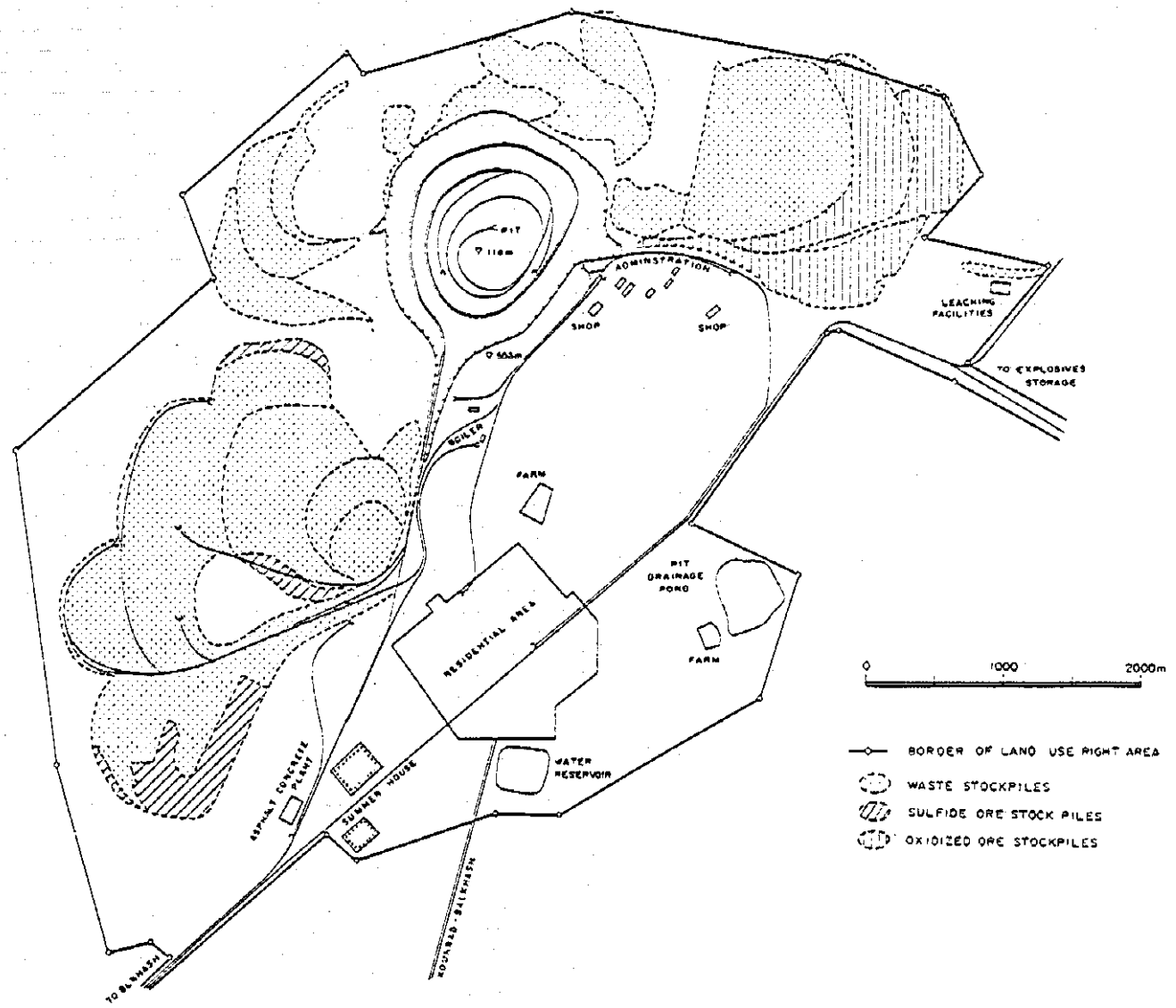


Fig. 2-1-2(3) General facilities layout at the Kounrad Mine

Table 2-1-2(3) Major Equipment List (1995)

Equipment	Type	Units	Year of Purchase	Util.*1	Avail.*2
Drills	SBSh-250	5	1988-1993	23%	95%
Excavators	EKG-5,8,10	13	1990-1995	59%	95%
Dumptrucks	40t,105t	18	1989-	31%	49%
Locomotives	EL-1,21	17	--	42%	93%

Note: *1 Util.=Utilization, *2 Avail.=Availability

The mine is operated 365 days per year, three shifts per day and 8 hours per shift. There are 1,255 employees working at the operation, which is characterized by the rail haulage system. This operation is overmanned and less productive compared to mines in the West. The north American open pits similar to this mine make greater use of trackless machines and have 200 to 300 personnel engaged directly in production. The Kounrad Mine has more than 800 employees(excluding Heat and Power Supply) under the chief engineer(Fig.2-1-2(4)).

There are 250 million tonnes of oxide ore stockpiled on the surface with a grade of 0.25 % Cu. The method of leaching oxide ore had been tested for 10 years starting in 1971, but failed to determine an appropriate technology. It was found suitable to apply leaching and SX-EW method to treat this type of ore. A joint venture with an American company was formed in 1992 to promote the feasibility study for application of leaching and SX-EW method. The project was approved in September 1995 but has yet to start because of inadequate financing.

2) Sayak

The Sayak Mine commenced development in 1971 and started production in 1975. It is 230km east of Balkhash along the Balkhash lake shore. The open-pit covers an area 1,900 m by 730 m with a depth of 290 m. Ore is mined by trackless machines and the bench height is 7.5 m and 15 m. Ore from the open-pit operation is transported to Balkhash for ore processing.

(4) Ore Dressing

The production history of the Balkhash concentrator which treats copper ores from two open pit mines is as follows:

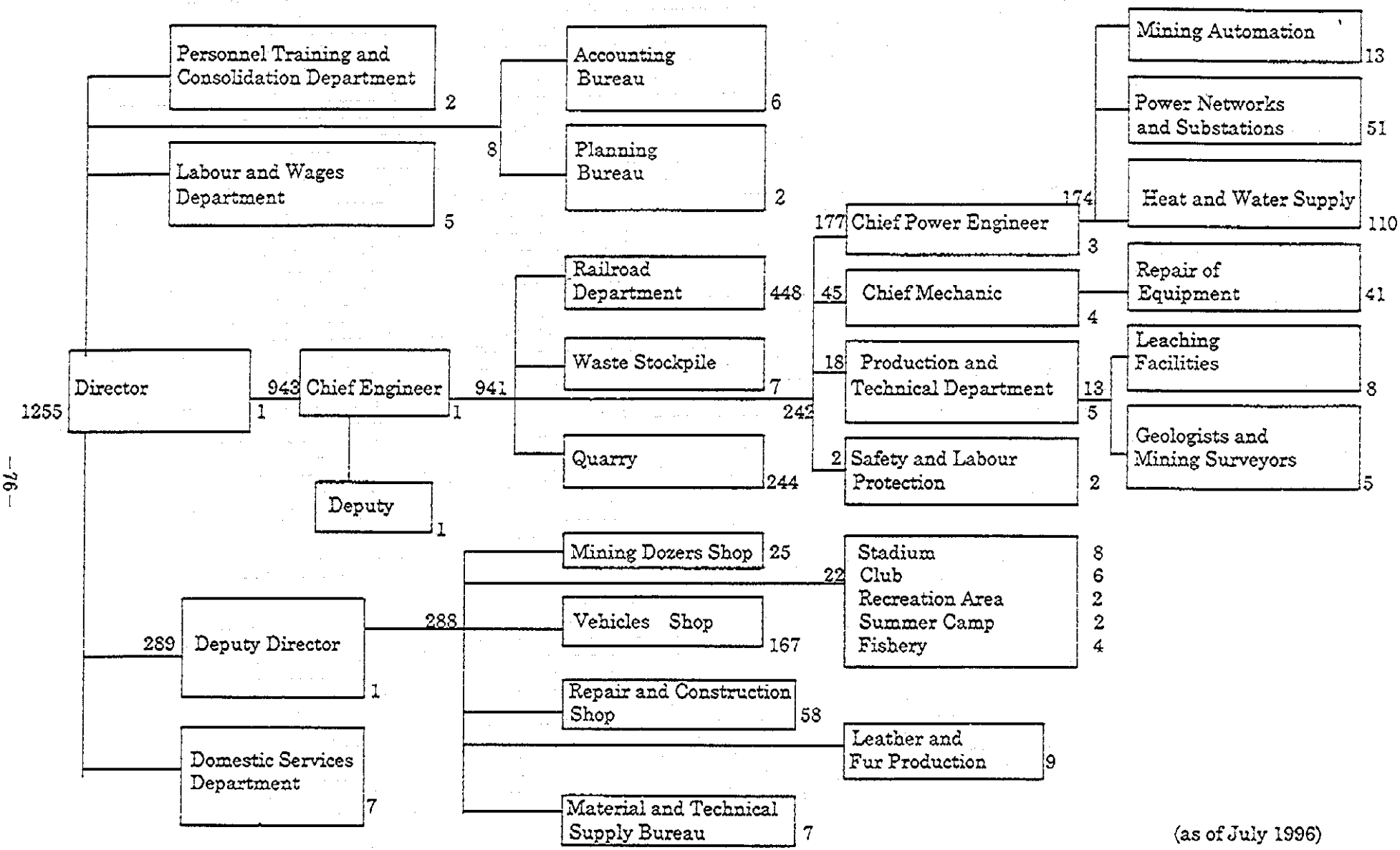


Fig. 2-1-2(4) Organization chart of the Kounrad Mine(as of July 1996)

Table 2-1-2(4) Balkhash concentrator

Item	Unit	1990	1991	1992	1993	1994	1995
Ore treated	kt	11,381	9,251	10,196	9,887	7,704	7,642
Head grade	%Cu	0.501	0.464	0.454	0.460	0.491	0.493
Cu recovery	%	82.0	80.5	78.0	72.6	73.9	75.4
Conc. Production	kt	302.2	240.0	249.5	231.4	193.5	200.1
Contained Cu	kt	46.749	34.568	36.126	31.721	28.060	28.385
Conc. Grade	%Cu	15.47	14.40	14.48	13.70	14.52	13.75

Source: Data from JSC "Balkhashmed"

The Balkhash complex has two concentrators, i.e. Kounrad and Sayak, which have a common crusher plant but separate plants for operations between the mill bins and flotation cell stages. A small plant, which was originally built to treat molybdenum ore from the east Kounrad Mine, is now treating smelter slag temporarily.

The Kounrad and Sayak concentrators were built in 1938, and treated 14,000 ktpa(design capacity is 12,000 ktpa) in 1988. The Sayak concentrator has a single stage fully autogenous grinding mills and the Kounrad concentrator has a rod-ball-ball grinding mills system. New OK CC-45 ceramic filters were installed for concentrate filters. The concentrator feed is a mixture of Sayak ore(making up 80 %) and smelter slag(20 %), and is fed into the 5th and 6th production lines.

The concentrators were operated only for ten days in January, February and March, 1996, and they treated the Sayak ores first and the smelter slag secondly. That is considered to be the reason why the availability of the concentrators was 76.6 % but the ore production from the Kounrad Mine was very small. They plan to treat 1,800 ktpa of slag at least until the year 2027.

On the day the author visited the plant, it was not treating copper ore but crushing calcite ore as a temporary assignment. The reason was reportedly a lack of rods for rod mills. Rods were being manufactured in Russia and delivered to the plant after an order had been placed with payment in advance.

The concentrates from Kounrad ore contain as little as 14 % Cu with 72 % recovery, those from Sayak ore are as low as 18 % Cu with 88 % recovery, and those from the smelter slag are 12 % Cu with 60 % recovery when separately treated and 72 % recovery when treated together with Sayak ore.

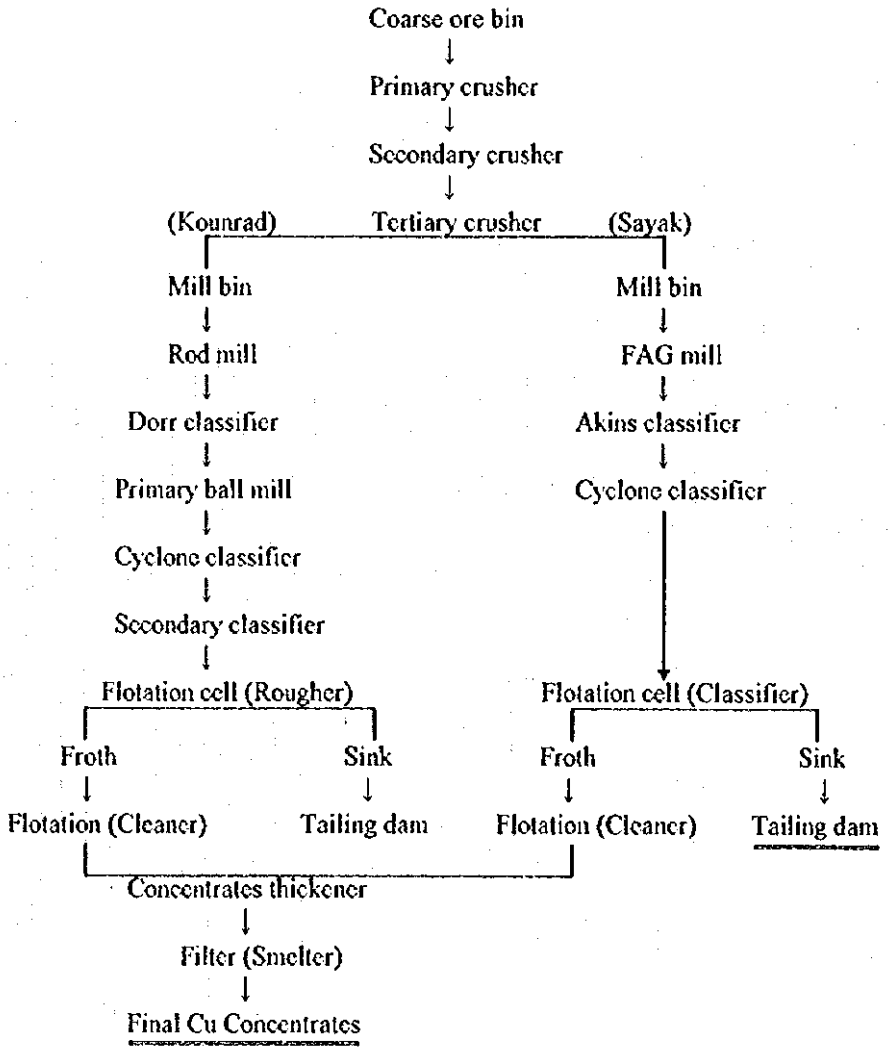
According to the engineer in charge, Giprotsvetment and the Kounrad Mine have cooperated to make a plan to modernize concentrators. The first phase includes renovation of grinding mills and flotation cells with $US 13 million budget. The second phase includes renovation of grinding mills, flotation cells, and pumps and installation of automatic control and sampling systems with $US 20 million budget.

They built the old tailing dam at a distance of 1.5 km from the plants in 1939 before which the tailing slurry was disposed in Balkhash Lake. The current dam was constructed in 1980. The total area of the dam is approximately 20 km^2 and 60 % of the industrial water is recycled.

Organization and manpower of the concentrators are as follows:

Section	Number
Administration	70
Crusher	72
Grinding	45
Flotation	40
Maintenance	490
Economical staff	37
Transportation	10
Total	764

The flowsheet of the Kounrad and Sayak concentrators are as follows:



(5) Smelting

They equip two reverberatory furnaces and two Vanukov furnaces for smelting concentrates. Converting furnaces are Pierce-Smith type and anode furnaces are reverberatory type. Main problem around the smelting area are severe working conditions caused by sulfur dioxide and dust emission. Around the sulfuric acid plant, sulfur dioxide leakage from flues was observed, so the inspection of the operation was poor. Following are recent operating data.

1) Reverberatory Furnace

Coal consumption : 6-8 tons/hr-furnace

Matte grade : 25-35% Cu

Cu% in slag : 0.63

Temperature : 1250-(1550℃)

2) Vanukov Furnace

Matte grade : 40-45%

Matte production ratio : about 40%

No. of operating : One of two

3) Converter Furnace

Treated matte : 120-150 tons/cycle

Cycle time : 8-10 hours

Campaign life : about 100 days

Blast air

Amount : 30-35 thousand Nm^3/hr

4) Anode Furnace

Typical operating time : 12 hours

5) Sulfuric Acid Plant

Inlet gas

SO2 content : 4-6%

Volume design : 45 thousand $Nm^3/hr/system$

actual : 30-40 thousand $Nm^3/hr/system \times 3$ systems

Outlet gas

SO2 content : 0.1-0.7%

(6) Refining

Their process may be conventional but the details are unknown because the questionnaire was not filled out. The time for the site survey was too short.

The production capacity is 300,000 tonnes per year. But owing to the shortage of concentrates, the production is about a half of the capacity.

About 450 persons including the staff services are employed.

The details, about the outline of process operation, are not clear. The tankhouse is made up of 120 sections. Actually they may use a half of cells. Each section contains 20 cells. The standard anode weight is 270 kg. The anode life is 21 days and the cathode life is 8 days. The reagents used are glue and thiourea. The scrap rate is typically 20 %. The temperature of electrolyte is 60℃. The production of copper sulfate is typically 300 tonnes per month. They do not recover nickel.

The appearance of product cathodes is not good. There are many nodules on the surface and edges. The product cathodes are strapped in bundles. The product cathodes are mainly sold to western Europe.

Table 2-1-2(5) Cathode Production(ton/year)

Capacity	1990	1991	1992	1993	1994	1995
300,000	163,400	129,600	126,600	138,000	135,200	140,000
%	54.5	43.2	42.2	46.0	45.1	46.7

Table 2-1-2(6) Main Operation Data of Balkhash Refinery

	Commercial tank	Starting sheet preparation
Life of anode (day)	21	
Weight of anode (kg)	250	
Anode scrap ratio (%)	20	
Life of cathode (day)	7	
Weight of cathode (kg)	70	
Tank number	2,400	
Temperature of electrolyte (℃)	55	45
Au:Ag in anode slime	1:14	

Table 2-1-2(7) Main Facility of Balkhash Refinery

	Manual	Automatic	Not installed
Starting sheet stripping machine	○		
Cathode preparation machine		○	
Anode press machine			×
Anode milling machine			×
Anode spacing machine			×
Anode scrap washing machine			×
Product copper handling machine		○	
Product copper washing: Bath washing type			

2-1-3 JSC "Leninogorsk PC"

(1) General

The JSC "Leninogorsk PC", an integrated operation from mining to smelting, recently had its management right given to the Ridder Invest Company.

Currently, the combinat owns four mines, two concentrators (processing capacity: 5.4 million tons/year), one zinc smelting plant, and one lead recycle plant. The number of employees totals about 12,000.

The combinat is an important enterprise located in Leninogorsk, 80 km northeast of Usti-Kamenogorsk, the provincial capital of the Eastern Kazakh Province. Besides the production of zinc, copper, and lead concentrates, the combinat also processes precious metal, sulfuric acid, cadmium, zinc-aluminum alloys, antimony-lead alloys, zinc sulfate, and others as the final products.

A long time ago, the mine of the combinat started when Philip Ridder found the Ridder-Sokole ore deposit in 1784. Oxidized zinc and lead ore iron oxide was mined on the surface until the 1980s. Since the concentrator was constructed in 1926, substantial production started, which led to the formation of the today's JSC "Leninogorsk PC".

(2) Geology and Ore Resources

Metallogenetic provinces in Kazakhstan are roughly divided into four. Of these, the Paleozoic group (in the Caledonian and Hercynian orogenic periods) including the Precambrian geology is widely developed in the Eastern Kazakhstan, and polymetallic ore deposits, containing copper, lead, and zinc, are developed in the Altai Mountains and its surroundings in Eastern Kazakhstan.

Ore deposits in the Leninogorsk area are featured with mineralization of copper, lead, and zinc in bedded and massive forms derived from volcanic origin in argillites, volcano-sedimentary breccias, microquartzites, and mixed volcanics of Devonian period in the Paleozoic era. Ore minerals in such ore deposits are sphalerite, pyrite, galena, and chalcopyrite, while gangue minerals are quartz and calcite.

The Devonian sedimentary and volcanic rocks in above mentioned host rock are intruded by albitophyre, porphrite sills, and diabase dykes. The ore deposits are formed along a small normal fault forming a graben and the mineralization continues along the fault extending up to 600 meter deep from the ground surface. Although the ore bodies in massive and/or bedded forms are generally concordant with bedding planes of the host rock, some of them are found in network-like pattern due to the movements by mineralization along the joint in later periods with a part that shows a network condition..

The JSC "Leninogorsk PC" operates three mines (underground mining) in 1995. The actual production and ore reserve breakdown of these mines are shown below.

Actual Production (1995)					Ore reserve				
Mine name	Ore reserve	Grade			Category				
	(unit:1000tons)	Cu(%)	Pb(%)	Zn(%)	(unit:1000tons)		Cu(%)	Pb(%)	Zn(%)
Tishinskoye	864	0.52	1.19	6.46	B+C1	31,581	0.61	1.0	6.08
Ridder-Sokolnoye	766	0.40	0.30	0.73	B+C1	41,716	0.49	0.47	1.17
40 years Lenin	-	-	-	-	-	-	-	-	-
Shubinskoye	68	0.92	0.23	0.92	A+B+C1	2,967	2.18	0.55	3.97
Total	3,038				C1 or more	76,264			

The combinat now depends on the Tishinskoye Mine for the major ore production.

However, the reduced productivity following increasingly deeper mining and problems arising from obsolete facilities and equipment have become a major concern.

In this area, there are distribution of many ore deposits and mineralizing spots similar to those found in the Tishinskoye Mine. Some of them had a detailed exploration and feasibility study. They will be the target for development in future. The following are the major ore deposits, which are expected to become major mines of the JSC "Leninogorsk PC" in the future.

a. Novo Leninogorsk Ore Deposit

This deposit is located 7km northeast of Leninogorsk. The ore deposit, made of polymetallic ore deposit, occurred in the volcanic sedimentary layer of the Silurian and Middle Devonian periods. The deposit was found in 1982.

The deposit, which is a part of the Leninogorsk ore deposit, is made of seven ore beds present in the form of bed or stockwork. The mineral composition changes from barite ore to Pb/Zn ore then to Cu-rich ore descending from the surface. Barite-polymetallic ore and polymetallic ore are also found.

According to a plan, the annual ore production is expected to reach 1,250,000 tons. A mineral dressing test and feasibility study have been completed. The ore reserve and grades of the Novo Leninogorsk ore deposit are stated below:

Ore reserve	Category	Cu(%)	Pb(%)	Zn(%)
34,970,000 tons	B+C1	0.16	1.44	4.05
16,060,000 tons	C2			

On the third site survey, it was discovered that the JSC "Leninogorsk PC" does not own the development right for this deposit and Obrocheskastostreyanskaya , a veterans group called "SHIT", owns the right.

b. Chekmar Ore Deposit

This ore deposit is located 50 km north of Leninogorsk, at altitudes of 650 to 1050 meters. The geological conditions are similar to other polymetallic ore deposits in this area. The Chekmar deposit belongs to three volcano-sedimentary mineralization belts (Guslyakovsky, Chekmar, South-Eastern). Some 88% of the total

ore reserves is developed in the Chekmar ore body. The ore reserve and grades are as follows:

Ore reserve	Category	Cu(%)	Pb(%)	Zn(%)
91,629,000 tons	C1	0.22	0.80	2.7
18,958,000 tons	C2	0.42	0.76	1.8

Mineralization is confirmed to continue at least 600 meters under the surface. A mineral dressing test and a feasibility study have been completed. A preparation of development is underway for this ore deposit, which will start with open pit mining. The planned ore volume for mining is estimated at 58.2 million tons and the total stripping volume is expected to reach 139.4 million m^3. The development of this deposit is limited by the three remaining problems that are shown below.

a) Build a new concentrator at the mine site.

b) Set up power lines (50 km).

c) Build water treatment plant (environmental countermeasure).

(3) Mining

The JSC "Leninogorsk PC" has four active underground mines, the Ridder-Sokolnoye, 40 years Lenin, Tishinskoye and Shubinskoye Mines. There are 800 employees that work underground at Tishinskoye. The grade of the ore mined last year was zinc 6.33%, lead 1.40%, copper 0.52%, silver 17.77 g/t and gold 0.89 g/t . The cut-off grade is 1.6% zinc equivalent. The dilution rate is 15% while the loss is at 5%. The company is presently about 600 meters below the surface and plans to mine 540 meters below this level. The grade of the orebody worsens as the company mines at deeper levels.

The 1996 production goal for the mine is 970,000 tons. The combinat uses sublevel stoping with backfilling to mine the ore. The distance between each sublevel is 60 meters. The main equipment are Tamrock twin boom miniborer, Tamrock roofbolter, Tora 2.5 cubic meter loader and Tatra 32 ton truck. After the ore is blasted, the loader dumps the rock into the ore pass. The ore is then loaded into 4 cubic meter cars and transported by a 14 ton electric locomotive to the skip. The capacity of the skip is 9 cubic meters.

At the other mines, they use Russian Federated hand held drills and scrapers. Shubinskoye uses sublevel stoping while the Ridder-Sokolnoye and 40 years Lenin use sublevel caving. The number of miners for the Shubinskoye, 40 years Lenin and Ridder-Sokolnoye mines are 30, 550 and 700 people, respectively. The 1995 mining cost per ton are as follows: Ridder-Sokolnoye-$9.20, Tishinskoye-$18.74 and Shubinskoye-$19.17.

(4) Processing

This combine has two ore dressing plants, a heavy liquid separation ore dressing plant to separate and remove gangue of Tishinskoye ore by using heavy liquid in a coarse grain stage and the second ore dressing plant (constructed in 1965) to carry out crushing, grinding, flotation, and dehydration of ore after gangue is removed and the third ore dressing plant (constructed in 1928) to process Ridder-Sokolnoye ore. Both the second and third ore dressing plants are located in the Ridder-Sokolnoye Mine, the heavy medium separation plant is about 10 km away from the second ore dressing plant, and ores are transported by railroad. Both the second and third ore dressing plants were constructed long time ago and a flow sheet is also antiquated. That is, the crushing process is composed of a relatively small cone crusher plus screen circuit, and in the grinding process a lot of small ball mills and a large number of small-size flotation machines are installed. In the former USSR era the machinery was renewed whenever necessary, but since the renewal of the machinery was delayed due to a lack of operation funds round about the time of the collapse of USSR, new machines have not been installed since 1993. Total 870 persons are working in the heavy medium separation plant and the second and third ore dressing plants, but according to the hearing, a ore dressing cost is 4.46 US$/t, which is lower than that of lead and zinc mines in the Western countries. In case the payroll cost becomes high from now on, it is thought that the proportion of the personnel cost to the total expenses will increase so that the numbers of personnel need be reduced. According to the operation performance in 1990 through 1995, the amount of processed ore has remarkably decreased particularly since 1993, and the operation rate is 74% and 44.5% in the second and third ore dressing plants, respectively.

The amount of metal during smelting has also decreased, and the production of Cu fell from 12,000 t/year to 7,000 t/year and that of Pb fell from 15,000 t/year to 9,000 t/year. Moreover, Zn was produced 70,000 t/year around 1990, but now its production has decreased to about 50,000 t/year. The capacity in the Leninogorsk Zn smeltery is 105,000 t/year, and a shortage is purchased mainly from the JSCs "Zyryanovsk lead Combine" and sometimes from "EKCChC" and "Tekeri Pb-Zn Combine". According to a major component analysis value in concentrate, the grade of concentrate in this ore dressing plant is relatively high although that of the Kazakhstan's mines is generally low, and the grade of both Cu concentrate and Zn concentrate exceed an average grade of concentrate in the world polymetal mines (Cu-Pb-Zn) in 1993.

Zn concentrate contains 2.2% of Al_2O_3 and 1.3% of CaO, which is high. In particular, it is possible that slime in crude ores is mixed in Al_2O_3. According to the hearing, the estimated production is 70,000 to 80,000 t/year, and from now on Zn smeltery need to continue to obtain their supplies of metal from other industrial complexes. With the development of the Chekmar deposit, it is expected that the amount of Zn metal produced from its own mine will be 100,000 t/year or more and the industrial complex expects that the self-supplying system will be established.

Second ore dressing plant

After being crushed into -50 mm with a jaw crusher and cone crusher in Tishinskoye mine, ore is screened and fine grain of -2 mm is sent to the above-mentioned heavy medium separation plant. In the heavy medium separation plant ore of -2 to +0.74 mm is separated by heavy medium to be recovered. Ore containing slime smaller than that is also recovered by flotation, and it is transported to the second ore dressing plant by railroad together with ore of coarse grain of -50 mm. After all, in the heavy medium separation plant gangue of maximum 25% is removed so that the crude ore grade increased by about 30%. Removed gangue is now mixed with cement to be used for filler in the mine. Ore is comminuted with a cone crusher and ball mill in the second ore dressing plant, and first of all it is separated into Cu/Pb mixed concentrate and settlings (Zn, Py: Pyrite) by Cu-Pb semibulk flotation by using NaCN and $ZnSO_4$. Cu-Pb mixed concentrate is separated into Cu and Pb by separation flotation and Cu concentrate and Pb concentrate are recovered. As for settlings of Cu-Pb semi-bulk flotation, Zn is activated and recovered by flotation with $CuSO_4$ to separate it from tailings. The processing capacity of the ore dressing plant is 1,200,000 t/year and the actual processing performance in and after 1990 is 800,000 to 1,000,000 t/year as shown in the table below. Since a lot of small machines with a small processing capacity are installed in the ore dressing plant, it is advisable, as a whole, to install new large-size machines. In particular, in the flotation process about 600 units of flotation machines with a tank capacity of 3 to 6 m^3 are installed in the entire second and third flotation plants so that their maintenance is troublesome. It is desirable that large-size flotation machines with a capacity of 20 to 30 m^3 be introduced to reduce cost such as electric power charges, support automatization, and increase the extraction percentage.

Third ore dressing plant

The processing capacity of the ore dressing plant is 2,800,000 t/year. The processed ore is Ridderskoye ore and that of containing much copper in Ridderskoye ore is also processed.

The grade of Cu, Pb, and Zn in Ridderskoye ore is so low that it may be taken for tailings. The crude ore value calculated from the crude ore grade and each metal price in 1995 is about US$ 40/t, which is less than half of the value of Tishinskoye ore.

However, Ridderskoye ore contains gold of 1.5 to 2 g/t and the value of gold to the value of crude ore is about 65%, which is quite high. Therefore, more importance is attached to gold than to Cu, Pb, and Zn, and coarse grain gold is recovered from flotation supply ore by gravity separation and gold and silver flotation concentrate is also recovered by flotation. Gold in tailings has a grain size of 15 to 20 microns, and a single unit makes up about 30%, a middling state with pyrite, etc. accounts for about 55%, and those which are surrounded by ore in dotted form account for about 15%. Tailings accumulated in the past in the tailing yard were processed total 250,000 tons by flotation in 1991 and 1994 in order to recover precious metal in tailings.

Bulk flotation is performed to recover Cu, Pb, and Zn by flotation and separate them from tailings. Zn and Cu are separated from bulk concentrate to obtain concentrate, but currently Cu and Pb are not separated.

According to the hearing, they wanted to bring out a scale merit of full operation by processing Ridderski ore of 2,800,000 t/year. Although the ore dressing facilities and flow sheet are old because they were built long time ago, it seems that they can be used from now on if proper maintenance is done. Tailings in the second and third ore dressing plants are sent to a dumping site. As the present dumping site will become full in 2006 at a dumping pace of 4,000,000 t/year, there is a plan that the banking is raised by about 32 m. According to the plan, with the raise, total about US$ 20,000,000 will be required for switching of hillside channel works, renewal works of pump pedestal and substation facilities, etc..

2-1-4 JSC "EKCChC"

(1) General

The present company started in 1964 as a division of the JSC "Irtysh PC". It became independent from JSC "Irtysh PC" in 1967 when the division was renamed JSC "EKCChC" . Under the state-owned company KRAMDS, the management right was given to Dalex Trading Ltd.,. Now Dalex owns 81% of the stock. The combinat owns three mines (Nicolaevska, Shemonaikha, Kamushinski) with open pit mining. Mining of the Kamushinski mine ended in 1994. Currently, the remaining two mines continue to operate. Ores produced are polymetallic complex ore, which is processed at the Nikolaevsky concentrator to produce in the form of copper concentrate, zinc concentrate, and copper-zinc bulk concentrate.

(2) Geology and Ore Resources

The ore deposits in this region are a part of the Kamyshynsy ore deposit in Roundy Altai area. The geological structure of this area belongs to the southwestern wing of the Aleisky syncline of the Irtysh fold-belt. The northwestern part of the Aleisky syncline structure faces with the Holodny Klyuch fault and the northern section of the syncline structure is inclined sharply by 40 to 60 degrees in the southwestern direction. In the southern part the diabase porphyry body is wide spread, where granitic rock of the Zmeinogorsky complex igneous rock penetrates. The ore deposit is classified as a polymetallic ore deposit that occurred in the volcanic sedimentary rock of the Devonian period.

As of 1996, the combinat operates two mines with open pit mining. The actual 1994 production and the ore reserve breakdown of these mines are as follows:

Actual Production (1994)					Ore reserve				
Mine name	Ore reserve	Grade			Category	Ore reserve	Grade		
	(unit:1000tons)	Cu(%)	Pb(%)	Zn(%)		(unit:1000tons)	Cu(%)	Pb(%)	Zn(%)
Nicolaevskoye	392	1.20	0.39	3.14	B+C1	23,402	2.54	0.49	
Shemonaihinskoye	333	3.30	1.44	7.76	B+C1	1,238	3.86	1.34	
Total	725				C1 or more	24,640			

Exploration in the surrounding ore deposits have already been carried according to a schedule and the ore deposit potential of this area is outlined. In particular, the Artemyevskoe deposit has high-grade ore and is expected as an alternative when mining in the Shemonaihinskoye mine ends. Though the Artemyevskoye deposit is mined underground, the site conditions including infrastructure are very good and qualified to be practical conditions for actual development project. Below are the grades and ore reserve found by the past evaluations.

Category	Ore reserve	Grade				
	(unit: 1000 tons)	Cu(%)	Pb(%)	Zn(%)	Au(g/t)	Ag(g/t)
B+C1	16,900	2.47	2.03	8.07	1.8	196
C2	612					

In addition, the EKCC has the Kamushinski mine, whose mining ended in 1994 and 350,000 tons of ore reserve is left unexploited.

(3) Mining

The Nicolaevskoye Mine was started in 1964. The combinat is currently mining at a depth of 250 meters. The final depth of the open pit will be 420 meters. There is 25 years of mine life left. The open pit has a working slope of 27° and a final slope of 42° with the distance between benches at 15 meters. The diameter of the open pit is 1.5 kilometers. The EKCC extracts polymetal ore by open pit method and produces copper and zinc concentrates. There are 270 people who work at the mine. All their equipment is made by the Russian Federation. The combinat drills, blasts with ANFO, and uses 5 and 10 cubic meter excavators to load the ore into 42 and 110 ton capacity trucks. There are a total of 80 trucks. The trucks go to a geophysical device that determines the grade of the ore. Depending on the grade of the ore, the trucks either takes the ore 6 kilometers to the concentrator or dumps the ore onto the stockpiles. The strip ratio is 6.15 cubic meters per ton of ore but this ratio will decrease to 3 cubic meters per ton of ore as mining continues down to the final depth. The cutoff grade is 0.7% copper that is conditional on the other metals. Kazgiprotvetsmet has made a mine plan for the Nicolaevskoye Mine to increase its production to 1 million tons per year in 1999. Their 1996 plan is 650,000 tons for Nicolaevskoye Mine which is the same as mine's production in 1995.

The Shemonaihinskoye Mine, began production in 1987, consists of two open pits that are separated by a small buffer. The combinat uses the same mine design as the Nicolaevskoye Mine but the bench levels are 10 meters apart. At the south pit, the depth is 185 meters with a final depth of the pit at 275 meters. There are 130 employees at the mine. The combinat has 35 trucks operating at the mine. The cutoff grade is 0.8% copper conditional on the other metals. The trucks take the ore to a warehouse where it is loaded on a train that goes about 15 kilometers to the Nicolaevskoye concentrator. Shemonaihinskoye Mine has only 1.2 million tons of ore reserve left. The 1995 mine production was 250,000 tons. In the period of 1996-1999, mine production will be 200,000 tons per year then EKCC will close the mine. The realization of the 1996 plan depends on the availability of equipment, fuel, diesel and electricity. The first quarter of 1996 mining costs for Nicolaevskoye and Shemonaihinskoye were $13.97/ton and $19.14/ton, respectively. There is 3% dilution and a 2% loss of ore. The miners at both mines work 10-15 days per month. There is a 50 million ton storage of low grade ore at 0.7% copper and 0.5% zinc that may be used for heap leaching in the future.

Dalex has invested $8 million at the Atemyevskoye mine. The total investment needed for this project is $15 million. It will take three years for EKCC to complete the surface and shaft facilities. Production will start at 200,000 tons per year and will be increased to 1 million tons per year after five years. The cut and fill stoping method will be used at Artemyevskoye.

The ownership of EKCC is Dalex 50%, government 44% and combinat staff 6%. The Dalex management contract is for ten years.

(4) Processing

The Nikolaevskoye ore dressing plant started in 1980, then a construction to increase production was carried out from 1992 to 1993 so that the concentrating capacity reached 1,200,000 tons/year. At present, since the Nicolaevskoye Mine, a major mine, gave production priority over stripping in the last years of the former USSR era, stripping is now mainly carried out in order to return open pit to a pit inclination safe for operation so that the production has declined.

The production in 1995 was about 500,000 t/year and the ore dressing plant is scheduled to make efforts to correct an open-cut mining pitch until 1997 and to recover the production to 1,000,000 t/year in 1998. Ore in the Nicolaevskoye Mine contains little lead and is rich in pyrite, known as yellow ore polymetal. The grain size is very fine. It is difficult to separate Cu from Zn or Zn from Fe. The original plan was that Cu and Zn were recovered in the form of Cu-Zn Bulk concentrate with a Cu grade of 8 to 12% and its recovery of 92% and a Zn grade of 15 to 19% and its recovery of 85% without separating Cu from Zn and Cu-Zn concentrate was smelted in a Kivcet furnace.

The planning for a new smelter near the ore dressing plant has come to a cancel because of financial difficulties. Until 1990 bulk concentrate was shipped as it was, but the separation of Cu and Zn has been started since 1990. The table below shows an operation performance in 1995. At present, the copper grade in copper concentrate produced from this ore dressing plant is 21%, and the zinc grade in zinc concentrate is 43%, which is very low.

In the former USSR era, since the concentrate grade in this industrial complex was low, the upper administration levels ordered that the concentrate be distributed to two or more smelter to mix it with a high-grade concentrate and serve it to a smelter. The half of Fe, which causes Zn concentrate to lower in Zn grade, exists in the form of pyrite and the remaining half exists in the form of iron zinc blend. In the latter case, it is difficult to raise the Zn concentrate grade.

About 40% of pyrite mixed into Zn concentrate is single unit, and 60% is middling of chalcopyrite and zinc blende.

In addition to ore of the Nicolaevskoye Mine, ore of Shemonaihinskoye Mine is transported 25 km by railroad to be processed in this ore dressing plant. This mine is a new mine which started processing in 1988. As Pb concentrate is not recovered for a reason of process in the Nikolaevsk ore dressing plant, it was processed in the Zyryanovsk ore dressing plant which is about 250 km away until 1991, but it was processed in the Nikolaevsk ore dressing plant due to a fall of Pb grade in crude ore. Almost all recovering Pb will be contained in Cu concentrate. At present, the ore reserves are small and the remaining reserves are about 900,000 t.

According to the plan prepared by the Kazmehanova Research Center in 1993 concerning the development of the Artemyevskoye deposit which is expected as the next-generation raw material base of this industrial complex, the total smelting capacity is 1,200,000 t/year, 800,000 t/year in terms of Artemyevskoye ore plus 400,000 t/year in terms of Nikolaevsk ore, and the existing Nikolaevsk ore dressing plant is modified. The

cost of the ore dressing plant modification work will be estimated at $ 30,000,000 to 35,000,000. The development is not making rapid progress because of financial difficulties. According to the hearing, the deposit is of zonal distribution peculiar to the Kuroko and greatly fluctuates in mineral such as barite, Kuroko, pyritic complex sulfide ore, etc.. Since the types of ore are full of variety, the ore dressing is difficult. The basic test results showed that Cu grade in Cu concentrate is 22% or less and Pb grade in Pb concentrate is 50% or less and an improvement in performance is a problem in both concentrates.

The ore dressing plant was constructed about 7 Km away from the Nikolaevskoye Mine considering the location of a dumping site and construction plan of the above-mentioned smelter, and ore is transported by 40 t trucks. Since the ore dressing plant is constructed relatively late, the large-size machinery is installed and a flow sheet is also modernized.

The electric power consumption rate is 68 kWh/t in this ore dressing plant. Since the track record of the typical ore dressing plant of kuroko in Japan (Matsumine ore dressing plant which was closed in 1994) has been 53.5 kWh/t, the former is slightly higher than the latter.

Copper concentrate is mainly sent to Irtysh copper smelter in Gulbokoe and is also supplied to distant smelter in Russia and Ural under the instructions of management transfer enterprises.

The personnel in the ore dressing plant is about 440 including repair workers of outside companies. It is about 10 times larger than the personnel in a mine of the same scale in Japan where it is no exaggeration to say that workers are cut down to a limit. About 40% of the workers are women. Operators in the site process and site control room engage in monitoring, and a lot of women caught my attention. However, repair work needs physical strength and is mostly carried out by male workers.

The monitoring workers do not perform repair work and the division of labor is practiced. In order to promote the rationalization, it is necessary to have a worker acquire multi-job skill so that he can perform monitoring work, small repair work, etc. by himself. Data such as a breakdown of cost is not provided so that a cost analysis cannot be made, but the ore dressing cost is relatively low, about US$ 7/t, considering how large the number of workers is. The cost is more or less the same as that of lead and zinc mines in the world. (The average ore dressing cost in 96 lead and zinc mines in the world in fiscal 1993 is US$ 6.79/t.)

2-1-5 JSC "Irtysh PC"

(1) General

This combinat, which is located in the Glubokovskii district of northwestern Ust-Kamenogorsk, consists of the Belousovkoye Mine and an accompanying concentrator, Irtyshskoye Mine, and Berezovska concentrator. The Belousovkoye Mine and the accompanying concentrator are located about 25 km north of Ust-Kamenogorsk, while the Berezovska concentrator is located 55km northwest of Ust-Kamenogorsk. The Irtysh mine is located 12 km east of the Berezovska concentrator. The Glubokovskii district has an altitude of 300 to 500 meters with low hills, and the Irtysh River runs nearby.

(2) Geology and Ore Resources

Ore deposits in this region consist of polymetallic ore deposit in shale controlled with fissure sharply inclined in the Shipulinskoi sedimentary layer/volcano-sedimentary layer of the Middle Devonian. The ore deposit is found in vein and/or massive forms at the contacts of metamorphic sedimentary rock (sericite-chlorite-quartz slate) and intrusive igneous rock.

The ores are similar to those found in the Leninogorsk district in terms of mode of occurance and ore paragenesis and are composed mainly of pyrite, chalcopyrite, galena, and sphalerite. Accessory minerals are small quantities of arsenopyrite, pyrrhotite, burnonite, magnetite, molybdenite, and electrum.

Mining in the Berezovkoye Mine started in 1797 and once produced 820,000 tons of ores per year. The mineral deposit consists of nine ore bodies. Except for the ore pillar, mining to a 200 meter depth from the ground surface has ended. The Irtyshskoye Mine was opened in 1964. Currently, the mine has four major ore bodies and many lens-form ore bodies are being explored. The actual production and ore reserve of the above two mines are as follows:

Actual Production (1995)					Ore reserve				
Mine name	Ore reserve	Grade			Category	Ore reserve	Grade		
	(unit:1000tons)	Cu(%)	Pb(%)	Zn(%)		(unit:1000tons)	Cu(%)	Pb(%)	Zn(%)
Belousovkoye	22.5	0.84	1.02	2.70	A+B+C1	6,463	1.33	1.25	5.11
Irtyshskoye	46.1	0.86	0.50	2.70	B+C1	12,553	2.06	0.85	5.57

Other surrounding ore deposits include the Yubileyno-Snegirihinskoye ore deposit, which is located about 110 km north of Ust-Kamenogorsk. The ore deposit is made of polymetallic ore deposit found in 1959. A final exploration was carried in 1987 through 1990. So far, a total drilling extension of 75,700 meters have been explored at drift-level 2 and a mineral dressing test was carried. Currently, preparation for development is underway in the Yubileyno-Snegirihinskoye ore deposit. Recently, an Oman oil company implemented a feasibility study but development is said to have stopped. Below is the ore reserve found so far.

Category	Ore reserve	Grade		
	(unit:1000tons)	Cu(%)	Pb(%)	Zn(%)
B+C1	36,000	4.36	0.94	6.08
C2	344	3.43	0.34	2.24

3) Mining

The combinat uses cut and fill stoping along with sublevel stoping at the Belousovkoye and Irtyshskoye mines. At the Belousovkoye mine, they are currently mining at the tenth level or 760 meters below the surface. The distance between each sublevel is 50 meters. There are 13 levels planned at the mine so there is not much ore reserve left. The fan blastholes are drilled by Russian Federated (RF) percussion drills. The blastholes are filled with ammonium cartridges with granulite that is initiated by an electric detonator. The roof is supported by 1.8 meter metal bolts grouted with cement. A RF scraper is used to pull the ore into the drawhole and it is loaded into a 2.2 cubic meter ore car. The RF locomotives transport the ore about 3 kilometers. After the rotary dump empties the ore car, the ore is crushed by a primary crusher to 400 millimeters and taken up by a 12 ton skip. The ore is transported to the Belousovka concentrator, same site as the mine, by 15 ton trucks. Belousovskoye has only 1.5 million tons of minable ore reserves. Last year's production was 64,400 tons with planned 1996 production at 200,000 tons. The 1995 mining cost was $31.37 per ton.

At the Irtyshskoye mine, they are mining 450 meters below the surface. They use the same equipment as the Belousovskoye mine. Ore that is mined at the Irtyshskoye mine is transported 12 kilometers by 15 ton truck to the Beryozovskaya concentrator. The 1995 production was 60,600 tons with 1996 plan production of 340,000 tons. The 1995 mining cost was $39.10 per ton. For the first half of 1996, the total production for both mines was 16,800 tons. The planned dilution at both mines is 20-40% with loss at 3%. There are 100 underground employees at the Belousovkoye Mine and 170 workers at the Irtyshskoye Mine. Now, the miners are working 7 hours a day, 3 shifts a day for 4 days a week. The production plans are heavily dependent on the availability of timber, explosives, backfill and electricity. The miners are working only 10-12 days a month.

The Yubileyno-Snegirihinskoye mine is located 100 kilometers away from Belousovskoye. There are 600,000 tons of ore that has been prepared for mining. The mine will have a capacity of 300,000 tons per year. The combinat will use sublevel stoping followed by backfilling. There is no electricity, haulage truck roads and infrastructure needed for mining operations. The infrastructure can be built within two years. There are no plans to build a concentrator at the mine site. The ore will be trucked to Belousovka for treatment. The transportation cost is 100 tenge per ton.

(4) Processing

This industrial complex has two ore dressing plants, Berousovka (Processing capacity: 800,000 t/year) and Berezovska(Processing capacity: 530,000 t/year).

Berousovka ore dressing plant: This is an old ore dressing plant constructed in 1945 to process

Berousovka ore and was processing 700,000 t/year or more in 1970's, almost in full operation. However with exhaustion of reserves in Berousovkoye Mine, the plant had been gradually decreasing the production. In order to make up for a decrease, the plant processed ore in Orlovskoye Mine, Irtyshskoye Mine, and Shemonaihinskoye Mine. In addition, efforts are made to modify part of the grinding process so that gold and silver ore can be processed, but an intermittent operation is only performed in the entire industrial complex because electricity cannot be supplied and goods such as fillers in the mine cannot be purchased due to an insufficient operation fund. The operation rate fell to about 10% in 1994 and 1995. Although the operation is resumed, there is a problem of supply of raw material crude ore and the full operation seems to be difficult. Also, since tailings equivalent to only 600,000 t can be accumulated in a dumping site, it is necessary to raise the embankment to do so in the future. It is possible to increase by about 3,500,000 t with 3m raise of the embankment.

Looking at the operation performance from 1990 through 1995, both concentrate grade and extraction percentage are low, leaving the performance for improvement. In particular, the Zn grade in Zn concentrate is about 45%, which is very low. The examination of performance in Cu-Pb-Zn polymetal mine ore dressing plant in the world in fiscal 1993 showed that the Zn grade in Zn concentrate is mostly 50% or more and the average value is 52.4%, and there is a big difference for this value. SiO_2 grade in Zn concentrate is 2.5% to 3%, which is not high, but Fe grade is high, from 9 to 13%. Until 1980's Fe was not mixed so much, and the Zn grade in Zn concentrate was 50 to 51%. It is thought that the performance has dropped off because ores in other mines such as the Orlovskoye Mine have been received since 1984 and the production has sharply decreased since 1990, and there is a big change in quality and quantity of crude ores and the concentration became difficult.

The ore dressing cost in 1995 was US$ 14.1/t, more than double the world cost because of an apparent low operation rate. The ore dressing reagent cost and electric power cost accounted for 40.6% and 21.5%, respectively. According to the hearing, much of the ore dressing reagent is imported and the tax imposed for it and transportation from overseas are resulted an increase in cost of reagent. The facilities are obsolete and a lot of small machines with a small processing capacity are installed. As they are well maintained, they can be operated for a while. At the time of the site investigation, the mine was not in operation. Mine drainage was required to be pumped up.

In particular, drainage of strong acid was neutralized in the ore dressing plant and discharged in a river. Precipitate is disposed of at a dumping site of tailings and the waste water treatment cost has to be burdened while the production is suspended.

Berezovska ore dressing plant: Berezovskoye Mine was closed and is now processing ore of Irtish mine. The mine is 15 km away from the ore dressing plant and ore is transported by truck. The processing amount of Irtyshskoye Mine was about 400,000 t/year between 1990 and 1992, but in 1995 it was 70,000 t/year. The current operation rate in the ore dressing plant is only about 15%, the same as that of the Berousovka ore dressing plant. The mill capacity is 530,000 t/year and ores in other mines such as the Shemonaihnskoye Mine are also concentrated. In addition, gold and silver ore of about 30,000 t/year with a gold and silver grade of 4 to 5 g/t has

been transported for concentration from the distant Zhambyl state since 1993, but this is not possible because of a high railway cost.

The ore dressing performance is the same as that of the Berousovka ore dressing plant and the Zn grade in Zn concentrate is only 43%, which is a very low value. The concentrate price is decided through negotiations between mine and smelter based on a quality classification which has been employed in the former USSR era. A remaining capacity for a dumping site of tailings is only 400,000 t like the case of the Berousovka ore dressing plant, and a raise of embankment is required to resume operation. (It is possible to increase by 2,000,000 t with 3m raise of the embankment). Not only washed-away Cu, Pb, and Zn but also Au and Ag are contained in the tailing accumulated in the past.

2-1-6 JSC "Zyryanovsk Lead Combine"

(1) General

JSC "Zyryanovsk Lead Combine" is one of the bigger enterprises in Kazakhstan mining industry, located in Zyryanovsk 160 km south-east of Ust-Kamenogorsk. The city has a population of 51,500 and is connected with Ust-Kamenogorsk that is the center of East Kazakhstan province by rail and a road. The mine owned by the Combine was opened in 1792 and has been in operation for 200 years.

Mines currently in operation comprises the Zyryanovskoye, Grekhovskoye and Maleevskoye Mine now under development. The mineral dressing plant was built in 1954 and a part of it was modernized and refurbished but the facilities are very old and getting extremely deteriorated. The configuration of personnel of the Combine is as follows:

Mining workers:	5,741
Technicians and experts:	1,017
Office staff (production related):	90
Non-production staff:	1,108

(2) Geology and ore resources of the mines in operation

This area has polymetal deposit in the volcanic sedimentary rocks of Devonian period. Zyryanovsk deposit is composed of many lens-shaped ore bodies extending in north-west and inclined in south-west. The size of ore bodies are 30-600m x 40-500m and 50-550m continuously to the depth direction.

Both Grekhovskoye and Zyryanovskoye deposits are confirmed to have the same structures with the depth of 500m. Maleevskoye deposit mainly comprises ore bodies of six areas.

The exploration has been completed so far in two areas and the developments are under way. The ore bodies are shaped like lumps with 600m in maximum width, 70m in depth and 1,500m in length. The ore bodies have the gentle inclination of 20 to 30 degrees.

Output and deposit of each mine are as follows:

Output (1995)				
Mines	Amount of ore	Quality		
	(1,000 tons)	Cu(%)	Pb(%)	Zn(%)
Zyryanovskoye	925	0.15	0.64	1.10
Grekhovskoye	461	0.29	0.84	1.96
Maleevskoye	2.32	1.34	8.23	

Deposit (Oct. 1, 1995)					
Mines	Classifications	Amount of ore (1,000 tons)	Quality		
			Cu(%)	Pb(%)	Zn(%)
Zyryanovskoye	B+C1	37,039	0.13	0.70	1.35
Grekhovskoye	B+C1	18,867	0.56	0.46	1.52
Maleevskoye	B+C1	39,211	2.60	1.19	7.84

(3)Mining

At the Zyryanovskoye Mine, the ore deposit was exploited by an open pit and now is exploited by sublevel stoping and sublevel caving methods. The combinat is mining at a depth of 800 meters. They use LHDs, scapers, and hand held drills. There is 1,000 cubic meters of water per hour that drains from the old pit into the Zyryanovskoye Mine. In addition to this problem, the ore grade is low (copper 0.16%, lead 0.64% and zinc 1.29%). The mine has high electricity and labor costs. All these factors contributed to the 250 million tenge loss last year. There were 925,300 tons of ore mined in 1995. The mining 1996 first quarter mining cost was $11.52 per ton. In the 1996 plan, the mine production will be 680,000 tons. There are 700 miners. The mine should be gradually closed.

The combinat is using sublevel caving method and mining at a depth of 700 meters at the Grehovskoye Mine. The mining cost for the first quarter of 1996 was $8.85 /ton. The main equipment are a 4 cubic meter LHD, twin boom jumbo, and Leninogorsk manufactured pneumatic drill. The main problem for increasing production is the lack of available self-propelled equipment due to lack of parts. The ore reserves at the mine are large but the grade is low (copper 0.56%, lead 0.46% and zinc 1.52%). The 1995 mine production was 461,000 tons.

In the 1996 plan, Grehovskoye Mine production will be 430,000 tons. There are 250 miners.

Now the combinat is constructing an exhaust ventilation shaft, surface structure for concrete backfill and water treatment facility at the Maleevskoye Mine. Last year's production was 312,900 tons. This year's production is expected to be 500,000 tons. Mining is occurring at the 11th to 13th levels. The depth of the 12th level is 650 meters below the surface. The ore is mined using sublevel stoping method. Each sublevel is 50 meters. After the stope is mined out, it is filled with dry waste and concrete. On each side of the stope, there is a 50 meter wide pillar. The pillars are mined by cut and fill stoping. The combination of these methods results in a 6.9% dilution and 1.5% loss. The main equipment are a 4 cubic meter LHD, twin boom jumbo, and Leninogorsk manufactured pneumatic drill. After the ore is blasted, the LHD dumps the ore down the orepass to the 13th level, main haulage level. Depending on the size of the ore car, ore is taken to the east shaft (production capacity of 300,000 tons/year) or to the Maleevskoye shaft (production capacity of 200,000 tons/year). The completion of the new shaft will make it possible to mine 1.5 million tons a year. The 1996 first quarter mining cost was $12.37/ton.

(4) Processing

The processing capacity is 6,000 t/year. According to the operation performance from 1990 through 1995, the operation rate was 70% and ore of 4,200,000 t/year or more was processed until 1992. The production has decreased since 1993 and the total production was about 1,900,000 t/year in 1995, and the operation rate was only 32%. Ore (Zyryanovskoye ore, Grehovskoye ore, and Maleevskoye ore) of the mine belonging to the industrial complex is mainly processed and ore of other mines is also processed to make up for a shortage of raw material.

A ore dressing plant is constructed at the mine-mouth of the Zyryanovskoye Mine, and Grehovskoye ore and Maleevskoye ore are transported to the Zyryanovskoye ore dressing plant by truck for 26 Km and __ Km, respectively. As for high-grade Maleevskoye ores in which a grade of mineable ore is 12% or more in terms of Cu, Pb, and Zn, ores obtained through the development are processed in this ore dressing plant since 1992. The development is not speeding up with the production of only 337,000 t/year in 1995.

A transportation cost by truck is now about US$ 1/t, and part of the railroad to the ore dressing plant is now under construction and this is also making little progress because of financial difficulties.

A transition of the amount of beneficiated ore, crude ore grade, and amount of metal from 1990 to 1996 are shown below. (In case of 1996, the track record from January to May is shown). The annual amount of processed ore of 4,000,000 tons is the largest scale in the present world lead and zinc mines, and until around 1992 the operation was continued by mainly using low-grade Zyranovskoye ore and Grehovskoye ore in such a way that a scale merit was pursued. Afterwards, the amount of processed ore in both mines decreased. However, as the amount of processing of high-grade Maleevskoye ore was increased, compared to 1990, the production of Pb decreased by half, but 80% of the production of Cu was maintained and almost the same amount of the production of Zn was maintained in 1995. From January to May 1996 lesser Zyryanovskoye ore and Grehovskoye ore were mined, but Cu and Pb were produced about 10,000 t/year and Zn was produced about 40,000 t/year base. According to the 1995 actual performance, Maleevskoye ore of which ore processing rate is 18% accounted for about 60% of the produced Cu and Zn, and the industrial complex has become dependent more on this mine. According to the operation performance, the Maleevskoye ore rich in mineral species and ore species (Ba-Pb-Zn, Ba-Zn, Ba-Cu-Pb-Zn-Py, Cu-Zn-Py, Ba: Barite, Py: Pyrite) is refractory ore composed of fine and compact grains. The Cu and Pb recovery, Zn concentrate grade, and Zn recovery are low and a lot of metal remains in tailings. At present, the ore is processed in the Zyryanovskoye ore dressing plant, but it is desired that a modern ore dressing plant having a flow sheet more suitable for Maleevskoye ore be constructed. On the other hand, as for ore other than that in its own mine, there is a shift toward processing of ore having high contents of precious metal such as gold and silver.

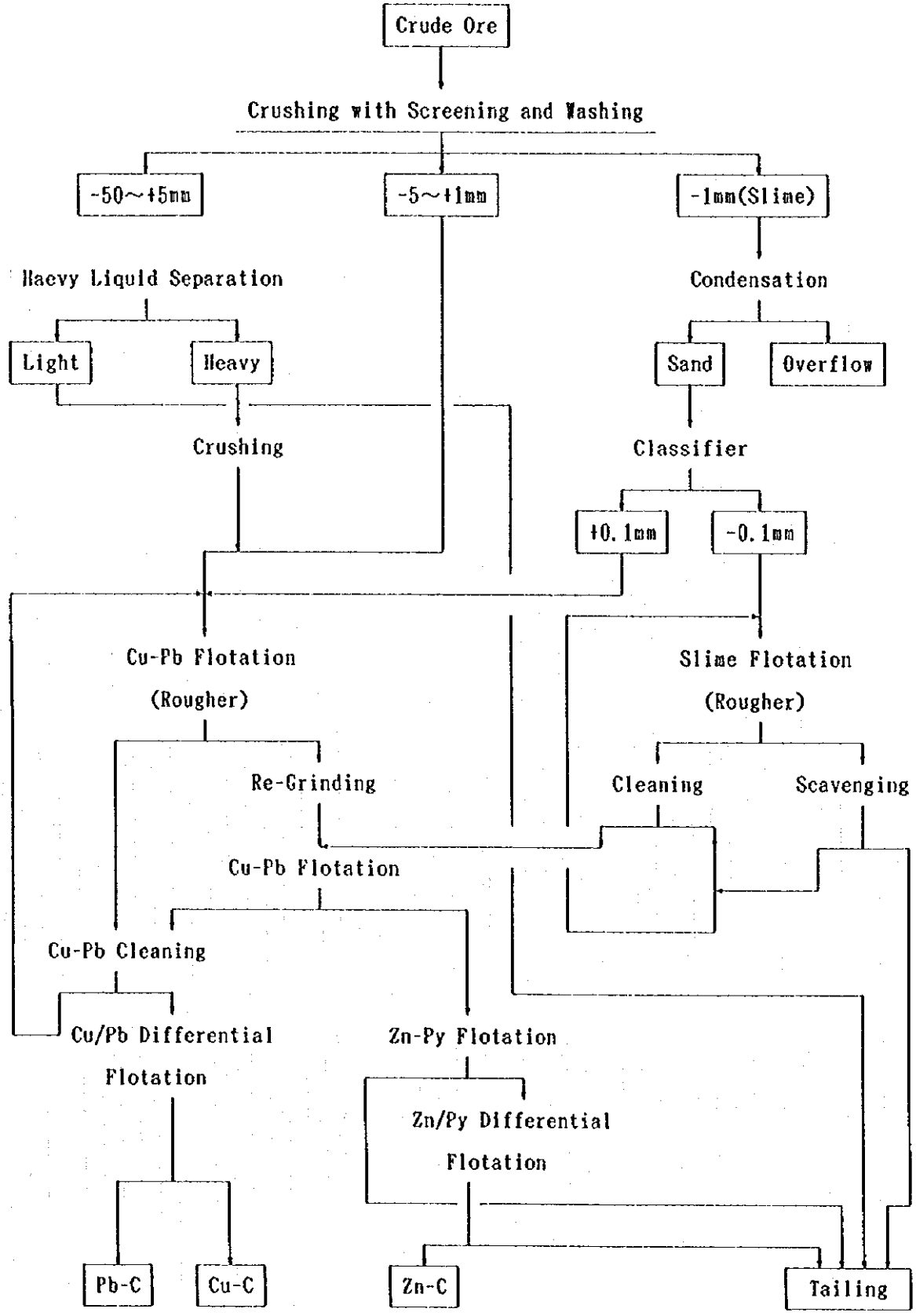
The ore dressing plant was constructed in 1956. Large flotation machines were partly introduced in 1988 in the flotation process and a modernization work was conducted, but the facilities are, as a whole, old. The operation is performed under separate flotation conditions by ore type such as Zyryanovskoye ore, Maleevskoye ore,

etc. but the industrial complex does not have independent processing facilities for each ore type. Therefore, the processing date is changed to process different type of ore.

It was in 1965 when automatic control of reagent in the flotation process was started. Among the nine ore dressing plants in the former USSR, it was the oldest and in those days a lot of engineers carried forward development of the automatic control system. The automatic control system is still in operation.

This system is composed of a small-size computer and I/O device installed in the central control room, on-line fluorescent X ray analyzer, reagent addition pump, etc. and is similar to an automatic control system installed in Japan in 1960's. As automatic control for processing, interlock, alarm, etc. other than automatic control of flotation reagent are not developed well, we cannot help saying that this ore dressing plant is far from being modernized. Almost all concentrate is sent to the Ust-Kamenogorsk smelter, but Cu concentrate may be sent to the Zhezkazgan Cu smelter or Balkhash Cu smelter, and Pb concentrate may be sent to the Shymkent Pb smelter.

The personnel in the ore dressing plant is total 742. Like other ore dressing plants in Kazakhstan, the percentage of workers who engage in repair and auxiliary work is large and they account for 70% of all the workers. Although there are a lot of workers, the ore dressing cost is 404 Tenge/t (US$ 6.03/t) according to the track record from January to April 1996, which is competitive enough compared to the cost of lead and zinc mines in the world. The electric power consumption is 38.8 kWh/t, which is a value lower than that of the Kuroko ore dressing plant in Japan. Since the electric power price is low (US$ 0.015/kWh), it is thought that the cost burden is light under the present conditions.



Flowsheet of Zyranovsk Concentrator

2-1-7 JSC "Zhezkent MC"

(1) General

The combinat, located in the northeast part of the Semipalatinsk State near the East Kazakhstan border and several kilometers from the Russian border. It has a typical continental climate with the temperature change during the year is large (about 80℃) and an annual rainfall of less than 40 mm so there is dry land. The Orlovskoye Mine started production in 1976. During the early 1980's, one million tons per year production was achieved. Since the concentrator was not built until 1989, the crude ore went to East Kazakhstan State's JSC "Irtysh PC", JSC "EKCChC" or 400 km to JSC "Zyryanovsk Lead Combine". Only a few km separate the main combinat from Russia's Altaisk mine concentrator. In 1995, Switzerland's Nova Resources Company entered into a management contract and manages the combinat. Presently, the recent privatization is progressing as 60% of the combinat stock is now owned by Nova Resources.

(2) Geology of ore resources of mines in operation

Orlovskoye is a poly-metal deposit abound in copper located 120km north-east of Semipalatinsk. It has been in operation since 1977 and the ore deposit is in the two strata of volcanic sedimentation rocks of the Devonian period (Osnovyaya stratum, Novaya stratum). (It is confined to the contact section between lava and sedimentation rock.) The ore body comprises several lumps that runs in many directions and has complicated inclination. The sizes are approx. 300x150m-600x400m with the average depth of 16-51m. The deposit has the same zonal structure as the Altai ore deposit with the upper part of the deposit is dominant in poly-metal and lower part in copper. The deposit contains iron pyrites, yellow-ores, zincblende, galenites and barites. The output and deposit of the Orlovskoye are as follows:

Output (1994)

Mines	Amount of ore (1,000 tons)	Quality Cu(%)	Pb(%)	Zn(%)
Orlovskoye	670	4.27	0.37	1.51

Deposit (1995)

Mines	Classifications	Amount of ore (1,000 tons)	Quality Cu(%)	Pb(%)	Zn(%)
Orlovskoye	B+C1	41,482	4.54	1.02	3.58

(3)Mining

The ownership of the JSC "Dzhezkent MCC" is 65% Nova Resources (Swiss company), 10% local staff and 25% government. The combinat uses cut and fill stoping method. Cement, sand and a small amount of tailings are used as fill to prevent spontaneous combustion. The mine has a capacity of one million tons per year

but Nova Resources wants better ore quality so production was reduced to 900,000 tons per year. The company is mining at a depth of 375 meters and has 6.5% dilution and 4.8% loss. The hand held drills and LHDs are manufactured in the Russian Federation. The ore is weak so shoterete and steel arches are used for roof support. There are 1,000 miners at the mine and 400 workers at the concentrator.

(4) Processing

This is a new ore dressing plant of which operation was started in January 1989 and it has a modern flow because of an introduction of the large type machinery. Ore from Orlovskoye Mine is processed and the processing capacity is 1,200,000 t/year.

This plant has been processing crude ore of 700,000 to 800,000 t/year since 1990 and in 1995 it processed 917,000 t/year which was the largest volume in the past. This industrial complex has been running under a management contract with NOVA Resources Inc.

in Switzerland. Since both in office and ore dressing plant a lot of people are actively working, the operation itself of the present industrial complex seems to be going smoothly. Orlovskoye ore contains little lead and is so-called yellow ore mainly composed of chalcopyrite and pyrite. Cu concentrate and Zn concentrate are recovered in the ore dressing process. However, as Pb is not recovered as concentrate, about 70% of Pb remains in Cu concentrate. Looking at the operation performance in 1989 through 1995, the Cu grade in crude ore is gradually rising while the Zn grade is falling (Change from 1989 to 1995, Cu: From 3.77% to 4.08%, Zn: From 3.00% to 2.13%).

The problem of an operation performance is that the Zn concentrate grade is low and Zn extraction percentage is 45%, which is extremely low. The Cu grade in Cu concentrate is 20 to 22% and Zn grade in Zn concentrate is less than 43%. Controlling the amount of use of sodium cyanide as inhibitor of Fe is subtle. If it is used in excess, Cu is also inhibited, causing a drop in extraction percentage of Cu. The microscopic observation of a Cu concentrate sample showed that not only Zn is mixed in a middling condition but also single unit Zn of relatively coarse grain, which naturally seems to enter Zn concentrate, exists. This indicates that the ore dressing operation is not going well. The ore dressing operation is conducted based on the Cu grade in crude ore and Cu with a high metal value and the Zn concentrate grade and extraction percentage seem to be decreased. Both concentrate grade and extraction percentage of Cu are not so low as those of Zn, but their performance is lower than that of Cu-Zn polymetal mines in the world, and the Au and Ag extraction percentage is about 50%, admits no doubt at all for improvement. The method of coping with a fluctuation in flotation operation is to promote automatic control, but we can hardly say that it is carried out successfully under the present conditions.

The personnel in the ore dressing plant is 380 and the operation cost in mining and ore dressing is now about 2,000 tenge/t (US$ 29.9). Three dumping sites of tailings are now located in a flat place near the ore dressing plant. The first dumping site (400 m x 800 m) is filled for the time being and the site raising by 3m is now being carried out. Upon completion of the work, tailings equivalent to about 8 years can be accumulated.

Tailings are now being accumulated in the second (800 m x 800 m) and third (800 m x 450 m), and there seems to be no problem for construction place.

2-1-8 JSC "Achpolymetal"

(1) General

Kentau is located about 40 km from of Turkesten and 200 km from Shymkent, the center of the JSC "Achpolymetal. The name of Combine came from the Achisai Mine. However, the present Achisai Mine is just one of the mines of JSC "Achpolymetal". The Achisai Mine is located about 60 km, by road, from the center of Kentau (Figure 1). The Combine has a long history so the infrastructure of the Combine, including housing, electricity facilities and transportation system is in somewhat good condition.

The population of Kentau is about 62,000 and approximately half of the population is associated with the JSC "Achpolymetal". In the former Soviet Union age, JSC "Achpolymetal" was a model combine for foreign visitors. Until 1992, JSC "Achpolymetal" was providing 65 percent and 50 percent of the barite and lead consumption, respectively for the Soviet Union.

The ownership of the JSC "Achpolymetal is; 90 percent by Kazakhstan government and 10 percent by the citizens. On September 1, 1995, River International (a corporation registered in Switzerland) reached a management contract with the Kazakhstan Government. From that time, River International controlled the Combine. The duration of the contract is five years, but an extension of the contract is possible. The contents of the management contract including a profit sharing system are unknown. However, River International seems to have taken over about 60 percent of the one billion Tenge debts of the Combine. In return, the guarantee to cover the future electricity costs of the Combine seems to have been granted by the Kazakhstan Government.

The Combine consists of one oxide zinc plant, two concentrators and four mines. The relationship of each plant, concentrator and mine are as follows;

Name of mine	Products	Name of concentrator
Ansai Mine	monobarite	Kentau concentrator
Glubokiy Mine	barite, lead	
Mirgalimsay Mine	barite, lead	Mirgalimsay concentrator
Achisai Mine	oxide zinc	Oxide zinc plant

The organization of the JSC "Achpolymetal" is shown on the Chart A-1. The organization of the Combine is too complicated to manage itself.

From 1993 to 1994, the number of the employees was dramatically decreased because of the limited operation of the Combine. In 1993, the number of employees was 8,555. In 1994, only 4,763 employees remained at the Combine. The reason for this worker reduction was not the improvement efforts at the Combine, but was the lack of work and money for its workers. Details on the number of employees are shown as follows;

	1993	1994
Industrial staff	6,622	3,822
Non-industrial staff	1,933	941
Total	8,555	4,763

(2) Geology and Ore Resources

The four mines, mentioned before, are located at the northwestern flank of the Karatau range. The deposits are hosted in dolomitic limestone of the Devonian age.

Both the Mirgalimsay and Glubokiy mines exploit the same ore deposit. The upper part of the deposit is operated by Miligarimsay and the lower by Glubokiy mine. The orebodies measure up to 900 m along the strike, 400 m wide and 1500 m along the dip. The ore reserves are listed in Table 2-1-8(1). The majority of the ore reserves is located at more than 400 m below the surface. Since the ore grade of both mines is rather low (Pb+Zn<1.5%), the mines have plans for barite recovery.

The ore deposit of the Ansaiy mine consists of monobarite and forms stratiform and tabular shapes. The orebodies strike and dip distance are 3 km and 600 m, respectively. The ore reserves are listed in Table 2-1-8(1) and about 25 percent of the reserves are planned for open pit mining.

The Achisai Mine produced lead and zinc sulfide ore before 1966. Afterward, the mine has been producing zinc oxide ores. The ore deposit consists of several tabular orebodies that are 30 m wide and can measure about 500 m and 100 m along the strike and dip, respectively. The ore reserves are listed in Table 2-1-8(1). A majority of the ore reserves are located between 100 and 400 m below the surface. The ore minerals consist of mainly smithsonite, calamine with subordinate amounts of calcite, siderite, quartz and hydrous ferric iron.

Table 2-1-8(1) Ore Reserves of JSC "Achpolymetal

Mine	Category	Reserves (thou. ton)	Pb(%)	Zn(%)	Ag(g/t)	BaSO4 (%)	Cut off	S.G
Miligalimsay (as of 1994)								
	A+B+C1	1,860	0.09	0.07	1.33	35.4		
Glubokoe (as of 1994)								
	A+B+C1	40,600	0.895	0.55	29.9	5.56		
Ansai (as of 1995)								
	B	11,392	-	-	-	47.7		
	C1	45,450	-	-	-	43.0		
	C2	17,645	-	-	-	41.8	3.6	
Total		74,487	-	-	-	43.4		

Achisai (as of 1995)

B	235	-	12.9	-	
C1	578	-	12.7	-	
C2	-				
Total	813	-	12.7	-	5.0

In the Karatau area surrounding the JSC "Achpolymetal, exploration was undertaken by the state using the Karatau geological expedition. Since Kazakhstan's independence, the structure for carrying out exploration has changed. Each company must contract for an expedition using their own account. Financial problems caused the exploration activities to diminish sharply. Three big stratiform ore deposits were found, namely; Shalkiya, Burabai-Zhalgyzagash and Talap deposits. Among these deposits, the Shalkiya deposit is developed and expected to be the future major lead supplier base for the JSC "Achpolymetal. The Talap and Burabai-Zhalgyzagash deposit have not reached the detailed exploration stage. The Talap deposit is state-owned but the JSC "Achpolymetal is negotiating to acquire the development right.

The Shalkiya Mine is owned by the state and operated by the JSC "Shalkiya Mine Management". This mine is located in the Kyzl-Orda region about 150 km from Kentau. It is connected to Kentau by rail and asphalt road. The population of the mining town is about 5,000 and basic infrastructure has been completed. This mine was discovered in 1963 and started production in 1984.

The ore deposit consists of two stratiform lead-zinc orebodies which are concordant with the geological structure. The orebodies measure more than 1 km along the strike, 500 m wide, more than 2 km along the dip and 12 m in average thickness (Fig.2-1-8(1)). The average ore grade of the lower orebody is slightly better than the upper orebody. The ore reserve is listed in Table 2-1-8(2).

The mine has one shaft and is scheduled to produce 500,000 tons of ore per year. In the future plans, the production will expand to 3 million tons of ore per year in the future. The applied mining method is sublevel caving utilizing KLD-M9 as the transportation facility. The mining development is more mechanized and larger scale than the JSC "Achpolymetal mines. The mining cost was 350 Tenge per ton of crude ore in 1993 to 1994 and 700 Tenge in 1995. The production cost and the sales price of crude ore to Kentau concentrator are the same. The recovery of the concentrate is rather low; 60% for lead and 70% for zinc.

Our team visited to this mine, but the operation was stopped because of lack of money. It seems the state ordered the production grade be raised from 5 to 7 percent of total lead and zinc content for the future operation.

The Talap deposit is located in the Kyzyl-Orda region about 70 km from Kentau. Since its discovery in 1984, there was continued surface exploration. In 1992, the JSC "Achpolymetal started detailed exploration. However, the activity was interrupted by lack of money and the exploration shaft which reached 42 m below the surface still remains. The ore deposit consists of three major stratiforms and several narrow lenticular orebodies (Fig.2-1-8(2)). Estimated ore reserves are listed in Table 2-1-8(2).

There are orebodies as large as 2.5 km along the strike and 1 km along the dip. About 60 percent of the ore reserves are included in the upper orebody (19.510 million tons, Pb 2.4%, Zn 4.5%) with the rest in the middle and lower orebodies (11.650 million tons). The upper orebody has rather high ore grade compared with other orebodies. From the flotation test of the lead-zinc sulfide ores containing more than 1 percent of lead and 1 to 1.5 percent of zinc, the recovery ratio was 80 to 85 percent for lead and 75 to 80 for zinc.

The Burabai-Zhalgyzagash deposit was discovered halfway between Shalkiya and Talap deposits. Geological characteristics are very similar to the Shalkiya and Talap deposits and consist of four stratiform orebodies. From the preliminary evaluation, the ore reserves are rather large, but the ore grade is low (Pb+Zn<3%).

Table 2-1-8(2) Ore Reserves of Surrounding Potentials

Mine	Category	Reserves (Thou. ton)	Pb(%)	Zn(%)	Ag(g/t)	BaSO4 (%)	Cut off S.G
Shalkiya (as of 1979)							
	B	18,993	1.2	3.2			
	C1	63,633.7	0.74	3.36	2.0		1.4
	C2	18,420.7	0.67	3.23			
	Total	101,047.5	0.67	3.23			
Talap (as of 1993)							
	C1	24,175.14	1.64	3.20			
	*C2	8,417.98	1.40	3.23			
	Total	32,593.12	1.58	3.14			

Note: Ore reserves of C2 contain a small amount of oxidized ore (107.07 thousand tons of Pb 1.30% and Zn 1.77%).

Burabai-Zhalgyzagash deposit							
Burabai	C2	10,853.1	1.73	2.04			
Zhalgyzagash	C2	18,635.7	1.25	1.67			
	Total	29,488.8	1.43	1.81			

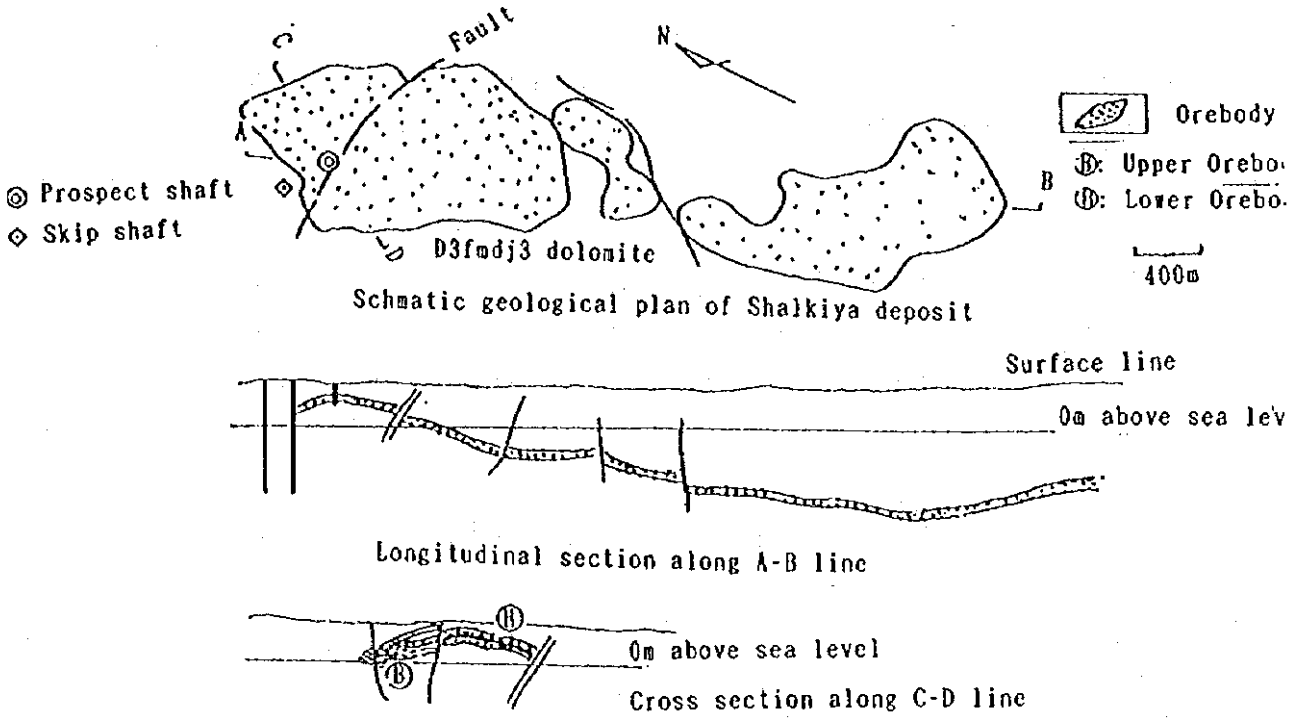


Fig. 2-1-8(1) Schematic Geological Information of Shalkiya deposit

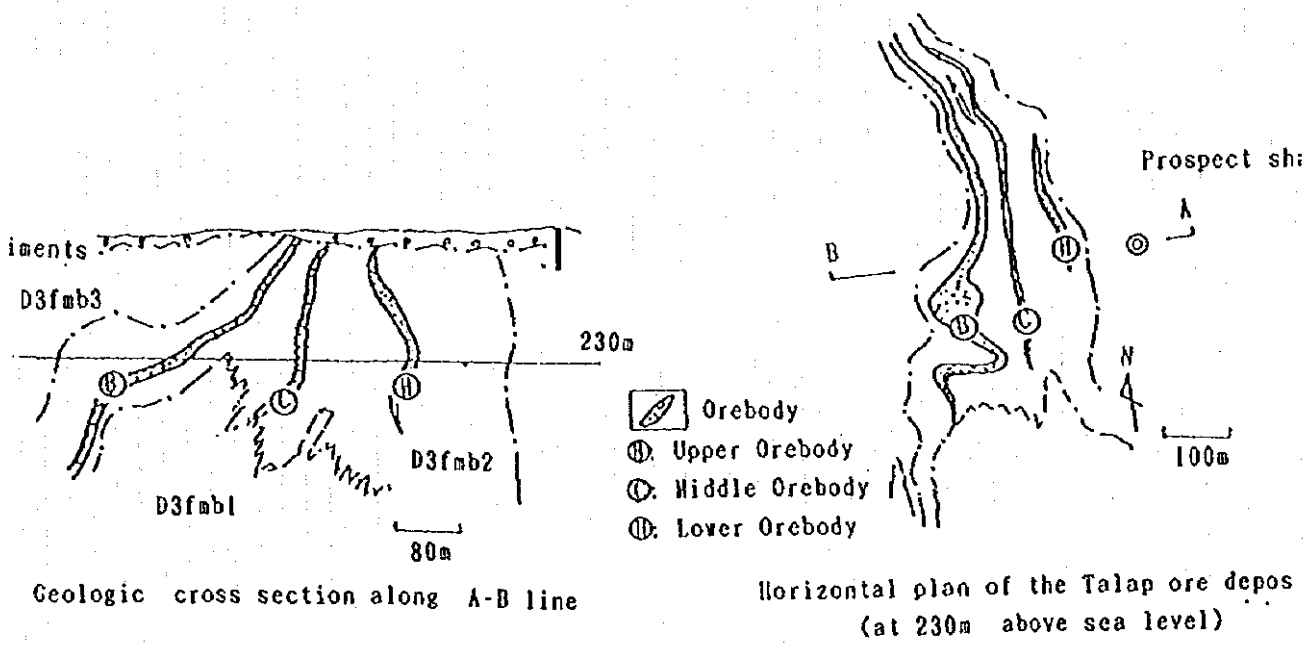


Fig. 2-1-8(2) Schematic Geological Information of Talap deposit

(3) Mining

The production records of the mines included in the JSC "Achpolymetal are shown in the Table 2-1-8(3)~(6). The Gulbokiy and Mirgalimsay mines have separate shafts and concentrators. The mining method is a conventional sublevel caving utilizing scrapers and hand drifters. In spite of rather good ground conditions, mechanization of mining has not proceeded. As shown in the Table 2-1-8(3),(4), the ore grade of both mines are rather low (Pb+Zn<1.5%). In 1994, 115 million tons of water was pumped up from underground while the production was only 81,000 tonnes of ore. Detailed mining cost data was not provided. However, mining efficiency is estimated to be low.

Achisai division consists of an underground mine and rotary kiln plant. Oxide zinc ore, which has an average zinc grade around 9 percent, is exploited from the Achisai Mine. The ore is mixed with a slag and converted to a pelletized oxide zinc by a rotary kiln plant. When our investigation team visited this district, the operation of the Achisai Mine was stopped because of the lack of money, especially needed for timbering. A top slicing method is applied at this mine that consumes a large volume of timber and is one of the most expensive mining methods. The basic system of the rotary kiln is shown at the Diagram 2-1-8(1).

The Ansai Mine is an open pit monobarite mine.. The production schedule of the Ansaiy mine is 700,000 tonnes per year. However, the lack of spare parts for transportation equipment is the reason only 250,000 tonnes per year is produced. Now, the Ansai Mine is the most profitable mine for the Combine.

Table 2-1-8(3) Run of Mine ore and Metal Grade of Glubokiy

		1990	1991	1992	1993	1994
Run of Mine ore	1,000t	2,026.0	1,167.4	1,314.9	801.3	40.0
Metal Grade	Pb (%)	0.867	0.851	0.831	0.897	0.950
	Zn (%)	0.50	0.496	0.50	0.53	0.27
	Ba (%)	7.51	7.0	0	0	9.95

Table 2-1-8(4) Run of Mine ore and Metal Grade of Mirgalimsay

		1990	1991	1992	1993	1994
Run of Mine ore	1,000t	1,600.7	1,549.6	1,184.3	501.3	41.0
Metal Grade	Pb (%)	0.639	0.660	0.648	0.71	0.84
	Ba (%)	10.55	11.87	11.07	11.36	0.95

Table 2-1-8(5) Run of Mine ore and Metal Grade of Ansai

		1990	1991	1992	1993	1994
Run of Mine ore	1,000t	192.6	63.9	76.1	124.4	94.4
Metal Grade	Ba (%)	62.32	56.32	54.04	49.73	44.05

Table 2-1-8(6) Run of Mine ore and Metal Grade of Achisai (Zinc Oxide Ore)

		1990	1991	1992	1993	1994
Run of Mine ore	1,000t	73.2	29.2	44.2	35.3	6.9
Metal Grade	Zn (%)	9.1	9.0	6.8	8.0	9.2

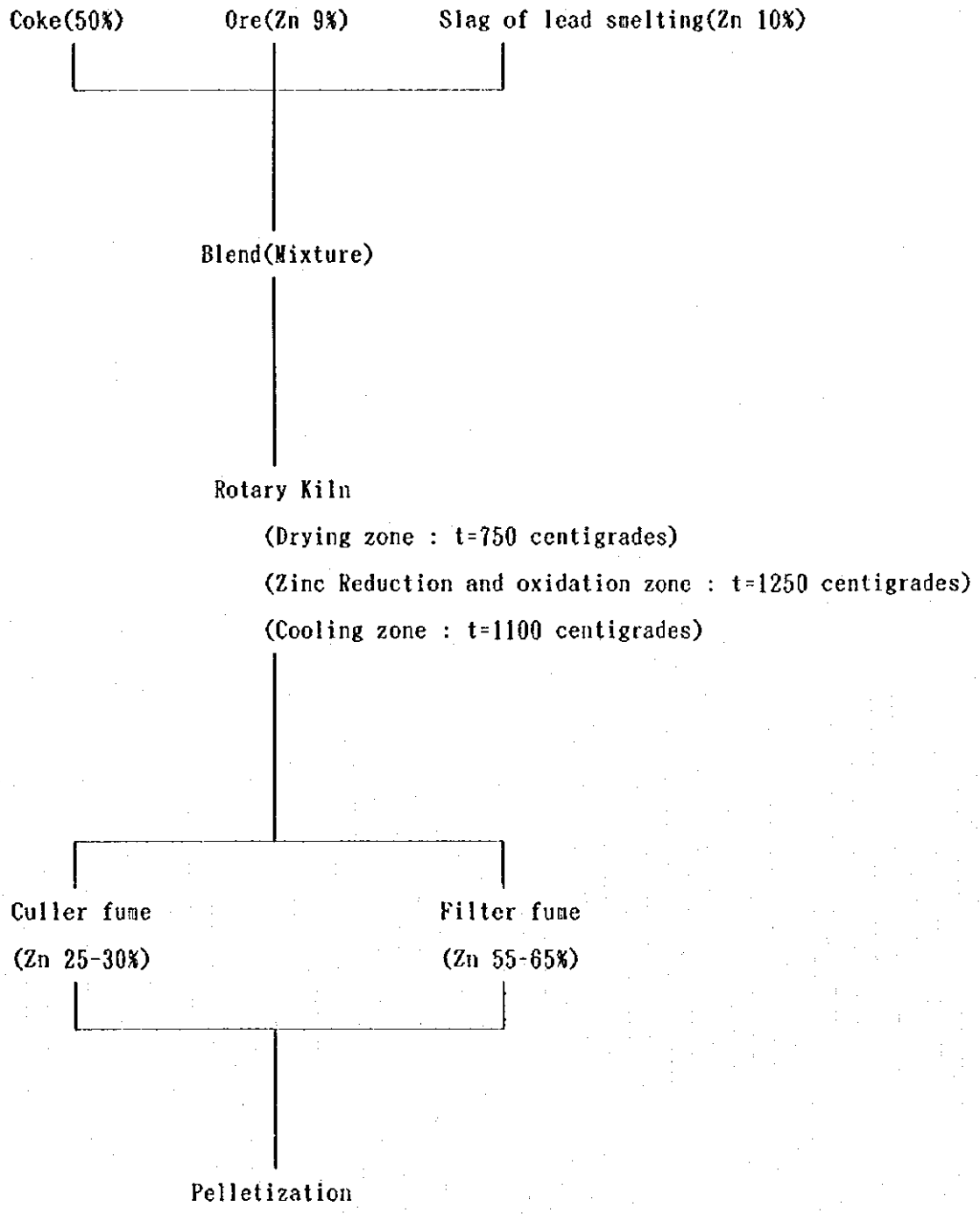


Fig.2-1-8(3) Achisaiy Oxide Zinc Pelletizing Plant

(4) Others

There are two concentrators at the JSC "Achpolymetal". The Mirgalimsay concentrator treats the ore from Mirgalimsay mine. The Kentau concentrator treats not only the ore from the Gulborskiy and Ansaiy mines of the Combine but also the ore from outside the Combine. The following shows the ore from the outside the Combine(Table 2-1-8(7)~(13)).

Table 2-1-8(7) Run of Mine ore and Metal Grade of Shalkiya Mine

		1990	1991	1992	1993	1994
Run of Mine ore	1,000t	215.3	294.6	269.1	343.7	62.7
Metal Grade	Pb (%)	0.918	1.000	0.970	1.000	0.960
	Zn (%)	2.82	2.66	2.48	2.49	2.48

Table 2-1-8(8) Run of Mine ore and Metal Grade of Zhairem Mine (lead-zinc sulphide)

		1990	1991	1992	1993	1994
Run of Mine ore	1,000t	486.8	542.9	292.7	59.0	-
Metal Grade	Pb (%)	1.31	1.64	1.266	1.40	
	Zn (%)	4.59	4.61	3.91	4.71	

Table 2-1-8(9) Run of Mine ore and Metal Grade of Zhairem Mine (mixed lead-zinc)

		1990	1991	1992	1993	1994
Run of Mine ore	1,000t	403.3	390.6	364.1	60.6	33.4
Metal Grade	Pb (%)	0.768	0.856	0.420	0.740	0.650
	Zn (%)	3.36	2.93	3.31	3.66	4.13

Table 2-1-8(10) Run of Mine ore and Metal Grade of Zhairem Mine (lead-zinc-barite)

		1990	1991	1992	1993	1994
Run of Mine ore	1,000t	395.3	350.0	410.7	186.9	68.7
Metal Grade	Pb (%)	1.325	1.34	1.28	1.51	1.64
	Zn (%)	2.00	1.83	1.70	1.95	1.60
	Ba (%)	42.66	40.97	39.05	37.59	44.05

Table 2-1-8(11) Run of Mine ore and Metal Grade of Zhairem Ushkatyn ore

		1990	1991	1992	1993	1994
Run of Mine ore	1,000t	248.0	287.2	354.6	133.2	6.5
Metal Grade	Pb (%)	4.04	3.77	3.77	3.65	11.06
	Ba (%)	16.34	21.58	17.98	21.15	27.93

Table 2-1-8(12) Run of Mine ore and Metal Grade of Zhairem monozinc ore

		1990	1991	1992	1993	1994
Run of Mine ore	1,000t	6.9	103.8	0.8		
Metal Grade	Pb (%)	0.3	0.0	0.0		
	Zn (%)	3.7	3.78	3.50		

Table 2-1-8(13) Run of Mine ore and Metal Grade of Zhairem monobarite ore

		1990	1991	1992	1993	1994
Run of Mine ore	1,000t	86.8	37.2	21.3	1.8	1.3
Metal Grade	Ba (%)	64.32	62.65	59.45	60.0	59.93

Total treated crude ore in JSC "Achpolymetal is summarized below.

Kentau concentrator-total ore treated (x1,000t)

	1990	1991	1992	1993	1994
From the Combine	2,218.6	1,231.3	1,391.0	925.7	134.4
From the outside mines	1,835.5	1,902.5	1,719.4	889.0	172.9
Total	4,054.1	3,133.8	3,110.4	1,814.7	307.3

Mirgalimsay concentrator- total ore treated (x1,000t)

	1990	1991	1992	1993	1994
Mirgalimsay mine	1,600.7	1,549.6	1,184.3	501.3	41.0

Combine-total ore treated (x1,000t)

	1990	1991	1992	1993	1994
Grand Total	5,654.8	4,683.4	4,294.7	2,316.0	348.3

Nominal capacity of each concentrator as follows.

Kentau concentrator	4,000,000 tonnes per year
Mirgalimsay concentrator	2,200,000 tonnes per year
Total	6,200,000 tonnes per year

Therefore, the utilization of each concentrator for each year calculated as follows;

		1990	1991	1992	1993	1994
Kentau	(%)	101.4	78.3	77.8	45.4	7.7
Mirgalimsay	(%)	72.8	70.4	53.8	22.9	1.9
Total	(%)	91.2	75.5	69.3	37.4	5.6

In 1994, the utilization of the Combine concentrators was less than 10 percent because of the reduction of ore supply from both the Shalkiya and the Zhairem Mines. When the investigation team visited the Kentau concentrator, only one out of seven circuits was operating. The seven circuits of the Combine are calcifying using three types of circuits. The first type is for monobarite ore. The second type is for mixed ore of barite and lead. The third type is for the mixed ore of lead and zinc.

As mentioned above, the main product of the Combine has become barite concentrates. The concentrates production and grade from the JSC "Achpolymetal are as follows;

		1990	1991	1992	1993	1994
Pb Conc.	(tonnes)	83,807	86,931	70,642	40,777	4,796
Pb	(%)	44.18	44.34	44.65	43.76	44.75
Zn Conc.	(tonnes)	85,302	88,925	55,939	35,896	5,586
Zn	(%)	46.14	44.15	43.73	42.92	43.14
Ba Conc.	(tonnes)	504,642	285,619	227,925	150,834	62,981
Ba	(%)	87.51	86.31	86.59	86.54	88.66

There is no visible environmental problem at the Combine. However, the Combine has a serious potential environmental problem. Tailings have been used as filling material in the Gulbokiy and Mirgalimsay mines. If the Combine stops pumping the tremendous amount of mine water because of economical reasons, the whole water system of Kentau would be contaminated by heavy metals. Until some measures are applied to the filling material, the Combine cannot cease the pumping up of the mine water.

Detailed cost data were not available. However, the lead concentrate sale price is 15,000 Tenge per tonne and the production cost of lead concentrates is 25,000 Tenge. Therefore, the present production of lead concentrates from the Gulbokiy and Mirgalimsay mines is not profitable. For the barite concentrates, the total production cost is 59 US dollars per tonne and the sales price is 80 US dollars per tonne. The production of barite

concentrates from the Ansaiy monobarite open pit is profitable. For the Achisaiy oxide zinc mine, the sales price and the pelletizing plant cost were not available. In 1994, the mining cost of the Achisai Mine is 745 Tenge per tonne. If an average exchange rate of 35.4 Tenge per US dollar in 1994 is applied, the above cost converts to about 21 US dollars per tonne of crude ore. This mining cost is about twice the mining cost of a comparative zinc sulfide underground mine. The reason for this expensive mining cost is probably from the poor ground condition and expensive mining method.

2-1-9 JSC "Tekeli Pb-Zn Combine"

(1) General

The JSC "Tekeli Pb-Zn Combine" is located in the Taldy-Kurgan region about 250 km from Almaty by road. The population of this district is about 30,000. At the end of September 1995, all operations of the JSC "Tekeli Pb-Zn Combine" were suspended due to the lack of money. The Combine cannot pay its energy bills so there was no heat even in the main office. Since December 1994, the Combine has become a Joint Stock Company (JSC) owned 90 percent by the Kazakhstan government and 10 percent by nationals. A management contract with a foreign company has not reached yet.

This Combine consists of two concentrators and three mines. The Tekeli mine and concentrator are the centers of the Combine. The Koksu Mine and concentrator are located about 40 km in a straight line and 75 km by road from the Tekeli concentration plant. The Tuyuk Mine is situated about 510 km away from the concentration plant. The Tekeli concentrator also treats the crude ore from the Zhairem Mine that is situated about 800 km away in a straight line from the Tekeli but it is not a part of the combine.

The organization of the JSC "Tekeli Pb-Zn Combine" is shown at the Diagram 2-1-9(1). The organization is a kind of double structure, which is controlled by the president and chief engineer.

There was about 4,000 employees at the Combine, though now only 2,600 employees remain. The details about the employees are shown in Table 2-1-9(1).

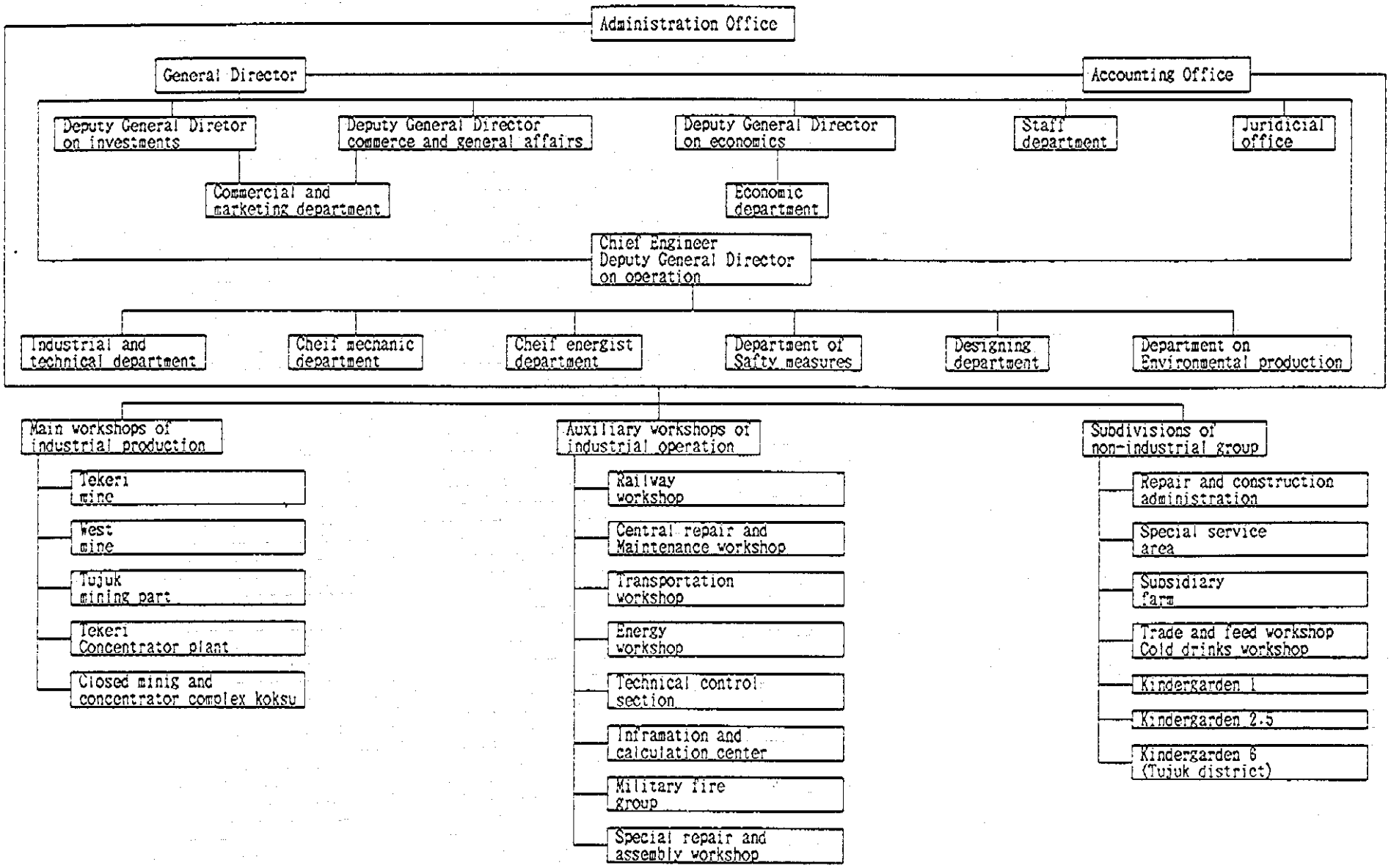


Fig.2-1-9(1) **Organization chart of the JSC "Tekeli Pb-Zn Combine"**

Table 2-1-9(1) Number of employees of the JSC Tekeri Lead-Zinc Combine

	Employees	Workers	Total
Tekeri mine	78	588	666
Tujuk mining and administration	26	130	156
Koksu Mining and concentration(closed)	4	38	42
Tekeri concentration plant	24	215	239
Railway center	20	178	198
Transportation center	12	157	169
Repair and maintenance workshop	14	131	145
Power station	14	157	171
Construction administration	11	99	110
Military and fire brigade	7	80	87
Information center	10	18	28
Building and assembly center	6	49	55
West mine	11	68	79
Trade and public catering complex	10	81	91
Technical control department	8	54	62
Special maintenance area	7	111	118
Kindergarden "Sun"	70	64	134
Administration	92	26	118
TOTAL	424	2,244	2,668

(2) Geology and Ore Resources

These two mines are operating on orebodies located in the same ore zone and close together (only 700m apart). The ore deposit is hosted in carbonaceous to argillaceous shale and dolomite of Tekeriiskkaya formation of Ripheian age. Orebodies form a lenticular shape that can reach a width of 35 m, length of 900 m along the strike and more than 1 km along its dip for the Tekeli mine. The West Tekeli mine have orebodies that are up to 8-10 m wide with a distance of 600 m on its strike and 600 m along its dip. Ore minerals of both deposits consist of mainly galena, sphalerite and pyrite with quartz and calcite as gangue minerals. Hydrothermal alteration and intrusive rocks are located along the orebody making the rock conditions poor. Ore reserves as of 1995 are listed in Table 2-1-9(2). The majority of the ore reserve for the Tekeli mine is between 600 to 1000 m below the surface while the West Tekeli mine is between 250 to 800 m below the surface. There was a slight reduction of lead content toward the deeper levels that was observed in both reserves.

Tuyuk Mine

At the Tuyuk mine, the ore deposit is hosted in tuff and porphyrites of the Kungeiskoi formation of the Middle Carboniferous age. It forms a massive and lenticular orebody. Ore minerals consist of mainly galena and barite with a little amount of sphalerite, pyrite, quartz and calcite as gangue minerals. Ore reserves as of 1995 are listed in Table 2-1-9(2). However, mine is actually producing ore of more than 12 percent lead content because of economic evaluation. Now, minable ore reserves that were calculated seem to be only two years of production (80 thousand ton). An exploration contract between the Combine and Zhungal geological expedition to find other minable ore was reached at the beginning of 1995, but it has not been realized because of lack of money. The state decided to stop the operation of the Koksu mine in 1993 because it was unprofitable due to the low ore grade (Pb+Zn<1.5%) and low of treatment recovery efficiency .

Table 2-1-9(2) Ore Reserves of JSC "Tekeli Pb-Zn Combine"

Mine	Category	Reserves (Thou. ton)	Pb(%)	Zn(%)	Ag(g/t)	BaSO4 (%)	Cut off	S.G
Tekeli (as of 1995)								
	A	1,908	2.76	5.49				**3.1
	B	1,980	3.96	4.54				
	C1	5,692	2.55	3.59			Pb>2.1	3.3
Total		9,580	2.89	4.17	28.8			
	C2	13,074	2.14	5.33	22.0			

Note: Specific gravity for polymetallic ore is 3.1 and for pyritic ore is 3.3.

West Tekeli (as of 1995)

	B+C1	2,006	2.67	4.21	21.0	
	C2	2,416	3.26	3.65	35.3	

Tuyuk (as of 1995)

	B	3,809	2.38	-	-	30.0	Pb>1%
	C1	9,826	0,96	-	-	58.4	BaSO4>20%
Total		13,635	1.35	-	13.6	50.5	
	C2	6,189	1.54	-	-	55.0	

Koksu (as of 1993) The mine was closed

Central Suuk-Tyuube

	B	597	1.71	-	-	-
	C1	603	1.31	-	-	-
Total		1,200	1.51	-	-	-
	C2	422	1.30	-	16.8	-

Koksu	B	424	2.5	-	-	-
	C1	676	1.45	-	-	-
Total		1,100	1.85	-	20.7	-

Mineral exploration around the JSC "Tekeli Pb-Zn Combine" was intensely carried out by Zhungal geological expedition during the former USSR period. Many ore deposits with potential lead and zinc ore were discovered and evaluated, but some of them remained undeveloped because of a low economic evaluation. Among these undeveloped areas are the following.

The Yablonoboe area is located near the JSC "Tekeli Pb-Zn Combine". Estimated more reserves are: 2.944 million tons, Pb 3.2% , Zn 3.42% and Ag 57g/t. Exploration work was finished in 1989. Ore grade is high, but the orebodies are small scale and evaluated as having low profitability.

The Aktyube area is located about 5 km apart from the Combine. Exploration work was finished in 1960. Since each orebody was small scale with low profitability potential, this area remained undeveloped.

The Telimanovskoe area is located about 15 km apart from the Combine. Exploration work was carried out in the 1980's. The ore deposit has been remained undeveloped caused by a low economic evaluation.

(3) Mining

The Tekeli mine suspended its operation at the end of September 1995. The Koksu mine was closed in 1993. The Tuyuk mine stopped its operation in early 1995. Therefore, there was no opportunity for the

investigation team to see the operation. There was no data about the Koksu mine but some data about the Tekeli mine was available.

Tekeli mine consists of the Tekeli and West Tekeli orebody as mentioned before. The mining method applied in this mine is sublevel stopping with a quick back fill. The deposit is divided into about 50 m wide blocks. Each block is again divided into four stopes. The height of each stope is about 50 m and sublevels are drifted every 25 m. The production drilling uses ring long-hole drilling. The broken ore is collected by scrapers. Immediately after one stope was exploited, the space is filled with waste and cement mixed material to prevent natural combustion. Average dimensions of the drifts is 3.5 m by 2.7 m and hand drifters are used for drifting. For production records, please refer to the Tekeli concentrator records. No data for mining was available on the Koksu and Tuyuk Mines.

(4) Others

The Tekeli concentrator was built in 1944. The capacity of the concentrator is 1.2 million tonnes per year. There are three circuits for the Tekeli, Zhairem and Tuyuk ore. The final products are lead and zinc concentrates. Barite concentrates were produced, but for the economical reasons, the production of barite concentrates was stopped. The records of ore treatment at the Tekeli concentrator are shown Table 2-1-9(3).

Table 2-1-9(3) Treated ore at the Tekeli concentrator

		1990	1991	1992	1993	1994
Tekeli ROM	1,000t	535.0	563.2	496.0	473.5	402.0
Cu	(%)	0.015	0.04	0.03	0.03	0.04
Pb	(%)	2.13	2.21	2.17	3.01	2.75
Zn	(%)	3.10	3.01	2.71	3.01	2.75
Ag	(g/t)	26.9	28.8	29.48	39.3	35.9
Tuyuk ROM	1,000t	19.6	12.9	32.0	26.0	29.2
Pb	(%)	0.90	-	8.41	9.92	16.2
Ba	(%)	60.25	76.54	55.79	39.03	-
Zhairem ROM	1,000t	503.6	509.7	504.1	351.7	
Pb	(%)	1.18	1.41	1.18	1.58	
Zn	(%)	3.22	3.34	3.15	4.31	
Ba	(%)	40.11	42.40	29.71	18.77	

Total concentrates produced from the Tekeli concentrator are shown in Table 2-1-9(4). Lead grade in

the lead concentrates and zinc grade in the zinc concentrates are rather low compared with Western standards.

Table 2-1-9(4) Concentrates production from Tekeli concentrator

		1990	1991	1992	1993	1994
Pb Conc.	tonne	22,338	25,478	23,861	22,935	19,776
Pb	(%)	52.84	52.95	51.29	50.48	55.41
Zn	(%)	7.18	8.02	8.10	9.13	6.13
Ag	(g/t)	627.2	628.3	641.12	629.40	415.60
Zn Conc.	tonne	53,401	52,961	50,495	50,545	17,841
Pb	(%)	2.43	2.67	2.92	3.02	3.91
Zn	(%)	45.32	47.28	46.12	46.63	49.50
Ag	(g/t)	68.6	79.6	69.94	86.20	76.00
From Tuyuk Mine						
Ba Conc.	tonne	94,322	86,745	49,590	26,297	
Ba	(%)	88.51	92.67	93.72	93.1	
From Zhairem Mine						
Ba Conc.	tonne	366,323	285,619	227,933	150,834	62,981
Ba	(%)	86.6	86.31	85.5	86.54	88.65

The Koksu concentrator has a nominal capacity of 320,000 tonnes per year. The combine staff is considering a lease on these concentrator facilities.

There are two dust problems at the Combine. One is the dust from the tailing dam and the other is the dust from the surface crushing plant. This surface crushing plant produces filling materials for the underground mine by crushing the waste of the old open pit.

The infrastructure is well furnished though there is no railway between the Tuyuk mine and the Tekeli concentrator. Electricity cost is about 2.5 Tenge per k W h. As mentioned in the mineral reserve section, the Koksu Mine has a low grade ore reserve and has already been abandoned by the Combine.

The Tuyuk Mine has a high lead grade zone, but revenues from the lead concentrates cannot cover the operation costs, especially the expensive transportation cost. The transportation costs became higher than the mining cost in 1995 because there is no railway between the Tuyuk Mine and the Tekeli concentrator. At the Tuyuk Mine, the high grade ore that remains is only 50,000 tonnes. Therefore, building a new concentrator near

the Tuyuk Mine is not realistic.

The Tekeli Mine has about 6 percent ore grade (combined lead and zinc). It is also not profitable at the present situation, despite its rather high grade polymetal in Kazakhstan.

The following is a comparison of revenue and primary cost for the Combine. The primary cost does not include the extraordinary tax and non-industrial activities.

		1994	1995
Treated ore	1,000t	431.2	281.2
Revenue	1,000 Tenge	301,117	323,980
Primary cost	1,000 Tenge	232,312	460,274
Revenue - Primary cost	1,000 Tenge	68,805	-136,294
Profit (including non-industrial)	1,000 Tenge	35,792	-121,049
Total profit (including tax)	1,000 Tenge	-31,700	-234,155
Primary cost	Tenge/tonne	539	1,637
Average exchange rate	Tenge/US$	35	60
Primary cost	US$/tonne	15.4	27.3

In 1994, the total revenue was, at least, higher than the primary cost. The combine suffered about a 32 million Tenge loss. In 1995, the total revenue could not cover its primary cost. Furthermore, the primary cost increased dramatically, even on a US dollar base in 1995.

2-1-10 Polymetal Smelters

1) Current situation of polymetal smelter

Three smelters suffered shortages of raw material, energy and auxiliary material because of lack of funds. The suspension of the operation of mines which supplied raw material to the smelters was due to small amount of funds so the rate of operation at the smelter was reduced. Particularly, at the Shymkent smelter, the operation was completely suspended. Although, we feared that the equipment might be damaged due to suspension or reduction of operation, we estimated that there would be no problem for restarting the operation by appropriate maintenance. However, we believed that the problem of corrosion which occurred by high temperature and sulfurous material was serious. At all three smelters, they are eager to make improvements for the manufacture of added value products and advance to downstream production by adapting necessary measures. The process flow charts of the lead plant for Shymkent, zinc plants for Ust-Kamenogorsk and Leninogorsk and copper plant for Gulbokoe are shown in Fig.2-1-10(1)~(3), respectively.

The equipment and current operating condition of each smelter are also shown in Table 2-1-10(1),(2).

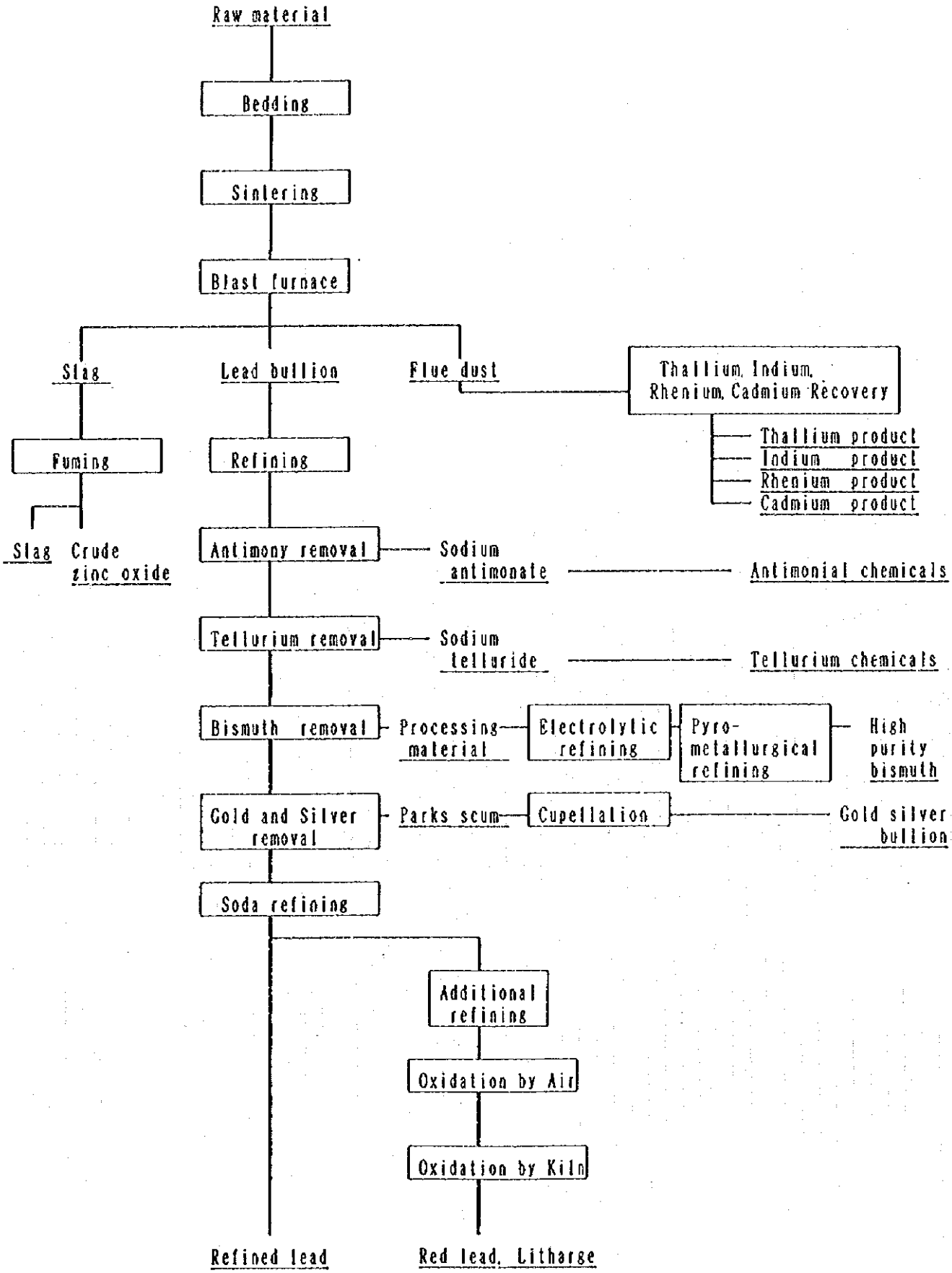


Fig.2-1-10(1) Lead plant flow chart for Shymkent

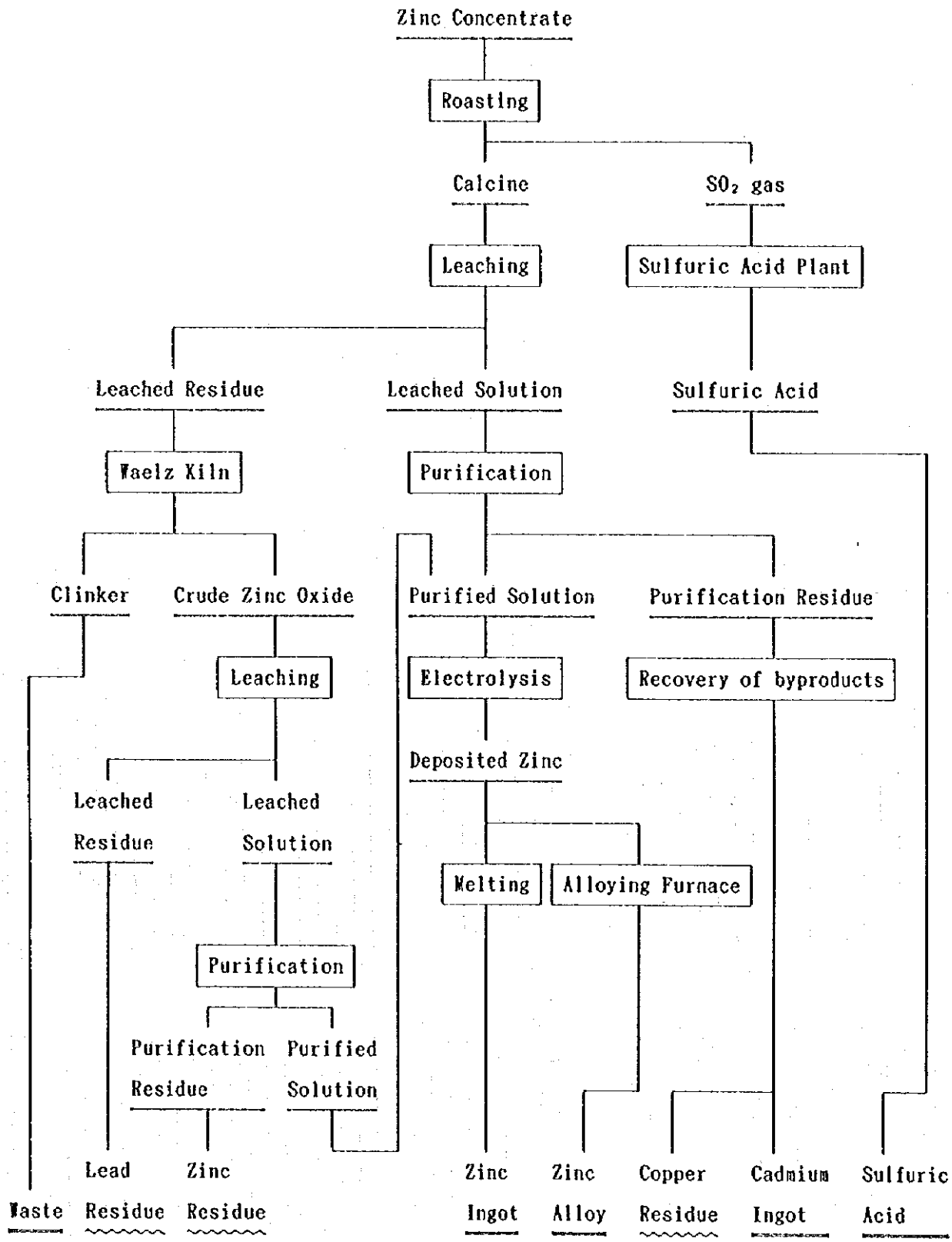


Fig. 2-1-10(2) Zinc plant flow chart for Ust-kamenogorsk and Leninogorsk

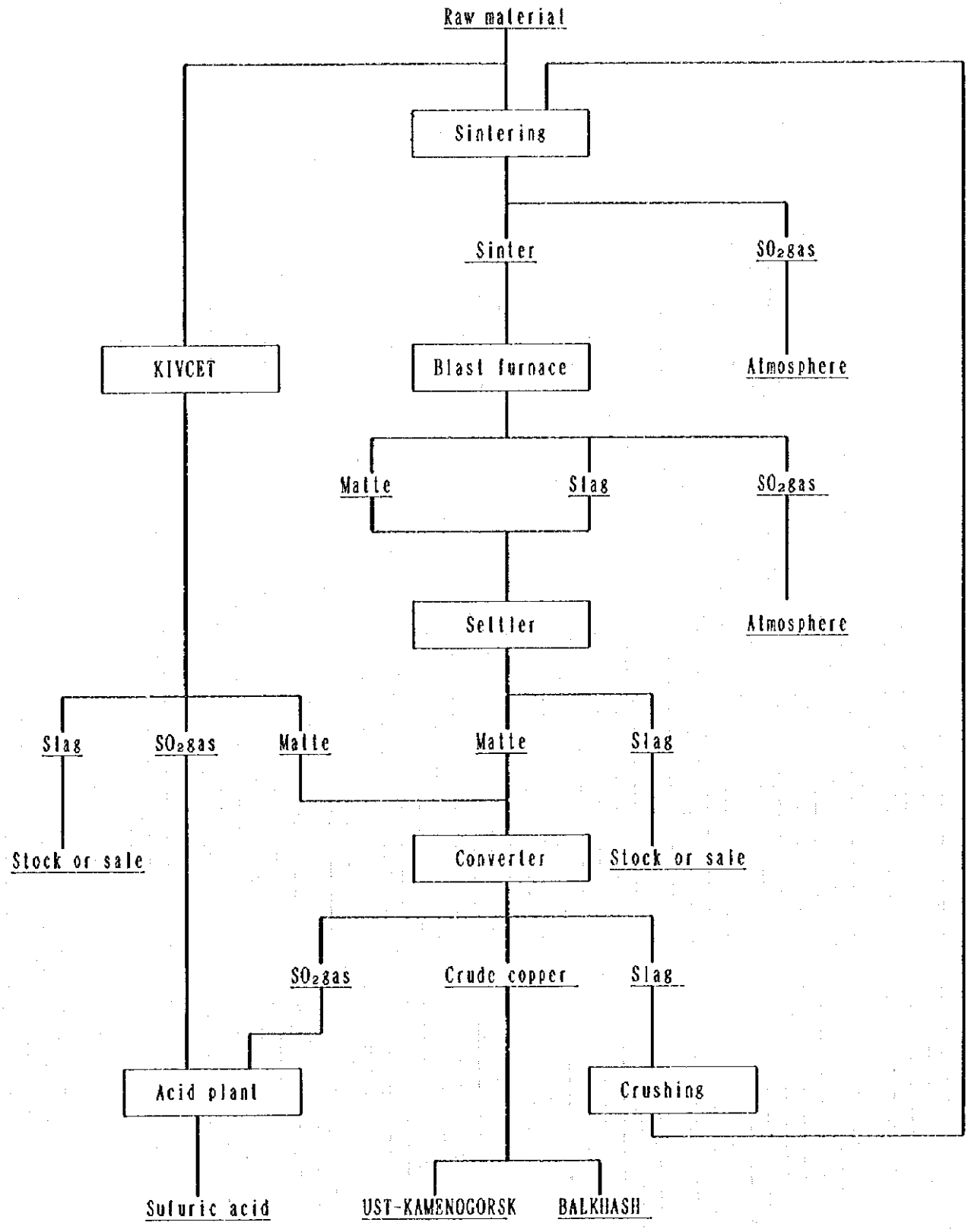


Fig.2-1-10(3) **Copper plant flow chart for Irtysh Copper Smelter**

LEAD

Table 2-1-10(1) General condition of Lead Smelter in Kazakhstan

		Shymkent	Ust-Kamenogorsk	Leninogorsk
Year Operation Started		1934	1952 (Blast Furnace) 1986 (Lead Kivcet Process)	1927
Production Capacity (t/y) Revised		160,200 160,200	200,000 145,900	44,000 20,000
Actual Production (t/y)		80,535 (1991) 31,700 (1995)	54,278 (1991) 44,800 (1995)	25,880 (95 expected) 12,500 (1995)
Raw Material Condition		Custom Smelter	Custom Smelter	Own Mine Conc. Battery Scrap
Manpower (men)		1,438	1,386	738
Character-istics	Raw Material	Concentrate	High Au/Ag Ore	Battery Scrap
	Process	Sintering Machine 2 sets	Sintering Machine 2 sets	Sintering Machine 1 set
		Blast Furnace 3 sets	Blast Furnace 3 sets Kivcet 1 set	Electric Furnace 5 sets
New Business Lead Storage Battery		Under Construction	Future Plan	Under Planning
Labor Cost (T/man-year)		4,250	5,000	9,800
Kazakhstan to Jpn labor cost ratio assuming Japanese labor cost =50,000 US$/man-year		1/60	1/50	1/27
Electric Power Cost (T/kWh)		2.0	2.06	0.9

Table 2-1-10(2) General condition of Zinc Smelter in Kazakhstan

ZINC

		Ust-Kamenogorsk	Leninogorsk
Year Operation Started		1st line 1917 2nd line 1952	1964
Production Capacity (t/year) Revised		240,000 186,400	110,000 106,500
Actual Production (t/year)		117,507 (1991) 95,700 (1995)	70,950 (95 expected) 72,600 (1995)
Raw Material Condition		Custom Smelter	Own Mine Concentrator
Manpower (men) include Sulfuric Acid Plant		2,020	1,929
Character-istics	Roasting	Furnace 8 sets	Furnace 5 sets
	Electrode (anode)	620 X 980 X 8 Ag 0.5%	610 X 1,080 X 8 Ag 1%
	Residue Treatment	Waelz 7 Furnaces	Waelz 2 Furnaces Jarosite Process Installed

SULFURIC ACID

	Shymkent	Ust-Kamenogorsk	Leninogorsk
Year Operation Started	3 lines	1st line 1953 2nd line 1956 3rd line 1986 Irtysh 1 line	3 lines
Production Capacity (t/year)	240 t/day 3 lines	330,000 Irtysh 65,000	
Actual Production (t/year)	40,248 (1991) 41,521 (1995)	175,089 (1991) 203,555 (1995)	89,690 (95 expected) 95,076 (1995)
Characteristics		New Plant Construction Stopped 300,000 t/year Discharged SO_2 0.3% Irtysh 60,000	

2) Features and problems of each smelter

(1) Shymkent

This smelter is far away from domestic raw material base. The nearest mine is located in Uzbekistan (neighboring country). Therefore, this smelter suffers several problems regarding payment, etc. resulting from import problems. On the other hand, it mainly depends on Uzbekistan for energy. Currently, the factory operations are suspended due to shortage of funds. The factory was closed on the day when we visited there. The workers were forced to wait at home without payment. When visiting on the third survey, the factory was operating but only 600 tons was produced in the first half of the year compared with the 30,000 tons per year which is expected in 1996. The features of the smelter is as follows.

Lead:

① It applies a regular processing method by sintering, blast furnace and pyro-metallurgical.

② Although this factory tried to process battery scrap, the supply preparation is incomplete.

③ This smelter is accelerating its diversification of products for downstream and a lead battery factory is now under construction.

④ It also produces lead chemical products such as red lead and litharge.

⑤ This smelter is far away from its raw material supply site and all its products must be exported. It depends on Uzbekistan for its energy. Therefore, sometimes it suffers difficulty in continuing the operation due to international trade.

(2) Ust-Kamenogorsk

This smelter possesses lead, zinc, copper and precious metal refining factories. It is a non-ferrous metal product industrial complex which produces refined zinc, lead, copper, gold, silver, cadmium and some fabricated products of zinc and lead. The equipment is small capacity and aged. The layout is not suitable so it can not operate efficiently. Of two zinc refining factories, one is closed. This refinery has four sulfuric acid production and factories, one of which is suspended. Its KIVCET process attracts world attention, but was suspended together with a copper KIVCET due to shortage of raw material and other reasons. The features of the smelter is as follows.

Lead

① The process includes two systems, that is sintering/blast furnace and KIVCET. Conventional pyro-metallurgical refining method is applied. The KIVCET process has a problem that needs to be solved for a continuous operation.

② Processing of gold/silver containing material is intended. Also, it is engaged in ornament fabrication because it has precious metal refining factory.

③ As for sintering emission gas, containing 2 - 3% SO_2, is discharged into the atmosphere. From environmental viewpoint, it is necessary to treat.

④ Dust emitting from the furnace and converter buildings must be treated for improvement in viewpoint of the working condition.

⑤ Waste effluent and atmospheric emision of the smelter is in serious condition. Sometimes the regulation

standards are not surpassed.

Zinc

① Calcination and electrolysis are carried out by conventional methods without any specific features. However, electrode distance and anode configuration are devised. The equipment is aged and has a small capacity. Also the connection between processes is not well organized. It is necessary to take fundamental countermeasures.

② The quality of zinc product is not higher than 99.9%.

③ The casting factory is mostly mechanized.

④ It has seven Welz furnaces for processing zinc leaching residue, but five are suspended.

⑤ It has eight roasters, but six are suspended.

⑥ It is necessary to take countermeasures for purification of electrolyte and reduction of mist in the cell house.

Copper (smelting factory in Irtysh and electrolytic factory in Ust-Kamenogorsk)

① Irtysh smelter produces black copper of about 35,000 tons annually. It transports about 34,000 tons to Balkhash and about 1,000 tons to Ust-Kamenogorsk annually for electrolytic refining. However, it is necessary to reconsider the whole production system.

② The use of the copper KIVCET in Irtysh is a matter which needs to be considered.

Sulfuric acid

① Ust-Kamenogorsk has three sets and Irtysh has one set of sulfuric acid production system. All of them are old. They have a problem of equipment corrosion due to excessive repetition of operation/suspension.

② In Irtysh as well as Ust Kamenogorsk, improved sulfuric acid production equipment construction is suspended.

③ It takes too long for a sulfuric acid tank vehicle to return. It it is necessary to consider the feasibility of gypsum production.

(3) Leninogorsk

Of the smelters which we visited this time, this is the only smelter that belonged to a mine. Although the production of mining operation dropped, there is a little fear about the supply of raw zinc material. The lead smelter converted from sulfide mineral treatment to lead scrap processing to overcome environmental problems. Currently, it is raising the lead production along with increasing the amount of scrap.

Among the three smelters, this smelter has a smaller debt burden than the others. Also management transfer has been carried out. According to our observation, it seems that this smelter has progressed in its survival program.

Lead:

① This smelter is specialized in scrap treating including disassembly, separation, and processing of battery scrap. It transfers all its lead concentrate from the mine to Ust-Kamenogorsk.

② Battery scrap disassembly and separation is a domestically developed technology.

③ Trial assembly of lead battery is carried out in cooperation with Valta (German corporation).

④ As for refining method, battery scrap is processed by electric furnace and lead secondary material is processed

by sintering/electric furnace. Lead refining is performed according to ordinary pyro-metallurgical method. This refinery has five lead electric furnaces.

⑤ Sintering emission gas is discharged to the atmosphere without SO 2 recovery. Thus, it is necessary to take an appropriate countermeasure in viewpoint of environment protection.

Zinc:

① The applied roasting and electrolytic process are ordinary methods without any extraordinary features. The mounted equipment is relatively new.

② This factory is engaged in a trial production of zinc alloy for galvanizing, electric anticorrosive protection, and zinc pellet for dry battery cell as downstream products.

③ Welz furnace is utilized for processing zinc leached residues. Jarosite process has been already investigated.

④ In calcination process, small size apparatuses are dispersed, therefore it is necessary to integrate them.

2-1-11 Metal Fabrication

(1) Metal fabrication

The metal working industries in Kazakhstan include the following plants:

- Dzhezkazgan	Wire rod plant
- Balkhash	Plate and bar plant
	Wire working plant
	Wire rod plant
	Enameled wire plant
- Taldy-Kurgan	Lead battery plant

In addition, there is a coin plant in Ust-Kamenogorsk and a small plant processing trolley wires in Almaty.

(2) Environment surrounding metal working

The economic conditions of the whole CIS region have been going worse since the collapse of the Soviet Union in 1991; the munitions industries have declined and no alternative industries have been created or fostered.

As a result the main industries in Kazakhstan are petrochemical, development of mining resources, light industries, furniture, etc. There are almost no consumer industries for semi-finished copper alloy depending almost exclusively on the CIS market except for TV and refrigerator assemblies at most. The metal working industry producing the copper and semi-finished copper alloy (plates, bars, wires and wire rods for electric cables base metal) in Kazakhstan, which used to mainly depend on the munitions industries (by about 60 percent), have heavily damaged and declined in sales volume in proportion to decline of the munitions industries.

Since the munitions demand has almost been lost, users of metal products have shifted far away to Russia, Belorus, Ukraine, and other countries. This shift, along with decrease in size of sales lot, has increased the transportation cost and forced manufactures to have warehouses at distribution bases. Furthermore, changes in commercial system after the former Soviet Union collapse made sales procedures more complicated and transactions more difficult to handle.

Shortage of fund, as represented by delay in payment of wages not only in Kazakhstan but also in the whole CIS region, the manufacturers are forced to sell semi-finished products such as cathodes, instead of passing them to further processing. This makes semi-finished products processors suffer from shortage of raw materials.

Such shortage of fund has forced the plate and bar plant in Balkhash to suspend the construction work which was half finished. The lead battery plant in Taldy-Kurgan holds a rationalization plan by renewing its equipment but is unable to realize the project.

Based on the above-mentioned situations, the government and the Ministry of International Trade and Industry of Japan conceive a special program outlined below as a national plan, although its details are not known.

1) Rebuilding existing equipment

2) Developing new products and promoting their exports

3) Soliciting investment from overseas

It is encouraging news that the MITI published its opinion that the economic indexes of May 1996 in Kazakhstan showed a rise of 3-4 percent from the level of the same period of the previous year.

(3) Situation of metal working industry in Dzhezkazgan

The wire rod plant in Dzhezkazgan was founded in 1994, capitalized by Kazakhstan side by 70 percent and ENTES of Turkey by 30 percent. The plant, built at a total construction cost of $22.5 million, adopted the Southwire Continuous Rod (SCR) method developed by Southwire, Inc., USA, and its 12 people, including 4 engineers, were expedited to train in the United States for one month when the equipment was installed. The equipment cost was $8 million.

The SCR method is a continuous casting process combining trams and belts. This process is the second largest, in terms of the number of units installed in the world, following the auto-clamp upcast method, but the largest in the world in terms of production capacity.

1) Capacity

12 tons/hour, 50,000 tons/year (8 hours/shift x 3 shifts, 5 days/week operation)

Note: All spare parts are purchased from Germany, Sweden, Italy, etc.

2) Number of employees: 110

Production line	39 persons (13 persons/shift x 3 shifts)
Other assignments	71 persons (managerial, maintenance, energy, warehouse, security, cleaning, etc.)

3) Actual production

1995	6,942.6 tons	
1996	10,923.6 tons (twice the actual production from January to June)	
	January, 1996	0
	February	722.5 tons
	March	530.7 tons
	April	1,869.7 tons
	May	806.9 tons
	June	1,512.4 tons
	Total	5,461.9 tons

Operation rate (actual production/equipment capacity)

1995	about 14%
1996	about 20%

4) Quality

- Quality control

Since all sales are handled by Samsung, the plant people have not direct contact with customers. During the past two years, the plant has not received any customer complaints.

Some insufficiencies in document control are observed ; for example, no process control charts are available. Surface characteristics and dimensions are not checked in the processes.

- Product quality

Various defects are observed. Many gas hole defects occur on casting lumps, which must be pointed out as a substantial problem in casting technique. Observed are scars which are assumed to have occurred by foreign matters (not exactly specified this time) which were mixed during casting and come to surface during rolling. On rolled 8 mm diameter plate surface are observed continuous scars, which are assumed to have occurred by contacting the roll guide or something during the processes including the final rolling. On the surface of the product after twisting test are observed in addition to more apparent scars, which occurred during the processes, small hair cracks occurred which have been caused by some defects.

(4) Situation of metal working industry in Balkhash

The plant for plates, bars and wires was moved in 1941 from Korchugin near Moscow to the present location in Balkhash, where the plant started production in 1942. The plant developed and installed in-house horizontal continuous casting (HCC) lines, on which eight or nine dies are circularly arranged. The plant started to produce non-oxygen copper, phosphor bronze, and brass. In 1995 the plant was equipped with wire rod producing equipment manufactured by Mannessmann, Germany, and started production of wire rods. In the same year the plant was furnished with an enameling line purchased from MAG, Austria. Now the line is under the trial run.

1) Equipment and actual production

- The plate and bar producing equipment is very old. Although the equipment is being concentrated now, it will not be competitive in terms of both productivity and quality.

The upstream process has two systems: the HCC process and a system of hot rolling of cast lumps with book mold. A lump by the book mold is 150mm (t) x 610-620mm (W) x 950-1000mm (L) in dimensions and about 800 kg in weight. The HCC process has two lines; a brass lump is 16mm (t) x 330mm (W) x 5000mm (L), while a copper lump is as 25mm (t) x 430mm (W) x 4500mm (L) in dimensions and 230-400 kg in weight. These lumps are very small (a lump is normally 3000-6000 kg in modern plants of the world).

The equipment after the facing includes a rough rolling mill, an intermediate rolling mill, and a finishing mill (now being transferred and re-installed for concentration). The rates of intermediate and finishing mills are as slow as 180 m/min.

No automatic control of thickness is provided. It is manually adjusted with pressurized screws. If this system is compared with a modern rolling mill, the latter is normally subjected to automatic thickness control; the thickness is hydraulically screw-controlled through feedback or feed forward from thickness

gauges, tension control, and speed control. A modern finishing mill is operated normally at the rate of 700-1000 m/min.

Other equipment includes three batch-type annealing furnaces, one washing machine, one welding unit, one slitter, and one shearing line.

Products are: non-oxygen copper, 90/10 copper, 63/37 brass, 1-3% Pb containing brass, 6% and 8% phosphor bronze, Cu-4Sn-3Zn, Cu-9Al-2Mg, Cu-3Cr-1Mg. Plate thickness of the products ranges from 0.5 mm to 2.5 mm.

Plant equipment is now being concentrated, it is recognized by the people concerned that by the mere concentration of the existing equipment will not solve the problem of competitiveness. Therefore, final packaging equipment and related facilities have already purchased ($41 million as of 1991). Main equipment purchased includes an HCC manufacture by Glize, four rolling mills (Skoda), an annealing furnace (Ebnor), two slitters, and one shearing line. The buildings and foundation works have almost been completed. However, lack of necessary fund ($25-30 million) does not allow the expansion to be completed. The purchased equipment is left as packaged.

Nevertheless it is planned to expand the annual equipment capacity by 45 thousand tons as the first step and by 30 thousand tons as the second step, and finally 75 thousand tons in total.

In addition to the copper, main product of the expanded equipment, the copper alloy will also be produced, and it is planned to them export to China, India and Southeast Asian countries.

As shown below, plates and bars were produced at a rate of about 10 thousand tons per year in 1990, just before the collapse of the Soviet Union in 1991. After that, the demand, about 60 percent of which had been munitions industry, declined to about 3.4 thousand tons in 1995 and 2.3 thousand tons in 1996 (twice the cumulative total of production during January through June). The production in 1996 was only 24 percent of that in 1990, includes 1.4 thousand tons of brass plates and bars and 0.6 thousand ton of copper plates and bars.

Under these circumstances, we made a tour of the plant for two days to find the machines in operation were only one or two units per day.

The production of plates and bars has been as follows:

1990	9,632 tons
1991	8,788 tons
1992	5,392 tons
1993	2,934 tons
1994	1,790 tons
1995	3,395 tons
1996	2,306 tons (twice the cumulative total production during Jan. through June)

The wire producing equipment, such as rolling mill, wire drawing mill, and annealing furnace, except

for the HCC lines, are obsolete. The rolling mill speed is 43 m/min. Consequently the wire producing facilities are not competitive in both productivity and product quality.

The upstream process employees an in-house fabricated HCC system, furnished with circularly arranged dies. The copper producing equipment includes one melting furnace and two holding furnaces. From each of the holding furnaces can be drawn eight strands. However, two out of the eight strands are used to draw 19-22 mm diameter ingot. The brass producing equipment consists of one melting furnace and three holding furnaces, from each of which nine strands of 12 mm diameter ingot are drawn.

Further process equipment includes one non-slip type wire drawing mill, three rolling mills, one slip-type wire drawing mill, four bell furnaces, and one annealing furnace. The product diameter is up to 1.18 mm diameter.

As of 1990, wire was produced at a rate of about 6.3 thousand tons per year. It declined sharply, as in the case of plates and bars, to 1.3 thousand tons in 1995 and to 0.9 thousand tons (twice the cumulative total of production during January through June), only 14 percent compared with the production in 1990. The production in 1996 includes 700 tons of HCC material and 100 tons of phosphor bronze.

The HCC for copper was operating on both two days of our visit while only one or two of the other mills were operating, as in the case of the plate and bar plant.

Wires (including copper HCC ingot) have been produced as listed below:

1990	6,297 tons
1991	6,822 tons
1992	3,373 tons
1993	783 tons
1994	1,271 tons
1995	1,323 tons
1996	909 tons (twice the cumulative total of production during Jan. through June)

- The wire rod producing equipment is new one purchased in 1995 from Demag Mannessmann, Germany. Its production capacity is 6.6-9 tons per hour and 31 thousand tons per year. The line is operated by 36 persons of three shifts, each shift composed of 12 persons. Actual production was:

1995	126 tons
1996	313 tons (twice the cumulative total of production during Jan. through June)

The operation rate (actual production/equipment capacity) is extremely low as shown below. The low operation rate can be explained by that the start-up of the enameled wire line is awaited.

1995	0.4%
1996	1%

- The enameled wire equipment was imported in 1995 from MAG, Austria, and is now under trial run. The equipment consists of MAG Ecoline: horizontal 5 lines 0.2-0.8 mm diameter, vertical 8 lines 0.8-

3 mm diameter. Its capacity is 12 thousand tons per year of 0.25-2.5 mm diameter product. Incidental facilities include a 30 m/s wire drawing mill manufactured by Heinrich, Germany. As of November 1995, 60 tons was shipped, without any problems.

2) Quality

- Quality control

No complaint for quality has been received in the past two years. As for the control document, a document which is a kind of combination of work order slip and work standard is available, but no work order slip was flowing at the production line. A quality controller was checking the thickness of plate, but no worker was checking.

- Plate and bar products

Defects in surface characteristics and plate deformation were observed as detailed later in this report. Rough handling was also observed that might damage the products.

- Wire products

Cracks in 19 mm diameter casting lumps were produced by improper working conditions in the HCC process. Many small defects were observed which would be gas holes. There were scars on the surface of 8 mm diameter wire. They were made after and before the wire drawing.

- Wire rod and enameled wire products

No sample.

(5) Situation of lead battery plant in Taldy-Kurgan

The battery plant started operations in January 1975. This is only one battery plant in Kazakhstan, while the whole CIS region holds eight battery plants, including one alkali battery plant.

The Taldy-Kurgan plant produces automobile batteries. Additive such as Sb is added to the electrode Pb to increase corrosion resistance similarly to the production method in Japan. Only grid type electrodes are used and no paste type was found. Plastic jars are also manufacturing in-house.

About 1.5 million batteries are currently manufactured per year. For these batteries, 29 thousand tons of lead are used. The plant holds 1,600 persons. Lead as raw material is purchased only from Ust-Kamenogorsk, Leninogorsk, and Shymkent; Ust-Kamenogorsk is the main supply source.

2-1-12 Economic Assessment of Operating Combines

(1) Production Cost Analysis

Data collected on production and costs in the years 1994 and 1995 at each combine are summarized in the attached data sheets (Table 2-1-12(1)~(7)). The collected data are incomplete particularly for costs because records of many items are considered confidential at the majority of combines.

1) Product Value vs. Production Cost

Since the break-up of the former USSR., the production of base metals (copper, lead and zinc) in the Republic of Kazakhstan has been declining with increasing cost of production. The total production costs at the majority of combines in the years 1994 and 1995 exceed the total values of products as shown in the data sheets, which has placed these combines in serious financial trouble. If the present situation continues, it is apparent that these combines will be forced to cease their operations shortly.

The total product values are estimated on the basis of the average sales prices of the year, according to the data sources, and should include all products. Table 2-1-12(1) indicates the unit value on a copper equivalent basis of the products of the major metal producers (Leninogorsk, Ust-Kamenogorsk, Balkhash, Zhezkazgan and Shymkent) in Kazakhstan in the years 1994 and 1995. Sales values of metals contained in concentrates must have been discounted from those based on the LME prices. Therefore, the values are adjusted on the basis of currently prevailing smelting and refining charges as indicated in the table.

The products of the combines at Leninogorsk and Ust-Kamenogorsk appear to be reasonably well valued in comparison with the LME metal prices if the total product values do not include precious metals (although the unit value on a copper equivalent basis at the Ust-Kamenogorsk in 1995 appears to be overvalued at US$3,595, blister at the Irtysh Copper Smelter is not counted in the estimation due to lack of data). On the other hand, the unit values of the cathode produced at the JSC "Balkhashmed" and the JSC "Zhezkazgantsvetmet" are apparently underestimated, ranging between 75 and 80% of the annual average of the LME copper prices. The unit value of cathode produced at the JSC "Balkhashmed" in the year 1995 is extremely underestimated, which may suggest that incorrect figures are included in the data for the year 1995 or that the year's operation was in an extraordinary state. Major reasons for the underestimation of cathode value of both combines are that the cathode has not been qualified by and registered in LME and that these cathode producers are weak in their bargaining power in the world metal market due to their geographical position, their inexperience in trading in the western market, the present political and economic environment in Kazakhstan and so forth. In general, the products of the non-ferrous metals combines in Kazakhstan are apparently being traded at lower prices than on the world market, taking account of values of precious metals and other by-products.

Production cost breakdown has been obtained only for the 1994 operations at the JSC "Balkhashmed" and the JSC "Zhezkazgantsvetmet" and for the 1995 operation at the JSC "Leninogorsk PC", and is summarized in Table 2-1-12(2).

The combined cost of mining and ore dressing at the JSC "Balkhashmed" exceeds the value of copper contained in concentrates at the 1994 average price of US$2,307 per ton. Therefore, the mining and ore-dressing sectors must have made losses in their 1994 operations. The losses were made up by the smelting and refining sectors treating concentrates purchased from other combines or on toll basis.

The Balkhash smelter treated concentrates of its own concentrator, purchased from other sources and on toll basis, amounting to 29,600, 48,600 and 57,000 tons of copper respectively. The raw material cost was US$49,717,000 for the purchased concentrates or US$1,023 for a ton of the contained copper which was considerably lower than the average copper price of the year. Excluding the raw material cost, the direct smelting-refining cost amounted to US$23,097,000 and was estimated at US$171 for a ton or US$0.08 for a pound of produced copper cathode. Although administration costs and other overheads should be added, the smelting-refining cost at the Balkhash Smelter appears to be lower than those of other smelter-refineries in the world. The all-up-cost, including overheads, amounted to US$167,696,000 in the year 1994 and was estimated at US$1,240 per ton or US$0.56 per pound of copper cathode.

The mining and ore dressing costs at the JSC "Zhezkazgantsvetmet" were much lower than those at the JSC "Balkhashmed" and were estimated at US$4.55 per ton of mine output and US$2.02 per ton of concentrator feed respectively. The smelting-refining cost, excluding the raw material cost, amounted to US$26,765,000 and was estimated at US$190 per ton or US$0.09 per pound of produced copper cathode. The all-up-cost of the year, including overheads, at US$1,294 per ton or US$0.59 per pound appears to be competitive on the world market.

Cost analysis for the JSC "Leninogorsk PC" is rather complicated because this combine mines polymetallic ores, treats various raw materials in addition to concentrates and produces different kinds of final products such as copper and lead concentrates and lead and zinc metals. The analysis was made on a copper equivalent basis by converting amounts of lead and zinc to copper using the average metal prices in the year 1995. The copper price remained at a relatively high level during the year, and therefore, the values of lead and zinc may be underestimated to some extent in this analysis.

The mining and ore dressing costs are estimated at US$10.77 per ton of mine output and at US$4.52 per ton of concentrator feed and are higher than those at the JSC "Zhezkazgantsvetmet". However, the combined cost at US$1,153 per ton of metals contained in concentrates on a copper equivalent basis appears to be reasonable, taking account of ore extraction from deep-seated deposits and of treatment of complex polymetallic ores. The Smelting cost is rather high at US$1,265 per ton of metal on a copper equivalent basis and accounts for approximately 43% of the value of produced metals. The all-up-cost to the final products (concentrates and metals) is estimated at US$2,446 per ton of metals produced in forms of pure metals and of sulphides in concentrates and amounts to approximately 83% of the market value of the final product in the year 1995 (US$2,936). This figure suggests that the 1995 operation at the JSC "Leninogorsk PC" may have been marginally profitable, taking account of smelting and refining charges for its concentrates. However, the concentrates produced at the JSC "Leninnogorsk PC" contain appreciable amounts of precious metals and should be sold at much

higher prices than those estimated only for contained base metals.

Although no break-down has been indicated, combined costs of mining and ore dressing for the year 1994 are available for some combines and are summarized in Table 2-1-12(3) together with those for the JSCs "Balkhashmed" (1994), "Zhezkazgantsvetmet" (1994) and "Leninogorsk PC"(1995). Exchange rates and copper equivalent factors are the same as used in Tables 2-1-12(1) and (2).

The mining and ore dressing operations at the JSC "Achpolymetal" and JSC "Irtysh PC" are apparently unprofitable. Similarly, the Balkhash and Karagailinski operations must have made losses at the average copper prices in the year 1994. The operations at the JSCs "Akshatau Ken-Baiytu Combinaty", "Zyryanovsk Lead Combine" and "Tekeli Pb-Zn Combine" appear to be marginal in terms of profit, taking account of smelting costs for their concentrates. The combines which made profits in their mining and ore dressing operations were JSC "Zhezkent MCC" and JSC "Zhezkazgantsvetmet" in the year 1994. The mining cost of US$7.53 per ton of mine output at the JSC "Balkhashmed" (the Kounrad and Sayak Mines) is comparable to an average open pit mine with a waste-to-ore ratio of 8 in North America. Excluding the Achisai and Irtysh operations, the combined costs of mining and ore-dressing appear to be reasonable for underground operations. The combined cost at the JSC "Zhezkent MCC" are somewhat higher than the average of the other combines but are well compensated by high values of its ores. The ore dressing cost of the JSC "Leninnogorsk PC" which produces three types of concentrate (copper, lead and zinc), is reasonable in comparison with the average of North American concentrators.

The 1994 total production costs at the JSC "UK Pb-Zn Combine" and JSC "Shymkent Lead Plant" amounted to 4,359 and 1,358 million Tenge or 124.5 and 388 million US Dollars respectively and were regarded as smelting-refining costs including overheads. The JSC "UK Pb-Zn Combine" including the Irtysh smelter produced 28,800 tons of copper in forms of blister and cathode, 47,800 tons of lead metal and 117,500 tons of zinc metal, while the JSC "Shymkent Lead Plant" produced 80,500 tons of lead metal only. The unit production costs for a ton of copper equivalent are estimated at US$1,372 for the Ust-Kamenogorsk and at US$2,008 for the Shimkent operation based on the same assumptions as those used for Table 2-1-12(2). The all-up cost of the 1994 Leninogorsk operation which includes mining and ore-dressing costs is estimated at US$1,765 per ton of a copper equivalent. These unit costs are apparently lower than the average copper price of the year at US$2,307 per ton. The all-up costs per ton of copper equivalent in the year 1994 appear to have stayed at economically profitable levels at these combines as well as at the JSC "Zhezkazgantsvetmet" and JSC "Balkhashmed". The reasons may be attributed mostly to low smelting-refining costs according to the analysis of the break-down costs at Zhezkazgan and Balkhash. The cost will increase significantly if sulphur dioxide emission were appropriately treated to produce sulphuric acid for environmental production. Table 2-1-12(4) compares the total production costs of major combines in the years 1994 and 1995. The unit costs substantially increased in the year 1995 at most combines except at the Irtysh and JSC "Balkhashmed". The unit cost per ton of equivalent copper at the Irtysh Combine improved considerably in the year 1995 but remained still far above the average copper price of the year at US$2,936. The unit cost at Balkhash reduced to nearly half that of the year 1994. The reason for the reduction is not known. According to

the cost performance in the year 1995, the operations at the JSCs "Achpolymetal", "Irtysh PC" and JSC "Shymkent Lead Plant" are not economically justified.

Reviewing the break-down of the production cost by items in Table 2-1-12(2), the labor costs account for 36.2%, 19.3% and 28.6% of the total costs at the JSCs "Balkhashmed" (1994), "Zhezkazgantsvetmet" (1994) and "Leninogorsk (1995) PC". The difference from combine to combine may be attributed to the difference in classification of subitems including social insurance, other fringes and social welfare charges associated with workers in the combines. Combined labor and other expenses range between 46.5% (JSC "Balkhashmed") and 52.2% (JSC "Leninogorsk PC") of the total costs. The production of these expenses appears to be significantly high in comparison with that in ordinary western operations. Main reasons are probably because the numbers of workers are much far larger than those of western enterprises with similar production capacities to those combines and because these combines are obliged to bear social welfare expenses as tradition in the former USSR.

Electricity is another major item of the production cost, particularly at the JSC "Zhezkazgantsvetmet" where electric furnaces are adopted for smelting. The raw material cost of the JSC "Balkhashmed" is also high, reflecting its nature as a custom smelter.

2) Operating Profit (Ref. Data Sheet)

According to the revenue and expense records of the year 1994, the JSCs "Leninogorsk PC", "Zhezkent MCC" and JSC "Zhezkazgantsvetmet" returned reasonable operating profits. The operating profit of the JSCs "Balkhashmed" and "Tekeli Pb-Zn Combine" were very marginal. Operating losses were recorded in other combines and were considerable for their turnovers of the year. The operation of these combines is not economically justified at all.

No revenue record has been obtained for the 1995 operation for any combines. The combines, which recorded a surplus of the total product values over the production costs, are the JSCs "Zyryanovsk Lead Combine", "Leninogorsk PC", "Zhezkazgantsvemet", "Balkhashmed" and "UK Pb-Zn Combine". Improvements are observed at the JSC "Zyryanovsk Lead Combine" and JSC "UK Pb-Zn Combine", compared to their 1994 operations. The operations at the JSCs "Achpolymetal", "Akshatau Ken-Baiytu Combinaty", "Irtysh PC"and "Shymkent Lead Plant" are apparently uneconomical.

(2) Financial Status

The accounting system in Kazakhstan which was introduced during the period of Perestroika (late 1980's) is in principle similar to that prevailing in the western world as before mentioned. The financial statements comprise a balance sheet, a profit-loss statement and other associated documents and are filed in the Ministry of Finance. The balance sheets and profit-loss statements as of the end of December 1994 and the end of September 1995 were obtained for the JSCs "UK Pb-Zn Combine", "EKCChC", "Tekeli Pb-Zn Combine" and "Achpolymetal" during the course of the First Site Investigation. However, it is practically impossible to

appropriately assess these documents due to a lack of information with respect to definition of each item in the documents. Table 2-1-12(5) is prepared by compiling data obtained from various sources.

Operating losses were recorded at a number of combines both in 1994 and 1995. However, the operation result of the non-ferrous metals industry as a whole improved significantly in 1995 from that in 1994. Never-the-less, the total of the accounts receivable for all combines, where data were available, recorded considerable deficit against the accounts payable in 1995, compared to a moderate surplus in 1994. This indicates that most combines are placed in seriously troubled financial situations. Under this circumstance it may be worth noting that the financial position of the JSC "Zhezkent MCC", the management of which has been transferred to a Swiss company named Nova Resources, appears to be sound in terms of balance between accounts payable and receivable. Table 2-1-12(6) shows the breakdown of the accounts receivable and payable as of January 1, 1996.

Unpaid bills for raw materials and other supplies are substantial, compared to other items of accounts payable, at smelters such as the Ust-Kamenogorsk, Zhezkazgan, Balkhash, Leninogorsk and Shymkent. This may be one of the major reasons why the accounts receivable is high compared to the annual turn-over at such raw material suppliers as the JSCs "Achpolymetal", "Zyryanovsk Lead Combine", "Irtysh PC" and "Akshatau Ken-Baiytu Combinaty". Shortage of cash flow or working capital at the major smelters appears to be adversely affecting the financial status of the raw material suppliers. It has been attested by various sources in the course of the current investigation that unpaid bills for electricity and salaries and wages are increasing rapidly. Although the amounts of accounts payable for these items was still notable as of January 1, 1996 at some combines, the bills for electricity were cleared at the JSCs "Zhezkent MCC", "Balkhashmed" and "UK Pb-Zn Combine". The salaries and wages were also paid off at the JSC "Zhezkent MCC" and JSC "Zhezkazgantsvetmet"s. A large number of unpaid bills for electricity at the JSC "Achpolymetal", may be explained by the fact that pumping water from its underground mine requires substantial electricity consumption. The amounts of accounts payable for the item 'others' were considerable at the JSCs "Zhezkazgantsvetmet", "Leninogorsk PC"and "Zyryanovsk Lead Combine". Since its breakdown is not indicated, the reason is not explained. One conceivable possibility is that this item may include payments made by manager companies that have taken over the management of these combines on a contract basis ('Management Transfer Contract'). It has been interpreted that the item 'Vipolnennieraboti' in Russian is unpaid bills for construction works completed by contractors. A large amount of accounts payable for this item is recorded at the JSCs "Zhezkazgantsvetmet", "UK Pb-Zn Combine"and "Zyryanovsk Lead Combine" where major repair works at the smelters or mine development works are in progress.

The loans payable as of January 1, 1995 is less than half of the accounts payable. No data is available for the amounts of loans in 1995. However, it is unlikely that any combines increased their borrowing for repayment of accounts payable during 1995 under the money market with extraordinarily high rates of interest. The present imbalance of accounts payable and receivable will further stress the financial position of the combines and will lead to further serious trouble. In addition, a substantial proportion of accounts payable and receivable is related to inter-combine trading of raw materials. Therefore, there is a possibility that accounts receivable from

other combines will become unrecoverable credits under the troubled financial situation of most combines at the present time.

The present financial difficulty of enterprises in Kazakhstan, not only of the non-ferrous metals industry but also of other industries, largely resulted from the sudden privatization of the enterprises without sufficient working capital and appropriate restructuring schedules.

(3) Product Sales

Table 2-1-12(7) indicates the 1994 export of metals to the CIS and other countries. The total amounts of exports in 1994, were 194,000 tons of copper, 50,700 tons of lead and 111,700 tons of zinc, compared to the year's production of copper, lead and zinc at 304,900, 137,700 and 172,500 tons respectively.

The amounts of copper and zinc exported to other than CIS countries exceeded those to CIS countries, while lead was mostly sold within the CIS. It must be noted that a large proportion of the amounts sold within the CIS was traded by barter deals. This indicates that most metal producers were forced to sell their products in exchange for consumables and other supplies necessary for maintaining their operations in the absence of adequate working capital. It has been mentioned earlier in this section that the metal products of Kazakhstan are under valued in comparison with the prices prevailing in the international market. Table 2-1-12(7) clearly indicate that the metal products were sold at prices far bellow the average of the year and that they were unduly undervalued for barter deals in particular. This kind of marketing practice, though inevitable, is probably one of the major causes which have put most combines into their present financial trouble.

Table 2-1-12(1) Unit Value of Product at Major Combines

Year: 1994

Name of Combine	Product	Contained Metal						Product Value				Value Before Sales Discount		Ratio to LME Price
								Total		Unit	Sales Discount			
		Cu (T.T)	Pb (T.T)	Zn (T.T)	Au (T)	Ag (T)	Cu-Eq (T.T)	Mln. Tenge	T.US$	US$/T	T.US$	Total T.US$	Unit Value US$/T	(%)
JSC "Leninogorsk PC"	Cu-Conc.	6.6					6.6				3,201			
	Pb-Conc.		8.8				2.1				1,019			
	Pb-Metal		9.4				2.3							
	Zn-Metal			55.0			23.7							
	Total						34.7	2,527	72,200	2,081	4,220	76,420	2,202	95.4
UKPb-Zn Combine	Cathode	2.4					2.4							
	Pb-Metal		47.8				11.5							
	Zn-Metal			117.5			50.5							
	Cu-Blister	26.4					26.4				4,646			
	Sub Total						90.8	7,249	207,114	2,281	4,646	211,760	2,332	101.1
	Au				9.5		46.1							
	Ag					408.5	27.3							
	Total						164.2	7,249	207,114	1,261	4,646	211,760	1,290	55.9
JSC "Balkhashmed"	Cathode	135.2					135.2	8,549	244,257	1,807			1,807	78.3
JSC "Zhezkazgantsvetmet"	Cathode	140.9					140.9	8,708	248,800	1,766			1,766	76.5
JSC "Shymkent Lead Plant"	Pb-Metal		80.5				-	1,284	36,686	455			455	83.0

LME Price Cu: US$/MT 2307
Pb: US$/MT 548, Cu Equiv Factor: 0.24
Zn: US$/MT 998, CuEquiv Factor: 0.43
Au: US$/OZ 384, Cu Equiv Factor: 4855
Ag: US$/OZ 5.28, Cu Equiv Factor: 66.8

Conc. Sales Discount US$/Cu.lb 0.22 = US$/Cu.T 485
Blister Sales Discount US$/Cu.lb 0.08 = US$/Cu.T 176
Exchange Rate: US$ 1 = 35 Tenge
JSC "Shymkent Lead Plant" : Estimated using only Pb Price.

Year: 1995

Name of Combine	Product	Contained Metal						Product Value				Value Before Sales Discount		Ratio to LME Price
								Total		Unit	Sales Discount			
		Cu (T.T)	Pb (T.T)	Zn (T.T)	Au (T)	Ag (T)	Cu-Eq (T.T)	Mln. Tenge	T.US$	US$/T	T.US$	Total T.US$	Unit Value US$/T	(%)
JSC "Leninogorsk PC"	Cu-Conc.	7.2					7.2							
	Pb-Conc.		9.8				2.1							
	Pb-Metal		12.5				2.6							
	Zn-Metal			72.6			25.4							
	Total						37.3	6,280	104,667	2,806	4,511	109,178	2,927	99.7
UKPb-Zn Combine	Cathode	5.4					5.4							
	Pb-Metal		44.8				9.4							
	Zn-Metal			95.7			33.5							
	Blister	N.A.					N.A.				N.A.			
	Sub Total						48.3	10,419	173,650	3,595			3,595	121.3
	Au				10.1		38.5							
	Ag					371.0	19.1							
	Total						105.9	10,419	173,650	1,640			1,640	55.8
JSC "Balkhashmed"	Cathode	117.9					117.9	9,400	156,667	1,329			1,329	45.3
JSC "Zhezkazgantsvetmet"	Cathode	132.2					132.2	184.40	307,333	2,325			2,325	79.2
JSC "Shymkent Lead Plant"	Pb-Metal	31.7					-	1,131	18,850	595			595	94.2

LME Price Cu: US$/MT 2936
Pb: US$/MT 631, Cu Equiv Factor: 0.21
Zn: US$/MT 1031, Cu Equiv Factor: 0.35
Au: US$/OZ 384, Cu Equiv Factor: 3815
Ag: US$/OZ 5.19, Cu Equiv Factor: 51.5

Conc. Sales Discount: US$/Cu.lb 0.22 = US$/Cu.T 485
Blister Sales Discount: US$/Cu.lb 0.08 = US$/Cu.T 176
Exchange Rate: US$ 1 = 60 Tenge
JSC "Shymkent Lead Plant" : Estimated using only Pb Price.

Table 2-1-12(2) Production Cost Break-down

	JSC "Balkhashmed" 1994						JSC "Zhezkazgantsvetmet" 1994						JSC "Leninogorsk PC" 1995					
	Mine	Conc.	Smelter	Others	Total		Mine	Conc.	Smelter	Others	Total		Mine	Conc.	Smelter	Others	Total	
	Mln Tenge	Mln Tenge	Mln Tenge	Mln Tenge	Mln Tenge	T.US$	Mln Tenge	Mln Tenge	Mln Tenge	Mln Tenge	Mln Tenge	T.US$	Mln Tenge	Mln Tenge	Mln Tenge	Mln Tenge	Mln Tenge	T.US$
Labour					2,126.1	60,745					1231.6	35,189	568.4	119.0	419.0	454.5	1,560.9	26,015
Salary & Wages													431.1	90.3	317.8	344.7	1,183.9	19,732
Soc. Insurance													19.2	4.0	14.2	13.6	51.0	850
Other Fringes													118.1	24.7	87.0	96.2	326.0	5,433
Raw Materials					1,740.1	49,717					1167.8	33,366		20.6	252.0		272.6	4,543
Ores														20.6			20.6	343
Concentrates															46.8		46.8	780
Others															205.2		205.2	3,420
Supplies					1,400.0	40,000					2048.6	58,531						
Sparepart					30.8	880												
Consumables					268.9	7,683							298.0	231.5	304.5	349.4	1,183.4	19,723
Explosives					32.7	934							231.4	231.5	158.6	294.8	916.3	15,272
Reagent																		
Fuel & Lab.					236.2	6,749					319.1	9,117	66.6		145.9	54.6	267	4,452
Others																		
Electricity					1,066.1	30,460					1633.7	46,677	200.1	132.8	455.9	92.0	880.8	14,660
Water					34.2	977					95.7	2,734	19.5	28.3	170.7	57.1	275.6	4,593
Other Supplies																		
Administration																		
Other Expenses					603.2	17,234					1,933.6	55,246	302.0	38.7	523.7	423.1	1,287.5	21,458
Total (Mln. Tenge)	1,943.2	497.4	2,548.5	880.3	5,869.4	167,696	2,680.0	1,148.6	2,104.6	448.1	6,381.5	182,329	1,388.0	570.9	2,125.8	1,376.1	5,460.8	91,013
(T. US$)	55,520	14,211	72,814	25,151	167,696		76,571	32,817	60,131	12,803	182,329		23,133	9,515	35,430	22,935	91,013	
Mine Output (T. Ton)	7,375						16,640						2,148					
Concentrator Feed (T. T.)		7,690						16,191						2,105				
Metal Content (T.T.) in Conc.																		
Cu		28.5						131.7						7.2				
Pb														9.8				
Zn														54.4				
Cu Equiv.		28.5						131.7						28.3 (9.2)				
Metal Output Cu			135.2						140.9									
Pb															12.5			
Zn															72.6			
Cu Equiv.			135.2						140.9						28.0 (37.2)			
Unit Cost (US$)/Mine Output T.	7.53						4.55						10.77					
/Conc. Feed T.		1.85						2.02						4.52				
/Cu Equiv. (T) in Conc.	1,948	498.6					582.8	249.2					817	336				
/Cu Equiv. (T) in Final Product			538.6	186.0		1,240			426.8	90.8		1,294			1,265	819.1 (616.5)		3,250 (2,446)

1,994 Exchange Rate: US$ 1 = 35 Tenge
Cu Equiv. Factor Pb: 0.24
Cu Equiv. Factor Zn: 0.43

1,995 Exchange Rate: US$ 1 = 60 Tenge
Cu Equiv. Factor Pb: 0.21
Cu Equiv. Factor Zn: 0.35
Metal Content in Conc., Cu Equiv. ( ) = Cu+Pb only
Metal Output, Cu Equiv. ( ) = Pb, Zn Metals+Cu, Pb in Conc.
Unit Cost/Cu Equiv. in Final Product: ( ) = Incl. Cu, Pb, in Conc.

Table 2-1-12(3) Combined Cost of Mining and Ore-dressing(1994)

Name of Combine	Mining Method	Production (Mln. Tange)		Cost (Mln. Tange)			Cost (T.US$)			Unit Cost (US$/T)			Cu Equiv. in Conc.	Combined Cost/Cu Equiv.
		Mine	Conc. Feed	Mine	Conc.	Total	Mine	Conc.	Total	Mine	Conc.	Total	T.T	US$/T
JSC "Achpolymetal"	U/G	221	340			603			17,285			50.84	1.5	11,523
JSC "Akshatau Ken-Barytu"	U/G	323	474			282			8,057			17.00	7.1	1,135
JSC "Zyryanovsk Lead Combine"	U/G	1,779	2,060			1,018			29,086			14.12	24.3	1,197
JSC "Irtysh PC"	U/G	69	146			182			5,200			35.62	0.6	8,667
JSC "Karagailinski MMC"	U/G	70	142			89			2,543			17.91	1.2	2,119
JSC "Tekeli Pb-Zn Combine"	U/G	466	480			260			7,429			15.48	6.8	1,093
JSC "Zhezkent MCC"	U/G	670	681			529			15,114			22.19	28.3	534
JSC "Zhezkazgantsvetmet"	U/G/O/P	16,840	16,191	2,680	1,149	3,829	76,751	32,817	109,568	4.55	2.02	6.57	131.7	832
JSC "Balkhashmed"	O/P	7,375	7,690	1,943	497	2,440	55,520	14,211	69,731	7.53	1.85	9.38	28.5	2,447
JSC "Leninogorsk PC" ('95)	U/G	2,148	2,105	1,388	571	1,959	23,133	9,515	32,648	10.77	4.52	15.29	28.3	1,153

Unit Cost: Mining Cost, devided by Mine Output, Ore-dressing Cost, divided by Conc. Feed for JSC "Zhezkazgantsvetmet", JSC "Balkhashmed" and JSC "Leninogorsk PC", Combined Cost for others, devided by Conc. Feed.

Mining and Ore-dressing Costs in North America

	Mine-Conc.	Capacity	Unit Cost/Ton of Capacity						
			Mine	Concentrator			Total		
	T/D	T.T/Y		1 Conc.	2 Conc.	3 Conc.	1 Conc.	2 Conc.	3 Conc.
Open Pit W/O = 1	30,000	5,200	1.88	4.08			5.96		
Open Pit W/O = 2			2.72				6.80		
Open Pit W/O = 4			4.38				8.46		
Open Pit W/O = 8			7.94				12.02		
Underground									
Block Caving	40,000	10,400	4.16	3.77	4.17	4.44	7.93	8.33	8.60
Room & Pillar	15,000	3,900	5.38	4.40	4.82	5.12	9.78	10.20	10.50
Room & Pillar	5,000	1,300	7.45	5.47	5.94	6.33	12.92	13.39	13.78
Cut & Fill	2,000	520	63.76	7.58	8.21	8.78	71.34	71.97	72.54

Table 2-1-12(4) Comparison of the 1994 and 1995 Production Cost

Name of Combine	Year: 1994							Year: 1995							Remarks
	Total Cost		Metals Produced or in Conc.				Unit Cost	Total Cost		Metals Produced or in Conc.				Unit Cost	
	Mln. Tenge	T US$	Cu T.T	Pb T.T	Zn T.T	Cu Equiv. T.T	US$/ Cu Equiv. T.	Mln. Tenge	T US$	Cu T.T	Pb T.T	Zn T.T	Cu-Equiv. T.T	US$/ Cu Equiv. T.	
JSC "Achpolymetal"	603	17,229		2.1	2.3	1.5	11,523	498	8,300		0.4	0.0	0.1	83,000	Mining, Ore Dressing
JSC "Akshatau Ken-Baiytu	282	8,057		1.2	15.9	7.4	1,135	972	16,200		1.0	26.2	9.4	1,723	Mining, Ore Dressing
JSC "Zyryanovsk Lead Combine"	1,018	29,086	8.1	10.4	31.8	24.3	1,197	2,233	37,217	9.6	11.3	39.7	25.9	1,436	Mining, Ore Dressing
JSC "Irtysh PC"	182	5,200	0.2	0.2	0.9	0.6	8,667	642	10,700	0.8	0.6	4.7	2.6	4,115	Mining, Ore Dressing
JSC "Karagailinski MMC"	89	2,543	1.0	0.3	0.3	1.2	2,119	NA		0.5	0.6	0.6	0.8		Mining, Ore Dressing
JSC "Leninogorsk PC"	2,138	61,086	6.6	18.2	55.0	34.6	1,765	5,461	91,017	7.2	22.3	72.6	37.3	2,441	Mining, Ore Dressing, Smelting
East-Kazakhstan	NA		13.2		25.9	24.3		NA		NA	NA	NA			Mining, Ore Dressing
JSC "Tekeli Pb-Zn Combine"	259	7,400		11.3	9.6	6.8	1,093	NA			7.3	7.3	4.1		Mining, Ore Dressing
JSC "Zhezkent MCC"	529	15,114	25.8		5.8	28.3	534	NA		33.2		8.9	36.3		Mining, Ore Dressing
JSC "Zhezkazgantsvetmet"	6,382	182,343	140.9			140.9	1,294	12,213	203,550	132.2			132.2	1,540	Mining, Ore Dressing, Smelting
JSC "Balkhashmed"	5,869	167,686	135.2			135.2	1,240	4,623	77,050	117.9			117.9	654	Mining, Ore Dressing, Smelting
JSC "UKPb-Zn Combine"	4,359	124,543	28.8	47.8	117.5	90.8	1,372	9,148	152,467	31.8	44.8	95.7	74.7	2,041	Smelting
JSC "Shymkent Lead Plant"	1,358	38,800		80.5		19.3	2,008	1,277	21,283		31.7		6.7	3,177	Smelting
Total	23,068	659,087	359.8	172.0	265.0	515.2	33,947	37,067	617,784	333.2	120.0	255.7	448.0	100,127	

LME Price Cu: US$/MT 2307
Pb: US$/MT 548, Cu Equiv. Factor: 0.24
Zn: US$/OZ 998, Cu Equiv. Factor: 0.43
Au: US$/OZ 384, Cu Equiv. Factor: 4855
Ag: US$/OZ 5.28, Cu Equiv. Factor: 66.8
Exchange Rate: US$1 = 35 Tenge

LME Price Cu: US$/MT 2936
Pb: US$/MT 631, Cu Equiv. Factor: 0.21
Zn: US$/OZ 1031, Cu Equiv. Factor: 0.35
Au: US$/OZ 384, Cu Equiv. Factor: 3815
Ag: US$/OZ 5.19, Cu Equiv. Factor: 51.5
Exchange Rate: US$1 = 60 Tenge

Table 2-1-12 (5) Financial Results Summary (Mln. Tenge)

1994

Name of Combine	Revenue				Cost				Operating Profit	Product Inventory (01-01-'95)	Account Receivable (01-01-'95)	Advance Payment	Account Payable (01-01-95)			Loan Payable (01-01-95)			
	Product Sales	Other Sales	Non-Sales	Total	Production	Others	Non-Sales	Total					Materials & Services	Others	Total	Bank Loan		Other Loan	Total
																Short Term	Long Term		
JSC "Achpolymetal"	207	26	3	236	603	0	8	611	-375	84	87		117.1	33.4	150.5	108.5	1.3	0	109.8
JSC "Akshatau Ken-Baiytu	245	0	14	259	282	0	60	342	-83	77	NA		135.8	29.5	165.3	3.3	0.3	0	3.6
JSC "Zyryanovsk Lead Combine"	1,081	-34	48	1,095	1,018	834	59	1,911	-816	178	342	2	171.4	58.7	230.1	182.6	82.9	0	265.5
JSC "Irtysh PC"	85	7	0	92	182	0	0	182	-90	11	NA		26.0	19.5	45.5	46.9	0.3	35.0	82.2
JSC "Karagailinski MMC"	44	15	0	59	89	0	22	111	-52	37	NA	7	70.5	6.8	77.3				
JSC "Leninogorsk PC"	3,031	3	176	3,210	2,138	0	265	2,403	807	300	NA	85	439.8	62.1	501.9	53.0	6.8	239.6	299.4
JSC "EKCChC"	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
JSC "Tekeli Pb-Zn Combine"	229	39	1	269	259	0	1	260	9	25	77		26.1	9.4	35.5	27.4	0.5	0	27.9
JSC "Zhezkent MCC"	566	29	35	630	529	1	6	536	84	77	NA		40.5	7.1	47.6	0.0	45.7	0	45.7
JSC "Zhezkazgantsvetmet"	7,633	121	478	8,232	6,382	0	3	6,385	1,847	1,191	2,784	419	1,154.8	1,045.0	2,199.8	154.6	2.2	0	176.8
JSC "Balkhashmed"	8,703	2	17	8,722	5,869	1,219	1,139	8,227	495	1,495	879		639.8	384.8	1,024.6	4.9	489.4	0	574.4
JSC "UKPb-Zn Combine"	5,534	101	0	5,635	4,359	0	2,622	6,981	-1,346	482	3,712		1,791.1	404.8	2,195.9	40.4	1.1	1,458.1	1,499.6
JSC "Shymkent Lead Plant"	1,114	26	24	1,164	1,358	130	32	1,520	-356	301	285		NA	NA	NA	NA	NA	NA	NA
Total	28,472	335	796	29,603	23,068	2,184	4,217	29,469	124	4,258	8,166	513	4,612.9	2,061.1	6,674.0	621.6	630.5	1,732.7	3,084.9

1995

Name of Combine	Revenue				Cost				Operating Profit	Product Inventory (01-01-'96)	Account Receivable (01-01-'96)	Advance Payment	Account Payable (01-01-96)			Loan Payable (01-01-96)			
	Product Sales	Other Sales	Non-Sales	Total	Production	Others	Non-Sales	Total					Materials & Services	Others	Total	Bank Loan		Other Loan	Total
																Short Term	Long Term		
JSC "Achpolymetal"	NA	NA	NA	NA	498	NA	NA	NA	-74	NA	113.1	NA	892.7	199.0	1,091.7	NA	NA	NA	NA
JSC "Akshatau Ken-Baiytu	NA	NA	NA	NA	972	NA	NA	NA	-197	NA	237.7	NA	205.3	281.7	487.0	NA	NA	NA	NA
JSC "Zyryanovsk Lead Combine"	NA	NA	NA	NA	2,233	NA	NA	NA	272	NA	249.1	NA	1,000.5	503.7	1,504.2	NA	NA	NA	NA
JSC "Irtysh PC"	NA	NA	NA	NA	642	NA	NA	NA	-363	NA	194.7	NA	231.0	43.0	274.0	NA	NA	NA	NA
JSC "Karagailinski MMC"	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
JSC "Leninogorsk PC"	NA	NA	NA	NA	5,461	NA	NA	NA	529	NA	513.4	NA	624.5	2,513.0	3,137.5	NA	NA	NA	NA
JSC "EKCChC"	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
JSC "Tekeli Pb-Zn Combine"	NA	NA	NA	NA	NA	NA	NA	NA	36	NA	25.0	NA	540.4	30.0	570.4	NA	NA	NA	NA
JSC "Zhezkent MCC"	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	18.0	NA	65.7	10.0	75.7	NA	NA	NA	NA
JSC "Zhezkazgantsvetmet"	NA	NA	NA	NA	12,213	NA	NA	NA	2,612	NA	2,390.0	NA	5,379.3	7,985.7	13,365.0	NA	NA	NA	NA
JSC "Balkhashmed"	NA	NA	NA	NA	4,623	NA	NA	NA	4,259	NA	394.0	NA	1,403.0	177.0	1,580.0	NA	NA	NA	NA
JSC "UKPb-Zn Combine"	NA	NA	NA	NA	9,148	NA	NA	NA	1,536	NA	1,583.4	NA	4,435.8	363.2	4,799.0	NA	NA	NA	NA
JSC "Shymkent Lead Plant"	NA	NA	NA	NA	1,277	NA	NA	NA	-108	NA	350.0	NA	1,316.0	NA	1,316.0	NA	NA	NA	NA
Total					37,067				8,502		6,068.4		16,094.2	12,106.3	28,200.5				

Table 2-1-12 (6) Breakdown of Accounts Receivable and Payable (Mln. Tenge)

as of Jan. 1 1996

Name of Combine	Account Receivable				Account Payable							
	Concentrate	Metal	Others	Total	Electricity	Railway	Raw Material & Supply	Contract Work	Salary and Wages	Budget	Others	Total
JSC "Achpolymetal"	113.1			113.1	634.3	85.0	30.9	35.7	54.0	52.8	199.0	1,091.7
JSC "Akshatau Ken-Baiytu	237.7			237.7	33.0		58.2	11.7	35.0	67.4	281.7	487.0
JSC "Zyryanovsk Lead Combine"	249.1			249.1	133.8		184.3	414.3	115.0	153.1	503.7	1,504.2
JSC "Irtysh PC"	194.7			194.7	176.0	7.0			40.0	14.0	43.0	274.0
JSC "Leninogorsk PC"		513.4		513.4	30.6		403.7	132.0	27.6	306.0	2,513.0	3,137.5
JSC "Tekeli Pb-Zn Combine"	25.0			25.0	69.0	6.0	204.6	187.4	47.0	27.0	30.0	570.4
JSC "Zhezkent MCC"	18.0			18.0			61.9	3.8			10.0	75.7
JSC "Zhezkazgantsvetmet"		2,390.0		2,390.0	365.1		2,210.0	2,649.0		155.5	7,985.7	13,365.0
JSC "Balkhashmed"		394.0		394.0			809.0	290.0	147.0	157.0	177.0	1,580.0
JSC "UKPb-Zn Combine"		1,583.4		1,583.4		11.0	2,430.4	1,560.3	252.9	181.2	363.2	4,799.0
JSC "Shymkent Lead Plant"		350.0		350.0	150.0	182.0	300.0	264.0	200.0	220.0		1,316.0
Total	837.6	5,230.8	0.0	6,068.4	1,591.8	291.0	6,693.0	5,548.2	918.5	1,334.0	12,106.3	28,200.5

Table 2-1-12(7) Metal Export in 1994

Export to Other than CIS Countries

Country	Copper			Lead			Zinc		
	Amount	Value		Amount	Value		Amount	Value	
	T.T.	Mln. Tenge	T.US$	T.T.	Mln. Tenge	T.US$	T.T.	Mln. Tenge	T.US$
China	1.2	41.6	2,504						
Austria	4.6	246.7	7,514						
U.K.	4.5	231.2	8,736				3.5	95.5	2,807
Germany	1.0	70.0	1,579				0.5	13.9	407
Italy	8.7	481.5	17,570				4.1	156.3	3,415
N Korea	2.5	281.6	5,835	2.9	45.8	1,351	15.6	374.5	12,704
Netherlands	31.7	1,933.4	61,138				1.0	39.3	855
USA	16.0	863.6	33,403						
Turkey	10.7	697.1	22,485	1.4	34.7	778	6.8	197.1	5,965
Switzerland	14.6	878.5	30,547	3.2	75.1	1,596	22.1	721.6	17,482
Sweden	2.0	64.6	5,248						
S. Korea	14.3	780.0	29,734						
Bulgaria				3.2	7.0	1,455	0.1	6.4	124
Iran							0.5	11.7	217
Cyprus							5.6	2353	7,173
Slovakian							0.6	16.3	400
Japan							0.4	2.7	288
Liechtenstein							1.5	82.6	1,536
Finland							1.5	35.8	1,223
Yugoslavia							0.3	16.3	304
Total	111.8	6,569.8	226,293	10.7	162.6	5,180	64.1	4,123	54,900

Estimated Average Exchange Rate: US$1=37.9 Tenge

Average Sales Price in 1994

Cu: 2024 US$/Ton

Pb: 484 US$/Ton

Zn: 856 US$/Ton

Average Metal Price in 1994 (LME)

Cu: 2307 US$/Ton

Pb: 548 US$/Ton

Zn: 998 US$/Ton

Export to CIS Countries

Country	Sales				Sales			
	Amount	Value		Price	Amount	Value		Price
	T.T.	Mln. Tenge	*T. US$	US$/T.	T.T.	Mln. Tenge	*T. US$	US$/T.
Copper Anode	21.5	1,386.2	36,575	1701	60.0	2,836	74,823	1,247
Rolled	0.3	20.4	538	1793	0.4	21	567	1,393
Total Copper	21.8	1,406.6	37,113	1702	60.4	2,857	75,380	1,248
Lead Metal	2.1	59.2	1,562	744	36.7	533	14,050	383
Rolled					1.2	25	665	554
Total Lead	2.1	59.2	1,562	744	37.9	558	14,715	388
Zinc Metal	29.9	309.5	8,166	273	17.7	484	12,757	721

*Exchane Rate: US$1= 37.9

2-2 Undeveloped Ore Deposits

2-2-1 The Ministry of Geology Role

1. Undeveloped Projects

As for undeveloped projects for base metals (copper, lead, zinc) from the initial stage of mining to the development preparation stage, MinGeo geological information bureau and local geological bureaus (South Kazakhstan Geological Bureau, East Kazakhstan Geological Bureau, Central Kazakhstan Geological Bureau) submitted 35 cases through the current survey. Among them, 23 cases are under control of East Kazakhstan Geological Bureau, five cases are under control of South Kazakhstan Geological Bureau and seven cases are under control of Central Kazakhstan Geological Bureau (Table 2-2-1(1)). Horethan 10 undeveloped projects have been transferred to joint venture organizations. As for the other projects, MinGeo possesses their mining rights and most of them are placed at initial stage for mining to accurate survey stage. The objective is to transfer the mining rights to the public. Most of 35 projects are concentrated in the East Kazakh State and include a large amount of black ore type polymetallic ore deposits. They also include skarn deposits, porphyry deposits, and copper contained sulfide deposits. Although we have no sufficient data about them, most of the projects are low quality. They are not regarded as economically feasible projects for development except Maleevkoe and Artemievskoye.

2. Policy and Role of Geological Ministry to the Undeveloped Projects

According to Geological Minister Mr. Daukeief and top bureaucrat of MinGeo (based on Capital Review dated November 16, 1995), the policy and role of MinGeo on the undeveloped projects are as follows and there is no chage of pohicy.

(1) MinGeo will not perform investment activities in the future. The role of Mingeo is to monitor and evaluate the results of wide area geological surveys.

(2) Publicize information to accelerate exploration and development by foreign corporations (charge for high quality information).

(3) Simplification of the procedure for obtaining license for exploration and development. The company that receives the license is obligated to pay the capital expenses.

(4) Quantity of ore, quality and economic performance are reviewed and officially accepted by an ore reserve committee. The policy and role of MinGeo has changed greatly compared to the age of USSR. The basic structure of the MinGeo organization has not been yet restructured, so there is not much activity in the above-mentioned policies and roles.

The role and current situation of MinGeo , local geological bureaus and state mining organizations are as follows.

MinGeo:

* Grant licenses, approval of ore quality and reserve, evaluation of economic performance, storage of reference materials, supply of information, geological survey, research, ore reserve management.

* Although the budget has been reduced dramatically along with related personnel and operations, restructuring of the organization has not been performed after the country became independent.

Local geological bureau:

* Direct survey work, management, geological survey, storage of reference materials, and ore reserve management according to the budget received from MinGeo.

* Same condition as MinGeo

State mining organization:

* Achievement of work submitted by local geological bureau. Mining by joint venture system with foreign corporation

* The proprietary right of state mining organization (Holding company) will be restructured according to the governmental decision dated October 28, 1995.

3. Current Activity of Mining

The budget of MinGeo was 3.6 billion Tenge in 1994 and reduced to 1.4 billion Tenge (about 23 million dollars) in 1995. In the Mingeo budget, 5% of the budget is for geological survey, 10% is for underground water and monitoring, and the rest is for chemical research, construction and equipment costs. The geological survey conducted by MinGeo does mostly wide area surveys. Base metal mining has been rarely conducted and suspended except the above-mentioned undeveloped projects. Only 11 million Tenge (about 200 thousand dollars) is budgeted for Chatyrkul and Shalkiya.

Foreign mining companies have not yet actively participated in Kazakhstan. Although 3K, Teck, Santa Fe Pacific, BHP and RTZ are trying to acquire the rights for gold mining projects, foreign companies do not appear highly interested in base metals. The current acquisition of licenses (mining and development rights) as of September 1995, was 293 license approvals. The approvals for base metals are 32 cases (18 cases for Pb and Zn and 14 cases for Cu), which is smaller than the 90 and 80 approvals for gold and petroleum, respectively. Although foreign companies are showing an interest to base metals in Kazakhstan, they have been doing little exploration. Therefore, it is believed that base metal exploration in Kazakhstan has almost stopped after independence.

4. Evaluation of Lead/Zinc Mining Projects

In the above 35 undeveloped projects, there are 28 lead/zinc mining projects and seven copper mining projects (including part of projects under development preparation). A comprehensive evaluation is necessary to determine whether these projects should be developed. Development of these projects will contribute to the promotion of the non-ferrous metal industry in Kazakhstan and the world market economy. Further evaluation is

needed to determine whether the suspended mines are profitable for restarting the mining operation. After comprehensive evaluation, based on the ore deposit condition (ore reserve, quality, potential, mineralization, depth), it is necessary to consider the potential economic performance of the project, site condition (infrastructure), legal system, tax system and countermeasure for environment. Presently, a project evaluation team is being conducted by the ore reserve committee. A feasibility report is being completed by the information center. Therefore, it is strongly recommended that "Western" evaluation methods be used for this evaluation. There are 28 lead/zinc mining projects, currently we have only outline information of the projects, therefore we cannot evaluate accurately them. As long as the projects are evaluated in terms of ore reserve and quality alone by Zn equivalent value, seven projects mentioned below have the probability of being a promising project. Now, it is necessary to make a detailed strategic plan for promising resources of copper, zinc and lead.

	Ore reserve (Million Ton)	Cu	Zn	
Yubileyno-Snegihinskoye	4.0	4.55%	5.87%	polymetal
Artemyevskoye	19.9	2.18	8.07	polymetal
Krasnoyarskoe	2.0	1.46	10.13	polymetal
Anismov-KL'uch(Spring)	3.4	3.40	5.33	polymetal
Oburchevskoe	3.8	1.14	8.47	polymetal
Maleevskoye	39.2	2.60	7.83	polymetal
Novo-Beryozovskaya	4.2	2.11	4.65	hydrothermal deposit

These deposits exist in East Kazakh State, which possesses other wide potential for mining. If mining activity is accelerated based on knowledge about the geological deposits, this area is considered to be a potential area which promising deposits will support the future non-ferrous metal industry of Kazakhstan.

5. Summary of issues and proposals for undeveloped projects

(1) Exploration activities of new mines

No exploration activity is implemented under the initiative of the Ministry of Geology. The exploration activities are relied upon foreign enterprises who are not active as far as base metals are concerned. Encouragement of exploration of new mines will eventually serve as a key for solution of the issues of raw materials supply and for the future economic development of the country. The important countermeasures conceived for encouragement of exploration of mimes are as follows:

① Active exploration by foreign enterprises

* Simplified license acquisition procedures.
* Review of the management rules of the National Board of Ore Reserve.
* Incentive grant on the development stage - taxation system etc.

* Improvement of information disclosure method (expansion of range of information available for free of charge). Review and rearrange the currently available information (Introduction of consultants from western countries).

② Active introduction of international institutions and ODA of each country

* Exploration of polymetal mines.

* Implementation of feasibility studies.

③ Establishment of the Exploration Corporation for;

* Support (subsidy and financing) of domestic private enterprises in their exploration activities.

* Technology development and project assessment.

* Promotion of wide area exploration (as for raising of funds support from international organizations, tax assessment on the mining products, or financing secured on the ore production).

(2) Measures to secure raw materials

A reasonable production plan taking into account the current refining capability, production capability and supply capability of ores at the existing mines will make possible stable mining industry and will lead to build up the economic base of the country. Since the grade of ore deposits in Kazakhstan, is considered inferior to those of other countries, in order to be competitive in the market economy, a longer range production plan through the analyses of ore deposit and its grade and based on the identification of economically exploitable ore deposit will be a valid measure for securing raw materials. As for the measures securing raw materials for the time being, it is necessary to make commercially available the high quality mineral deposits, for instance, at Artemyevskoye (referred to above mentioned list) as early as possible.

① Appropriate plan - introduction of support from international organizations and foreign governments

* Analysis of the volume of ore deposit - identification of economically exploitable ore deposit.

* Individual assessment of undeveloped projects and prioritization of exploration.

* Long range planning for raw materials supply - including reviews of effective mine exploration systems, roles of the government/private sectors, and roles of supports from international organizations.

② Measures for privatization of the industrial complex and the nationally owned exploration companies

* System to promote the exploration by privatization Reviews of exploration subsidies, financing for exploration and tax reduction systems.

* Point at issues and their solutions in the current privatization programs.

(3) Review of reorganization of the Ministry of Geology

Reorganization of the Ministry of Geology and review of the method of administration promote new mines exploration appropriate for the long range stable supply of raw materials will be the bases for development of competitive nonferrous metal industries.

Toward this end, the Japanese governmental organizations for the mining exploration and its policies for the promotion of exploration will provide a good reference to above mentioned reorganization and review. Advice from specialists will be also another effective solutions.

Table 2-2-1(1) List of Base Metal Projects in Kazakhstan

NAME OF PROJECTS	METAL KINDS	STAGE	KINDS OF MINERALS	TYPE OF ORE DEPOSITS	GEOLOGY/ORE DEPOSITS	ORE RSVS Mn Tons*	ORE GRADE (Upper)/METAL QUANTITY (Lower)** Cu	Zn	Pb	Au	Ag	Other	REMARKS
1 CHEKMAR	Pb,Zn Cu,Au Ag,Mg,F/S Bi,Cd Te,Ba S	Detailed Expl., Metallurgy Test Compltd. Under Const.	(Principal) Sph,Gn,Py,Ccp (Associated) Asp,Ht,Mt, Low grade ore	Altay Type Hydrothermal Polymetal	Three volcanic-sedimentary mineralzd formations, Guslyakovsky, Chekmar (Upper), South-Eastern(Lower). 88 % of TTL ore resvs contained in Chekmar. Inclined length of ore body, 120-400m, vertical depth from surface 0-620 m.	C1:91.6 C2:19.0	0.22% 198 kt 0.43% 81 kt	2.17% 1988 kt 2.07% 393 kt	0.80%(0.28g/t) 729 kt (28.8 t) 0.76% 144 kt		11.2 g/t 1016 t 15.3 g/t 233 t	Cd:% .007 Bar	Location:East-Kazakhstan State,46 km north of Leninogorsk city, 650-1050 m above sea level. J/V partner:Leninogorsky Polymetallic Combine. Mining method:O.P.(Mining right already obtained) Total drill length:268.5 thous. m, underground exploration:3 levels. Expected TTL explortn budget:US$13.87 Mn
2 NOVO-LENINOGORSKOYE	Pb,Zn Cu	Detailed Expl., Metallurgy Test completed. Under Const.	(Principal) Sph,Gn,Py,Ccp	Stratiform Pyrite-bearing Polymetal	7 ore beds in Silurian and lower/ middle Devonian volcanic-sedimentary formations. They belong to Leninogorsk ore deposit group. Three major deposits (Surovskaya, Bogataya, Baryte) represents 96 % of TTL ore reserve. Subordinate deposits are Nadejda, Zapadnaya, Severnaya, Uspenskaya. Length of each ore body, 70-300 m, thickness 9.5-31.3m. There are two kinds of ores, baryte-polymetalic ore/polymetalic ore.	C1:35.0 C2:16.1	0.16% 55 kt 0.19% 31 kt	4.05% 1418 kt 2.47% 397 kt	1.44% 503 kt 0.71% 114 kt		32.5 g/t 953 t 16.4 g/t 280 t		Location:East-Kazakhstan State, Golubokovsky district, in gently sloped valley, 10 km east of Leninogorsk city. Mining method:U.G.(Mining right unobtnd) Expected TTL explortn budget:US$16.5 Mn.
3 YUBILEINO-SNEGIRIHINSKOYE	Cu Pb,Zn Se,Bi Cd,S Te,Ba	Detailed Expl., Metallurgy Test F/S Compltd. Under Const.	(Principal) Py,Ccp,Sph,Gn (Accessory) S,Au,Ag,Cd,Bi, Se,Te,Bar (Asp,Pyrr,Mar,Bis)	Altay Type Hydrothermal Polymetal	Shale ore in middle Devonian Shipunov sedimentary/volcanic sedimentary formations. Principal 4 deposits and small lenses stretching in WSW direction, steeply dipping SE. Dimension of ore deposits, horizontal length 20-260m, inclined length 50-360m, thickness 3.5-5.9m, depth 10-340m. Oxidized zone, 0-60m.	B+C1: 4.0 C2: 0.3	4.55% 183 kt 3.43% 12 kt	5.87% 237 kt 2.24% 8 kt	0.89%(0.76g/t) 36 kt (3.35 t) 0.32% 1 kt		49.9 g/t 201 t	Bar: 5.2%	Location:East-Kazakhstan State, 110 km from Ust-Kamenogorsk city. Mining right already obtained. J/V partner:Irtysh Polymetal JSC. Mining method:U.G. Exploration:underground(2 levels)/ drilling(TTL length 75.7 thous. m) Expected TTL explortn budget:US$5.1 Mn.
4 ARTEMIEVSKOYE	Cu Pb,Zn	Detailed Expl., Under Shaft Sinking.	(Principal) Py,Ccp,Sph,Gn (Accessory) Asp,Magnetite	Polymetal	7 ore beds in Devonian volcanic sediments, stretching in 4 km length, gently dipping SE. Depth from surface, 0-800 m.	C1:19.9 C2:0.61	2.18% 435 kt 0.67% 4 kt	7.54% 1370 kt 5.53% 505.4 kt	2.18% 435 kt 2.22% 14 kt	1.8 g/t 27.47 t 0.7 g/t 6.0 t	121.5 g/t 2422 t 1671.6g/t 1023 t		Location:East-Kazakhstan State, 400 m a.s.l. J/V partner:East-Kazakhstan Cheaical and Metallurgical Combine. Mining method:U.G.(Mining right unobtained). Infra.:Well developed.
5 KRASNOYARSKOE	Cu Pb,Zn	Exploration in Early Stage	(Principal) Ccp,Gn,Py,Sph (Accessory) Magnetite,Pyrr low grade ore	Polymetal Hydrothermal	Deposits in middle/late Devonian, highly slatinized volcanic sediments Located in Novo-Beryozovsky district 8 deposits stretching SW with steep dip, 250-860 m length, 100-650 m depth.	C1:0.35 C2:1.62	2.23% 8 kt 1.30% 21 kt	(10.13%) (199.6) (kt)	3.06% 11 kt 1.40% 23 kt	0.3 g/t 0.135 t 0.2 g/t 0.1 t	(110.8) (g/t) (218.3t)	Cd:% .025 0.04 Sb:% 0.30 0.38	Location:East-Kazakhstan State, 55 km NW of Ust-Kamenogorsk city, 4 km from Predgornoye railway station. Mining method:U.G.(Mining right unobtained). Infra:In southern part, economically well developed.
6 ANTISIMOV-KL'UCH(KEY)	Cu,Zn Pb,Au Ag,Se Te,Bi S,Cd	Detailed Expl.	(Principal) Py,Sph,Ccp,Gn (Accessory) Mt,Ht,Tet,Asp, Bor,Ruthenium, Gold nugget	Altay Type Hydrothermal Polymetal	Hydrothermal ore deposits in middle Devonian shale, situated in NE wing of Platonov anticline. There are 3 lens-shaped stratiform ore deposits steeply dipping NE with thickness 4.2-15.1 m, depth of 120-550 m.	C1:3.04 C2:0.41	3.01% 94 kt 5.47% 22 kt	(5.33%) (181.3) (kt)	0.73%(0.28g/t) 22 kt (1.0 t) 0.71% 3 kt		37.1 g/t 113 t 30.3 g/t 12.3 t		Location:East-Kazakhstan State,110 km NE of Ust-Kamenogorsk city, 4 km from Yubileino-Snegirikhinskoye ore deposit, 100 km NE of Belousovsk smelter. J/V partner:Irtysh Polymetal JSC. Mining method:U.G.(Mining right obtnd) Infra:Economically well developed area, but no power line.

*:( ); Calculated from flwg formula:Metal quantity x 1/Ore grade **:( );Calculated by flwg formula:Ore reserve x Ore grade or Reference from other data

NAME OF PROJECTS	METAL KINDS	STAGE	KINDS OF MINERALS	TYPE OF ORE DEPOSITS	GEOLOGY/ORE DEPOSITS	ORE RSVS Mo Tons*	ORE GRADE (Upper)/METAL QUANTITY (Lower)** Cu	Zn	Pb	Au	Ag	Other	REMARKS
7 RULIKHINSKOE	Cu Pb, Zn	Explortn Stage	(Principal) Py, Sph, Ccp, Gn (Accessory) Bor, Ccc	Pyrite-bearing Polymetal	2 ore beds in Devonian volcanic sediments gently dipping with depth 40-400 m.	C1:0.51 C2:1.72	0.93% 5 kt 2.18% 38 kt	8.9% 57.6 kt	1.96% 10 kt 1.10% 19 kt	0.55 g/t 0.4 t	59.72 g/t 38.7 t		Location:East-Kazakhstan State, open slightly hilly area with altitude 360-400 m a.s.l. Situated 10 km E of of East-Kazakhstan Chemical and Copper Combine. Mining method:U.G. (Mining right unobtnd) Infra:Economically well developed area.
8 OBURCHEVSKOE	Pb, Zn Cu, Ag Au, Cd S	Detailed Expl.	(Principal) Sph, Gn, Py, Ccp (Accessory) Small quantity of low grade ore, Electrum	Altay Type Hydrothermal Polymetal	2 sheets of gently dipping ore beds at wing of Ridder-Sokolsk Brahikupol structure in Devonian volcanic sediments. Depth, 790-1100 m.	C1:0.96 C2:2.73	1.30% 13 kt 1.10% 30 kt	(C1+C2:) (8.47%) (318.1) (kt)	5.36% 52 kt 2.27% 62 kt	(C1+C2:) (0.46g/t) (1.7 t)	32.7 g/t 32 t 18.3 g/t 50 t	Bi Se Hg	Location:East-Kazakhstan State, 7 km SE of Leninogorsk city. Situated on mountain slope close to Novo-Leninogorsk deposit. Mining method:U.G. (Mining right unobtnd)
9 DOLINNOE	Au, Cu Pb, Zn Ag, Cd Bi, Se	Under Detailed Exploration	(Principal) Sph, Gn, Ccp, Py (Accessory) Low grade ore, Electrum	Altay Type Hydrothermal Polymetal	2 vein and disseminated types of ore body in Devonian volcanic sediments. Depth, 450-650 m.	C1:1.75 C2:5.47	0.26% 5 kt 0.22% 12 kt	(C1+C2:) (2.74%) (75.6kt)	0.88% 15 kt 0.78% 43 kt	(C1+C2:) (7.63g/t) (21.1 t)	82.3 g/t 120 t	Sb Mo	Location:East-Kazakhstan State, 6 km E of Leninogorsk city. Situated in even relief valley, partially swampy. Mining method:U.G. (Mining right unobtnd) Infra:Economically well developed area.
10 STREZHANSKOE	Pb, Zn	Detailed Expl.	(Principal) Sph, Ccp, Gn, Py (Accessory) Asp, Pyrr, Marcasite, Low grade ore	Altay Type Hydrothermal Polymetal	20 ore deposits steeply dipping NE. in Devonian volcanic sediments. Depth, 10-310 m.	C1:2.50 C2:2.33	1.85% 47 kt 1.64% 38 kt	(4.40%) (212.4) (kt)	0.86% 22 kt 0.70% 16 kt	(0.54g/t) (2.6 t)	57.1 g/t 143 t 53.8 g/t 125 t	Sb, Cd Se Te In	Location:East-Kazakhstan State, 28 km NE of Leninogorsk city. Altitude, 650-1080 m a.s.l. Mining method:U.G. (Mining right unobtnd) Infra:Economically well developed area.
11 VAVILONSKOE	Cu	Under Exploration	(Principal) Pyrr, Ccp, Ccc (Accessory) Py, Sph, Magnetite, Asp	Copper-Pyrrhotite	9 stratiform ore deposits steeply dipping SW with aver. thickness 7 m, depth 0-450 m. Ore deposits composed of massive (87 %), disseminated (13 %).	C1:3.82 C2:5.27	1.07% 41 kt 1.75% 92 kt						Location:East-Kazakhstan State, 60 km SW of Shemonaiha city. Slightly hilly with altitude, 250-400 m. Mining method:O.P. (Mining right unobtnd) Infra:Economically well developed area.
12 KARCHIGINSKOE	Cu	Under Exploration	(Principal) Ccp, Py, Pyrr (Accessory) Sph, Asp	Copper-Pyrrhotite	Ore deposits situated 2-10 km apart in same horizon, gently dipping NE with 20-30 degrees. Exploration executed upto 200 m depth.	B+C1: 4.02 C2:1.09	2.72% 109 kt 2.99% 33 kt	0.31% 10.9 kt 0.31% 8.7 kt		1.01 g/t 4.05 t	5.5 g/t 28 t		Location:East-Kazakhstan State, hilly area with altitude 1000-1200 m a.s.l. Mining method:O.P. (Applying for mining right). Infra:Economically undeveloped area.
13 MALEEVSKOE	Pb, Zn Cu, Cd Bi	Detailed Expl., F/S Completed. Under Const.	(Principal) Gn, Sph, Ccp, Py (Accessory) Asp, Tennantite, Tetrahedrite, Pyrr	Hydrothermal Polymetal	3 ore deposit groups which composed of 2-15 ore deposits gently/steeply dipping NNE. Oxidation zone reaches upto 20-25 m depth.	C1:39.2 C2:5.52	2.60% 1018 kt 1.39% 77 kt	(7.83%) (3514.7) (kt)	1.19% 466 kt 1.59% 88 kt	(0.54g/t) (24.4 t)	78.4 g/t 3074 t 68.9 g/t 270 t	Bar: 6.6%	Location:East-Kazakhstan State, 20 km N of Zyryanovsk city, situated at rocky hill with altitude 450-950 m. J/V partner:Zyryanovsk Lead Combine. Mining method:O.P. (Mining right obtnd) Infra:Economically developed area. Power is suppliable from Bukhtarma Hydro-electric Power Station/Ust-Kamenogorsk city.
14 NIKITINSKOE	Pb, Zn Cu	Under Explortn/ Evaluation	(Principal) Py, Sph, Gn, Ccp (Accessory) Pyrr, Pentlandite	Pyrite-Polymetal	Hydrothermally altered ore body with small-scaled intrusion. Mineralization is localized in silicate/carbonate-silicate rocks.	C2:1.42	0.90% 13 kt	2.63% 37.4 kt	2.26% 32 kt				Location:East-Kazakhstan State, at rocky area with altitude 2000-2900 m a.s.l. Mining right: unobtained. Infra:Economically not well developed.
15 AKTOGAI	Cu, Mo	Detailed Expl., F/S Completed.	Ccp, Py, Molybdenite	Porphyry-Copper	Quartzose stockwork in granitic rocks having ring structure with diameter 2.5 km, area 5 square km.	B+C1: 1528.3	0.39% 5885 kt			0.03 g/t 43.95 t	1.03 g/t 1576 t	Mo:% 0.008 121.7 kt	Location:Semipalatinskaya State, 420 km E of Balkhash Smelter. Situated on semi-arid hills with altitude 500-520 m a.s.l Mining method:O.P. (Mining right, obtained by Kazamerican Mining Company Inc.) Infra:Unpopulated/undeveloped.
16 AIDARLY	Cu, Mo	Detailed Expl., F/S Completed.	Ccp, Py, Molybdenite	Porphyry-Copper	Belongs to Aktogai ore deposit zone, composed of ellipsoidal quartzose stockwork with unmineralized core in center. Area of ore-hydrithermally altered granitic rocks, 5 square km.	B+C1: 1529.3	0.38% 5871 kt			C2: 0.014 g/t 14.14 t	1.79 g/t 2169 t	Mo:% 0.01 154.3 kt	Location:10 km SE of Aktogai city. Mining method: O.P. (Mining right, obtnd by Kazamerican Mining Company Inc.) Infra:Power is obtainable from Kapchagai Hydro-electric Power Station.

*:( ); Calculated from flwg formula:Metal quantity x 1/Ore grade

**:( ):Calculated by flwg formula:Ore reserve x Ore grade or Reference from other data

NAME OF PROJECTS	METAL KINDS	STAGE	KINDS OF MINERALS	TYPE OF ORE DEPOSITS	GEOLOGY/ORE DEPOSITS	ORE RSVS Mn Tons*	ORE GRADE (Upper)/METAL QUANTITY (Lower)** Cu	Zn	Pb	Au	Ag	Other	REMARKS
17 AKBASTAU	Cu,Zn (Au)	Detailed Expl., F/S Completed.	(Principal) Py,Ccp,Sph (Accessory) Gn,Bor	Pyrite-Copper	3 ore deposit groups consisting of 14 ore deposits steeply dipping E. Oxide ore covers 40 % of total ore reserve.	C1:9.30 C2:3.18	1.77% 165 kt 1.71% 55 kt	6.1% 219.5 kt 3.48% 15.8 kt	0.9% 33.9 kt 0.55% 2.5 kt	0.75 g/t 2.7 t 0.5 g/t 0.17 t	15.1 g/t 141 t 13.8 g/t 44 t		Location:Semipalatinskaya State,430 km NE of Almaty city situated on small hills with altitude 775-900 m. Mining method: O.P. and U.G.(Mining right, obtained by Akkus JSC.) Infra:Unpopulated/undeveloped area. Water suppliable from 100 km distance.
18 KOSMURUN	Cu,Zn (Au)	Detailed Expl., F/S Completed.	(Principal) Ccp,Sph (Accessory) Gn,Molybdenite ,Pyrr	Pyrite-Copper	2 ore zones captured having post-formed structure.High grade gold ore body discovered in oxidation zone.	C1:19.1 C2:1.86	3.37% 645 kt 2.89% 54 kt	0.74% 216.4 kt 0.89% 35.74 kt		14.3 g/t 17.9 g/t	20.0 g/t 383 t 20.0 g/t 37 t		Location:Semipalatinskaya State. Mining right:Obtained by Akkus JSC. Mining method: O.P. and U.G.
19 MIZEK	Au,Ag	Under Explortn/ Evaluation	(Principal) Py,Ccp,Sph,Gn	Gold-Polymetal	Deposit is hosted in Upper Ordovician crushed anticlinal structure. Exploration reaches upto 500 m depth	C2:6.84	1.11% 76 kt	0.34% 27.56 kt	0.02% 1 kt	5.38 g/t 43.7 t	4.29 g/t 29 t		Location:Semipalatinskaya State,330 km SW of Semipalatinsk city.Geography,small hills with altitude 900-1000 m.a.s.l. Mining method: O.P. and U.G. Infra:Unpopulated/undeveloped area.
20 RADNIKOVAYE-MESTORODHENIE-SVINZA Y ZINKA	Pb,Zn Ag	Under Expl. based on C2 category in which 50 % was transferred to C1 category.	(Principal) Gn,Sph (Accessory) Py,Ccp,Mo Cerussite in oxide zone,	Quartz-Sericite Bearing Hydrothermal Vein	3 steeply dipping network or vein type ore deposits developed in frame of Devonian rhyolite, dacite and porphyllite with width 1000 m, thickness 20 m. Oxidation,0-20 m. Exploration executed to 500 m depth.	C2+P1: 22.7 (C2:2.0)		1.97% 447.8 kt (2%) (40 kt)	6.59% 1494.4kt (10%) (200 kt)		17.6 g/t 399.8 t	Cd:% 0.01 Mo:% .016	Location:Janbul State,33 km SE of Aksuek village. Exploration/mining right:Hold by "Asier" Geological Research Company till Jan 17, 1996.Concession area,30 square km. Total drill length:18000 m.Past expenditure for exploration,US$3 Mn. Mining method:O.P.(to 100 m depth) and U.G. Infra:30 km from railway station,18 km from 110 KV transmission line.
21 IRISU	Cu,Fe Co,Au	Under Expl. based on C2 category, partially C1.	Magnetite,Ccp,Py,Pyrr	Skarn	Contact metasomatic deposit originated in contact part of carbonate rocks and basic rocks intruded therein.Exploration executed upto 300-400 m depth.	C2:250	0.3% (750 kt)			0.13 g/t (32.5 t)	1.2 g/t 45.1 t	Fe:48% Co:% .033	Location:Chimkent State. Mining right: Unobtained.
22 SHALKIA	Pb,Zn	Detailed Expl.	Gn,Sph,Py		2 gently dipping ore deposits in Carboniferous carbonate rocks. Having outcrop, it reaches 700 m depth with 5 km length. Depth of oxidation,50 m.	B+C1:		3.5%	B: 1% 703.6 kt C1:0.67% 122.8 kt	0.01-0.08 g/t	3.13 g/t 258.4 t 3.13 g/t 57.6 t		Location:Kisil・Orda State. Mining right: Unobtained.
23 BORLY	Mo,Cu S,Re Se	Detailed Expl.	(Principal) Py,Ccp,Mo (Accessory) Sph,Gn,Bor,Ccc ,Pyrr,Malachite,Ilmenite	Porphyry-Copper	2 corn type ore deposits accompanied by granodioritic porphyry. Size,450x800 m and 120x260 m,depth more than 600 m.Oxidation,38 m.	A+B+C1+ C2:94.4	0.34% 317.3 kt			0.03 g/t 2.8 t	3.4 g/t 314.1 t	Mo:% .011 Re: .4g/t	Location:Dhezkazgan State,50 km NW of Balkhash city. Infra:30 km to Kounrad where railway available,8 km to Barli highway where power transmission available. Mining method: O.P.
24 KARATASSKATA Group	Cu,Mo Au,Ag S,In Re,Se Te	Detailed Expl.	(Principal) Ccp,Mo, Magnetite (Accessory) Py,Ht,Mal,Lim	Skarn	4 ore deposits in granodiorite and porphyrry.	A+B+C1+ C2:82.4	(0.33%) 273.8 kt			0.01 g/t 1.0 t	6.5 g/t 498.2 t	Mo:% .041	Location:Dhezkazgan State,Priozersk district,10 km W of Balkhash city. Infra:45 km NE to Sara-Kum railway station,40 km E to highway.
25 ZYRYANOVSKOYE	Zn,Pb Cu,Sn Sb,Hg Bi,Cd S,Te	Under Expl.	(Principal) Ccp,Sph,Py (Accessory) Tet,Ten,Mcs, Asp,Mt,Mo	Altay Type Hydrothermal	Steeply dipping ore deposits develped in wing and joint of anticlinal structure in Middle Devonian volcanic sediments.	A+B+C1+ C2:60.5	0.18% 112.1 kt	1.55% 939.8 kt	0.75% 460.2 kt	0.12 g/t 7.6 t	16.0 g/t 970.3 t		Location:East-Kazakhstan State.in concession area of Zyryanovsk Cosbine. Mining method: U.G. Infra:Developed area for mining.
26 GREHOVSKOYE	Pb,Zn Cu,Sn Cd,Sb Ag,Te	Under Expl.	(Principal) Gn,Sph (Accessory) Pyrr,Tet,Ten, Py,Mcs,Asp	Hydrothermal	Steeply dipping lens or ribbon-form ore deposits in anticlinal structure in strongly slatinized volcanic sediments of Middle Devonian.	A+B+C1+ C2:52.0	0.68% 351.3 kt	1.75% 907.7 kt	0.51% 267.1 kt	0.11 g/t 5.9 t	8.8 g/t 457.3 t		Location:East-Kazakhstan State.12 km SE of Zyryanovsk city. Mining method: U.G. Infra: Connects to Zyryanovsk city by highway.

*:( ); Calculated from flwg formula:Metal quantity x 1/Ore grade

**:( );Calculated by flwg formula:Ore reserve x Ore grade or Reference from other data

NAME OF PROJECTS	METAL KINDS	STAGE	KINDS OF MINERALS	TYPE OF ORE DEPOSITS	GEOLOGY/ORE DEPOSITS	ORE RSVS Mn Tons*	ORE GRADE (Upper)/METAL QUANTITY (Lower)** Cu	Zn	Pb	Au	Ag	Other	REMARKS
27 MAYSKOYE	Pb, Zn, Cu, Cd	Detailed Expl.	(Principal) Sph, Gn, Ccp, Py (Accessory) Anglesite, Asp, Cerussite, Plumojarosite	Altay-Type Hydrothermal	Developed in Middle Devonian strongly slatinized volcanic sediments. Steeply dipping belt-type ore deposits located in east wing of Revniushinsky anticlinal structure with length 200-860 m.	22.9	0.13% 30.8 kt	1.96% 448.1 kt	0.75% 171.1 kt	0.28 g/t	32.9 g/t 753.4 t	Cd	Location: East-Kazakhstan State, 14 km E of Zyryanovsk railway station. Mining method: U.G. Infra: connected to city by road, economically developed area.
28 NOVO-BERYOZOVSKAYA	Zn, Cu, Pb, Sb, Bi, S, Cd	Reserved for Exploitation	(Principal) Py, Pyrr, Sph, Ccp (Accessory) Gn, Ten, Bar, Bis, Mo, Galenobismuthinite	Altay-Type Hydrothermal	Vein-type ore deposits steeply dipping W in Middle/Late Devonian volcanic sediments. Width, 180-400 m, length, 540-820 m.	4.2	2.11% 88.5 kt	4.65% 195.3 kt	0.14% 6.0 kt	0.39 g/t 1.6 t	15.8 g/t 66.4 t		Location: East-Kazakhstan State, 8 km NW of Pryedgornoye station. Geography: 350-550 m a.s.l. Infra: Economically developed area.
29 MIRGALIMSAY	Pb, Au, Se, Te, In, Tl, Ge, Ba	Reserved for Exploitation	(Principal) Gn, Sph, Py	Stratiform Pb/Zn Deposit in Carbonate Rocks	Stratiform ore deposits situated in wing of Kenkol anticlinal zone. Surface extension, 8600 m, gently/steeply dipping with inclined length 1700 m.	68.1		0.67% 456.3 kt	1.17% 795.8 kt		17.3 g/t 1178 t	Bar: 8.6%	Location: Chimkentskaya State, Turkenstan District, close to Kentau city. Infra: Economically developed area.
30 YABLONOVOYE	Pb, Zn, Ag, Te, Tl, Ge	In Early Stage of Exploration Stage	(Principal) Py, Sph, Gn, Lim (Accessory) Ccp	Proterozoic Carbonaceous/ Carbonate Stratiform Deposit	Many steeply dipping belt-type ore deposits with width 12-240 m, inclined length 12-225 m, thickness 2.3-3.3 m.	3.0		3.13-4.8 % 150.8 kt	3.22% 95.3 kt		56.8 g/t (170.4 t)		Location: Taldy-Korganskaya State, 10 km E of Tekely railway station. Geography: Altitude, 1300-1550 m a.s.l. Infra: Economically developed area.
31 KOKSAY	Cu, Mo, S, Re, Se, Te	Expl. Completed Reserved for Exploitation	(Principal) Ccp, Py, Mo, Bor, Mt (Accessory) Gn, Sph, Cov, Ht, Tungstenite	Porphyry-Copper in Granodiorite /Porphyry	Developed with hydrothermal eruption in northern periphery of grano-diorite/porphyry. Size of rock stock, 170m x 2100m (dip 9 degrees) x depth over 1200 m.	(321.5)	0.51% 1639.6kt			0.12 g/t 37.2 t	1.24 g/t 396 t	Mo: 0.005 %	Location: Taldy-Korganskaya State, Gvardey district, 50 km NE of Sary-Ozec railway station. Altitude: 1260-1400 m a.s.l. Infra: Economically developed area, 18 km from 110 KV transmission sidetrack.
32 DHELANDINSKAYA Group	Cu, Au	Detailed Expl. Reserved for Exploitation	(Principal) Bor, Ccp (Accessory) Py, Gn, Sph, Cov, Mal, Az	Stratiform in Sand stone/ Carbonate silt stone	Stratiform deposits developed in north wing of Dhezkazgan geosyncline composed of compact rocks.	168.0	1.37% 2305.5 kt				15.3 g/t 2571.8 t		Location: Dhezkazgan State, Dhezdin district, 35 km N of Dhezkazgan ore deposit.
33 DHAMAN-AIBATSKOYE	Cu, Pb, Ag	In Early Stage of Exploration	(Principal) Ccp, Py, Gn (Accessory) Cov, Mal	Stratiform in Sand stone/ Silt stone	10 belt-type ore beds developed in Dhaman-Aibat anticline.	C1+C2: 217.0	1.66% 3610.8 kt		0.23% 500.1 kt		20.8 g/t 4715 t	Reg/t 1.46 S: % 0.75	Location: Dhezkazgan State, Dhana-Arkinsky district, 160 km SE of Dhezkazgan ore deposit. Infra: Economically undeveloped area.
34 SHUBINSKOYE	Zn, Cu, Pb, Cd, Te, Se, Bi	Under Construction	(Principal) Sph, Ccp, Py, Gn (Accessory) Asp, Mcs, Low grade ore	Altay-Type Hydrothermal	Steeply dipping vein type ore deposits located between two layers in fractured zone.	3.4	2.20% 75.0 kt	3.98% 135.4 kt	0.66% 19.1 kt	0.5 g/t 1.7 t	20 g/t 67.6 t	Cd/Te Se/Bi	Location: East-Kazakhstan State, 14 km from Leninogorsk railway station. Geography: Vast/gentle hills of altitude 1000-1110 m a.s.l. Cd: 244 g/t, Te: 9 g/t, Se: 17 g/t, Bi: 54 g/t
35 AKZHAL	Zn, Pb (Au, Ag, Cd)	In operation since 1950	(Principal) Gn, Sph (Accessory) Pyrr, freiberg-ite, polybazyte, native silver	Hydrothermal Polymetal	Vein-Disseminated ore bodies are located in carbonate rocks having interstratum and lens shaped form.	B: 0.654 C1: 25.57 26.226 C2: 4.795		4.84% 1270.1kt 4.75% 202.7kt	1.17% 306.6 kt 1.06% 23.5 kt	0.14 g/t 18.445 t 0.14 g/t 3.375 t	41.66 g/t 768.4 t 22.9 g/t 566.4 t	Cd: % 0.04 11 kt 0.01 1.8kt	Location: Dhezkazgan State, 130 km north from Balkhash city. Open pit. Proposed production 900,000 tons of ore/year.

*: ( ): Calculated from flwg formula: Metal quantity x 1/Ore grade

**: ( ): Calculated by flwg formula: Ore reserve x Ore grade or Reference from other data

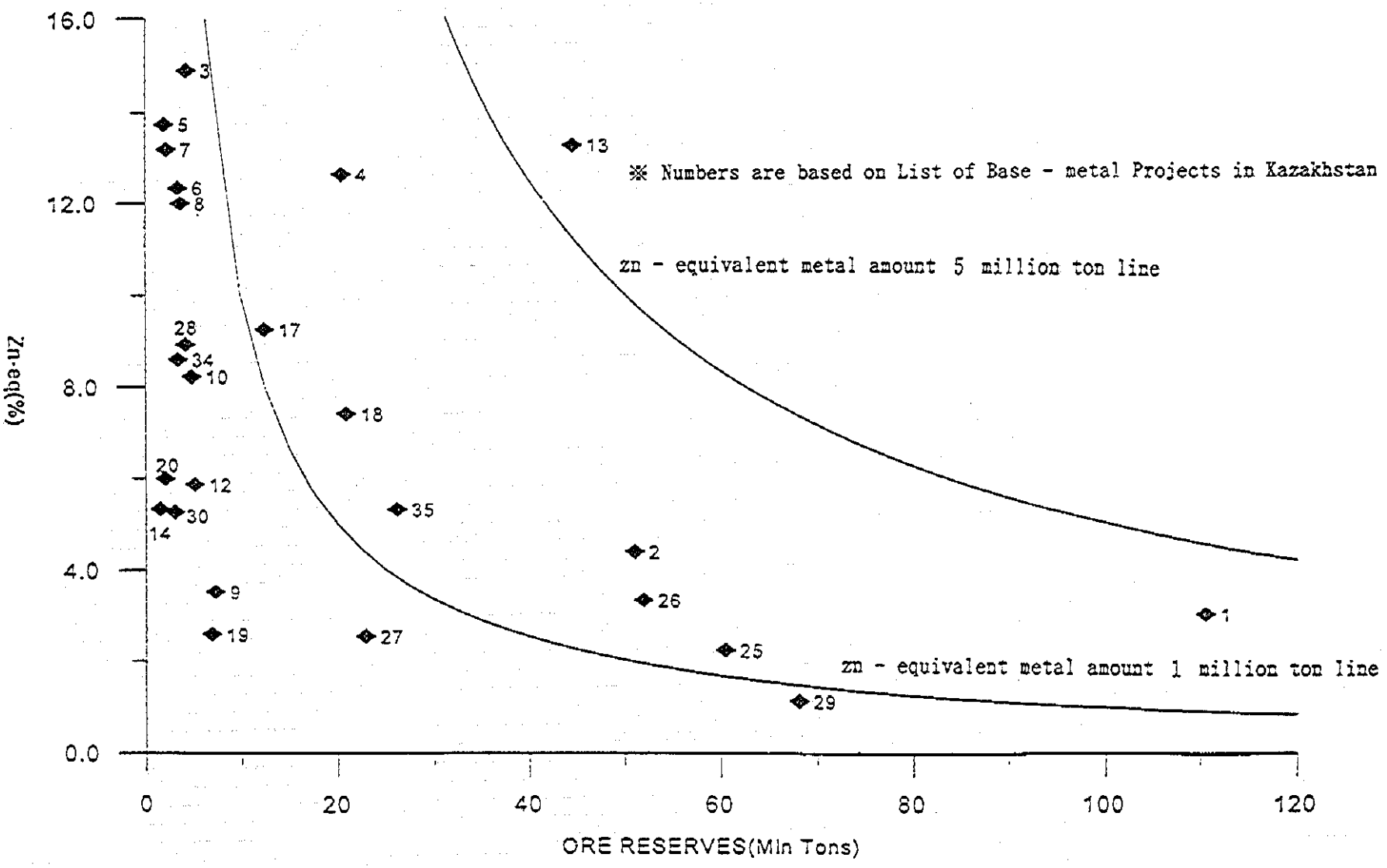


Fig.2-2-1(1) Kazakhstan Undeveloped Ore Deposit Zn-equivalent Grade and Ore Reserve Relationship Diagram