2-2-2 Deposits Under Development

(1) Koktau - Chilisai

The ore deposit of the Koktau is located about 140km by road to the east of the town of Aktubinsk, which is the capital city of the Aktubinskaya Province.

As a concentrator for the mine, Chilisai is located about 160 km to the southwest of the Koktau Mine by rail or 280 km by road, formerly operated for beneficiation of phosphorous ore but has been now upgraded for treatment of sulphide ore.

1) Geology and Ore Resources

The ore deposit of the Koktau is located at the latitude of 49° 30'N and the longitude of 57° 30'E, near the town of Oktyabr'sk in Aktubinskaya Province. There are famous chromite and nickel mines for approximately 50 km to the west. The mine has been licensed to the JSC "Balkhashmed" for exploitation. The nearest concentrator and smelter is, Balkhash which is about 450 km by railway.

It is a dry, steppe area having a continental climate. The altitude of the deposit area is 235-290 m above sea level. The topography shows gentle rolling hills and is crossed by the River Orb, which flows all year round and has been dammed.

The ore deposit is a cupriferous iron sulfide and massive sulfide. It is in the boundary between metamorphosed basic rocks of Silurian age and granodiorites of Devonian age and is capped by an acidic rock, sericite silicified dacite. It has three orebodies, Northern, Central and Southern all of which are aligned along NNE-SSW axes.

The southern, the largest one, which shows 88 % of the ore reserve of Koktau, strikes NE-SW and dips 60° N. The orebody is separated into two kinds of layered ore. The upper part is rich in chalcopyrite and lower is rich in pyrite(Fig.2-2-2(1)).

The geological ore reserve of the Koktau is 46 million tons(C1+C2) at an average grade of 1.83 % Cu (Table 2-2-2(1)).

Table 2-2-2(1) Reserve of the Koktau Deposit(as of 1979)

	Southern			Central			Northern	Total		
Category	C1	C2	C1+C2	C1	C2	C1+C2	C2	C1	C2	C1+C2
Ores(mil.T)	37.4	2.3	39.69	2.5	1.5	4.0	2.78	39.9	6.59	46.47
Copper(%)	1.87	2.04	1.88	1.19	1.60	1.34	1.77	1.83	1.83	1.83
Metal (th.T)	699.0	47.1	746.1	29.8	24.0	53.8	49.2	728.8	120.3	849.1
Sulfur(%)	37.4	34.6	37.2	36.2	28.4	33.3	41.7	37.3	36.2	37.2

Density of Ore: 4.1t/m³ Density of Waste: 2.8t/m³

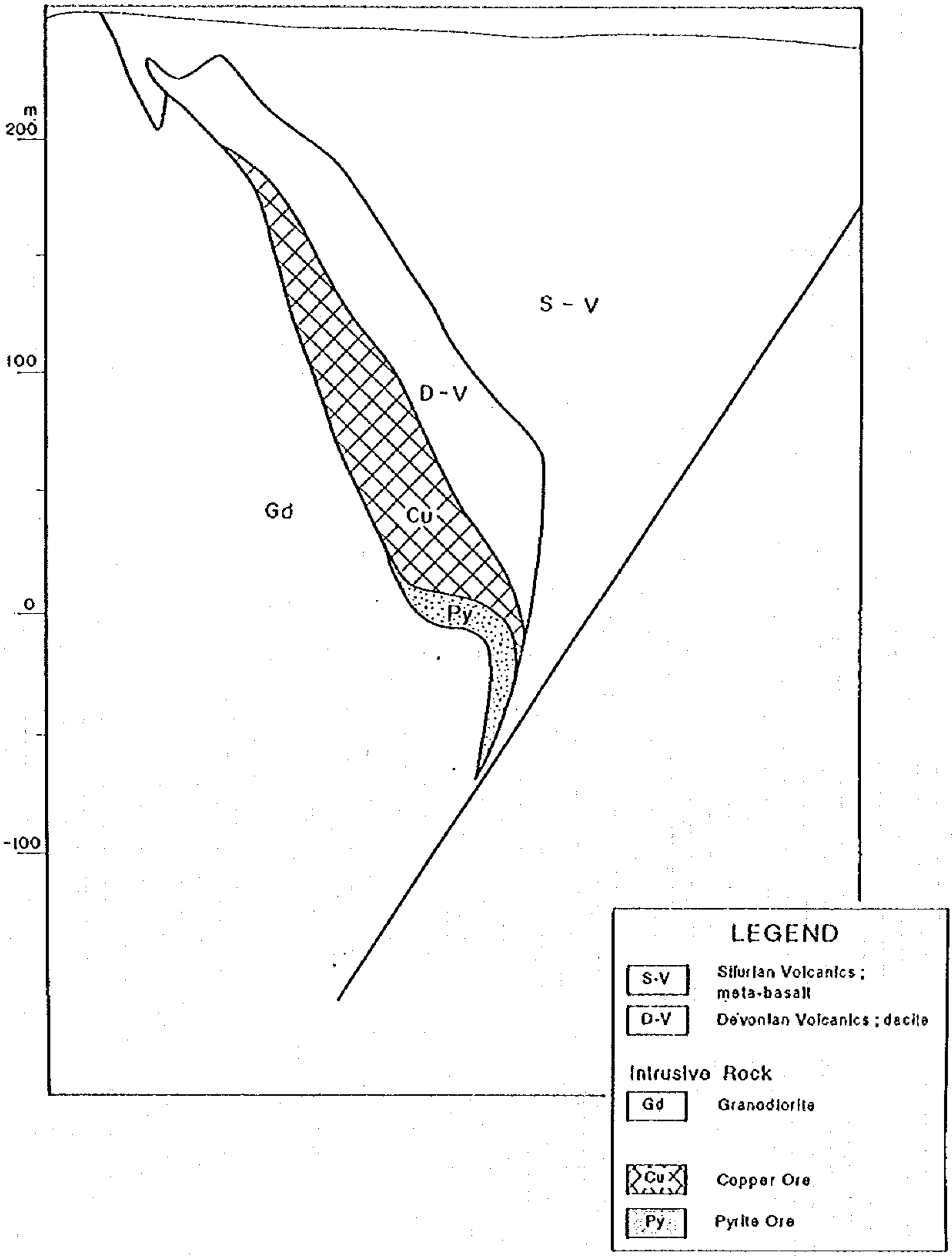

Fig. 2-2-2(1) Schematic Cross-Section of Koktau (1:2,500)

2) Concentrator

The Chilisai concentrator used to be a plant for phosphate ores, but is no longer profitable because of the demand decline influenced by the collapse of the former Soviet Union. On the other hand Balkhash does not have enough copper concentrates to feed the smelter. It is therefore intended to develop the Koktau copper mine, and to transport ore by rail approximately 160km northeast to the Chilisai concentrator, and to modify the concentrator to produce copper concentrates that will be transported to Balkhash.

According to the plan, the plant will treat 2.3 million tons of ore and produce copper concentrates containing 35 thousand tons of copper annually. Approximately 80 to 90 % of the modification work of 18 million rubles (budgeted in 1991) has been completed while the main remaining jobs are the construction of a tailing dam and pre-stripping of the open pit. The projected copper recovery is between 83 and 87% with concentrate grades being as low as 20 % Cu which is reportedly higher than that of a Russian concentrator which is located nearby.

Originally the Chilisai plant was designed to treat 6 million tons of phosphate ores, and the existing flotation cells have not been used since installation in 1985. Concerning infrastructure, its water supply is from water wells located 40km away, and they purchase electric power from both Kazakhstan and Russia at a cost of 3 Tenge per kWh. Due to the severe winter weather, the product will not be shipped during the months from November to March.

3) Development and Operation Plan

In 1979, higher parts of the Central and Southern Orebodies are planned to be mined by open pit. The mineable ore reserve in the open pit is 32 million tons at an average grade of 1.76 % Cu. Other ores are planned to be mined by an underground mine.

The dimension of the open pit are as follows.

Length and width of surface: 2,000m × 1,000m

Length and width of bottom: 100m × 50m

Elevation of Top: 260m above sea level

Depth of bottom: 315m

Overall angle of pit: 36°

The orebody is covered with thick metamorphosed basic rock, around 100 m or more in thickness more. As a result, the volume of the waste is 91 million m^3 and the waste ratio is high($9.6m^3/m^3$).

4) Progress of Development and Construction

The railway to the Deposit was completed in 1984. Operations for development and construction have started and overburden of 2 million m^3 has been removed. But working has stopped due to lack of money.

The Koktau and Chilisai Projects appear to be well advanced compared to other projects and are expected to become a new source of raw material for the JSC "Balkhashmed" in the near future. An urgent is required decision on whether or not to further develop the mine.

5) Economic Assessment

Detailed economic assessments including discounted cash flows have not been done. Economic figures in a Report of 1979 and according to verbal presentations at the mine site are as follows.

Maximum production rate of ores: 2.3 million tons/year

Production rate of concentrates: 184,000 ton/year

Grade of copper concentrate: 20.4%

Recovery into copper concentrate: 83-85%

Workers in the mine: 340 including 80 at the pit face and 76 engineers and technicians

Mine operating cost: 2.5 US$

Capital investment: 11 million

Although a railway to the mine has been completed, the transportation cost in the future is the most important factor for the viability of this project, because the distances between mine and concentrator and between concentrator and smelter are very great.

(2) Boshekul

1) Geology and Ore Reserves

The Boshekul ore deposit is located at the latitude of 51° 51'N and the longitude of 74° 18'E, approximately 55 km by road to the WNW of the town of Ekibastuz. The mine has been licensed to the JSC "Balkhashmed" for exploitation.

It is located in a dry, steppe area having a continental climate. The altitude of the deposit is 230-270 m above sea level. The topography shows plain to gentle rolling hills with Lake Bozshasor of 3 km^2 area.

The ore deposit is referred to as porphyry copper, hydrothermally altered plagiogranite and porphyrite with impregnated ores.

The geology comprises pyroxine-hornblende porphyrite and its tuff of lower Cambrian age, and sandstone of Cambrian age with plagiogranite and diorite porphyry intrusion. Copper-molybdenum mineralization is linked to plagiogranite and extends to porphyrite and its tuff(Fig.2-2-2(2)).

The orebody shows four sheet-like zones as follows. A leaching zone with thickness from 2 to 35 m, an oxidized zone with thickness from 3 to 29 m, a secondary enriched zone with thickness from around 20 m and a primary sulfide zone. Main ore minerals are represented by chalcopyrite, molydenite, pyrite and chalcocite.

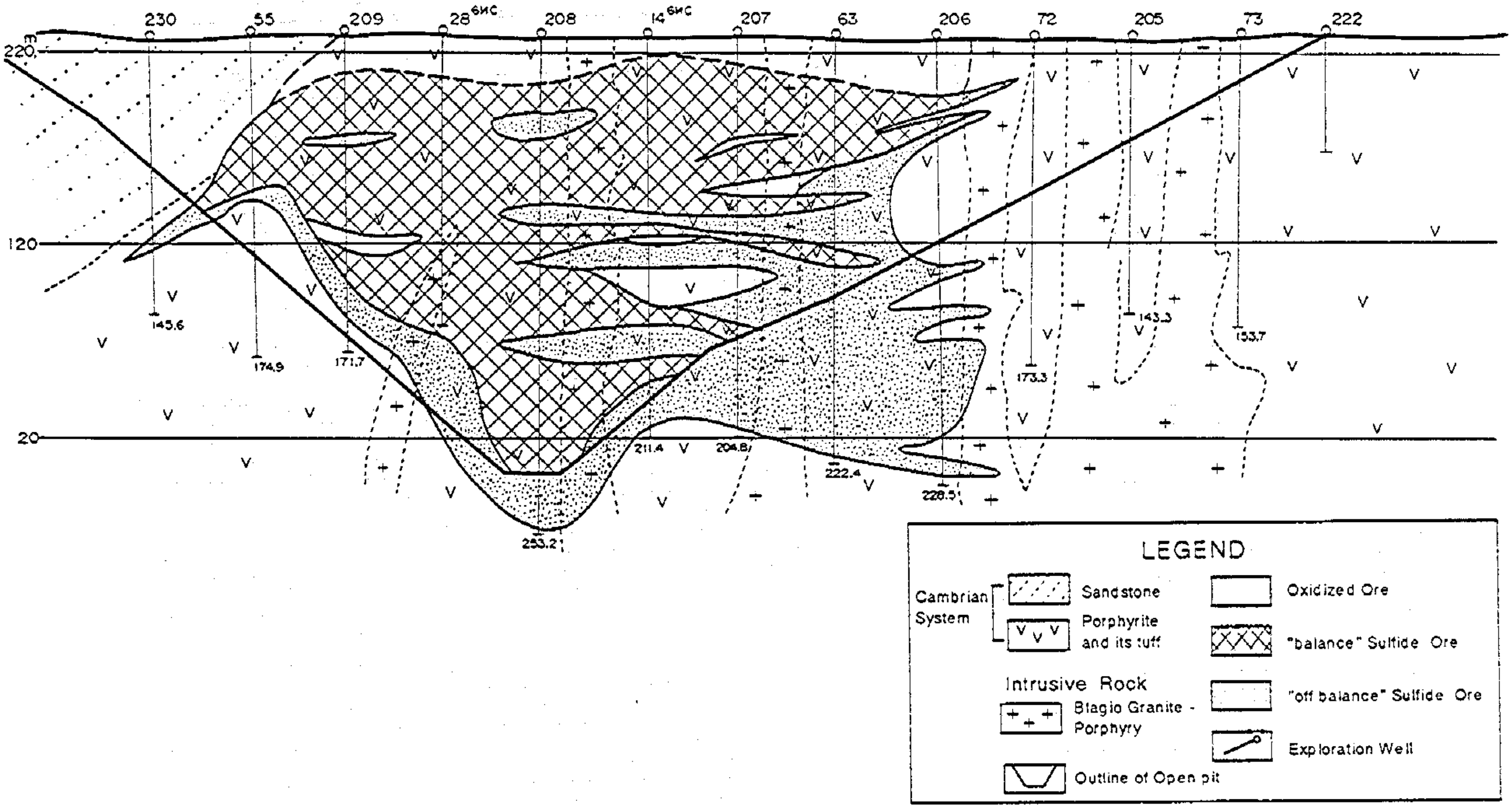

Fig.2-2-2(2) Cross-Section of Boshekul (1:3,000)

The width of orebody is around 400 m and it extends from 230 m above sea level to its base at sea level.

The geological ore reserve of Boshekul is 176 million tons(C1+C2) at an average grade of 0.72 % Cu (Table 2-2-2(2)).

Table2-2-2(2) Reserves of the Boshekul Deposit(as of 1995)

	Category C1+C2	Mineable
Ores (Mt)	176	171
Copper (%)	0.72	0.65
Metal (Kt)	1,270	1,110
Molybdenum (%)	0.013	0.01
Gold (g/t)	0.28	0.216
Silver (g/t)	9.2	7.18

Specific Gravity: 2.6t/m³ Cut-off Grade: 0.50%

2) Concentrator

Grades and Recoveries of concentrate are shown in Table 2-2-2(3).

Table 2-2-2(3) Grades and Recoveries of Concentrate of the Boshekul

Metal	Cu	Mo	Au	Ag
Grade	20.7%	10.0%	6.33g/t	257g/t
Recovery (%)	86.0	85.0	79.4	96.9 ?

3) Development and Operation Plan

Open pit mining is planned. The mineable ore reserve of the open pit is 171 million tons at an average grade of 0.65%.

Dimensions of the open pit are as follows.

Width of surface: 700m

Width of bottom: 30m

Elevation of top: 230m above sea level

Elevation of bottom: 0m a.s.l.

Overall angle of pit: 30-40°

4) Progress of Development and Construction

Infrastructures such as railways, access roads and power lines to the deposit have been constructed. Attempts to put the ore deposit into production have been made several times since 1970 and overburden and oxide ores of 24 million tons have been removed and stockpiled. But work has stopped due to lack of money. The development of the ore deposit is now suspended due to financial constraints.

The Boshekul Project appears to be the most advanced copper project near to the JSC "Balkhashmed". An urgent decision whether or not to develop this mine is required.

5) Economic Assessment

Figures of economic assessment are not available.

(3) Aktogay and Aydarley

1) Geology and Ore Resources

The ore deposits of Aktogay and Ayderly are located at the latitude of 46° 57'N and the longitude of 80° 05'E, near the town of Aktogay in the southernmost part of Semipalatinskaya Province. The deposits are a distance of 30 km to east of the town of Aktogay by road. The mine has been licensed to the JSC "Balkhashmed" for exploitation. The nearest concentrator and smelter are at Balkhash which is about 420 km by rail from the station of Aktogay.

It was reported that currently there is no water or power supply at the Aktogay Mine. However a 110 kW power supply and fresh (70th.m^3/day) and industrial quality water (346th.m^3/day) are available in the nearby town of Aktogay.

The area is represented by a semi-desert with scattered sand dunes and "solonchak"(salt marsh) vegetation. The average and maximum temperatures of summer are 18℃ and 35℃ and the average and minimum temperatures of winter are -20℃ and -40℃.

The altitude of the deposit area is 390-470 m above sea level. The topography shows plains with gentle hills and shallow lakes.

The orebody was discovered by geochemical surveys for Uranium in 1974. Geochemical, geophysical and drilling surveys were carried out in 1975-1980. In 1980 and 1995, economic assessments were carried out.

The ore field is elongated to EW direction and includes three deposits, Aydarley, Aktogay and Kyzylkia from west to east. Boundaries of the field are determined by the morphology of the Koldarsky intrusive massif which contacts with sediments of the Keregetassky Formation of Lower Carboniferous.

The ore deposits are of porphyry copper associated with porphyritic granodiorite, granodiorite porphyry and breccia dykes. The deposit is characterized by concentric alteration zones, the center of which is a barren, highly silicified zone. Granitoids represent 70% of the ores and undefined volcanics represent 30 %.

The shape of the Aktogay orebody is a thick-walled, truncated elliptical overturned cone, which has a length of 2,100 m, a width of 1,650 m and depth of 630 m. An oxide zone is developed at 15-20 m depth, rarely down to 30-35 m. The thickness of the secondary enriched zone is from 2-3 m to 25-30 m. The reserve of oxide ores is 83 million tons(Fig.2-2-2(3)).

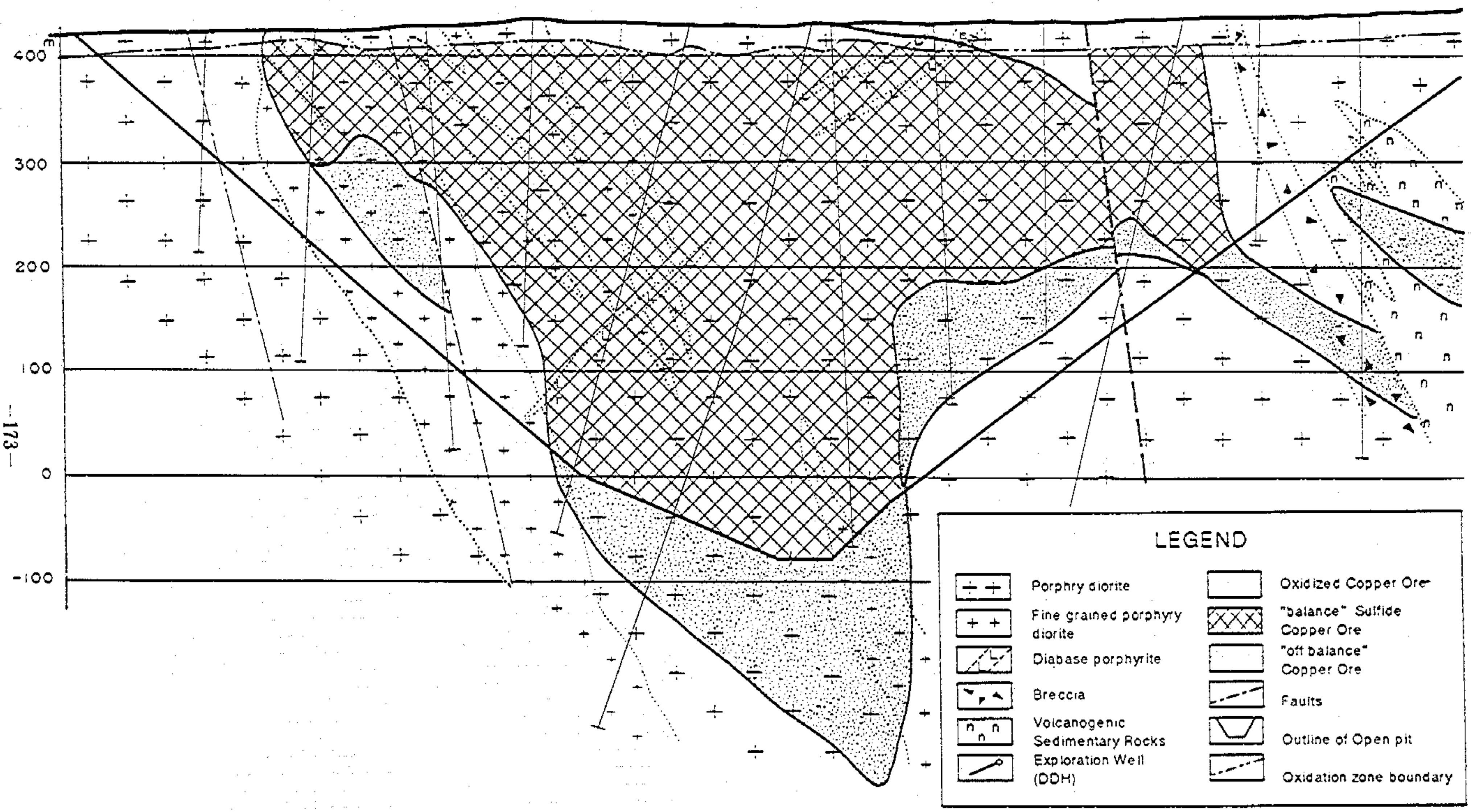

Fig.2-2-2(3) Cross-Section of Aktogay (1:5,000)

Major ore minerals are chalcopyrite, pyrite, molybdenite and magnetite.

The ore reserve of the Aktogay deposit in the open pit is 1,445 million tons (B+C1) at a grade of 0.385 % Cu, excluding oxide ores (Table 2-2-2(4)).

Table 2-2-2(4) Reserves of the Aktogy Deposit(as of 1980)

Category	Oxide	B	C1	B+C1	Mineable
Ores (Mt)	83	275	1,170	1,445	1,430
Copper (%)	0.39	0.46	0.37	0.39	0.374
Metal (Kt)	328	1,267	4,295	5,561	0.008
Moly. (%)		0.010	0.008	0.008	
Gold (g/t)		0.03	0.03	0.03	
Silver (g/t)		1.26	1.05	1.09	

Specific Gravity of Sulfide: 2.65t/m^3

Specific Gravity of Oxide & Waste: 2.60t/m^3

Cut-off Grade: 0.20% Commercial Grade: 0.31%

Maximum Thickness of Orebody: 15m

Minimum Thickness of Hollowrock: 15m

The Aydarley Deposit is almost identical in its setting and physical condition to the Aktogay Deposit. The ore reserve of the Aydarley deposit is 1,529 million tons (B+C1) at a grade of 0.38 % Cu(Table 2-2-2(5)).

Table 2-2-2(5) Reserve of the Aydarlev

as of 1980

Category	B+C1
Ores(mil.T)	1,529
Copper(%)	0.38
Metal(th.T)	5,811

2) Concentrator

A concentrator of the Aktogay is designed at a location 2 km from the edge of the pit. It will handle 36 million tons of ores every year.

Ore dressing is planned to be carried out by bulk-selective flow-sheet producing copper concentrate and molybdenum middlings. It is expected to produce standard copper concentrate containing 15 % copper and molybdenum middlings containing 22 % molybdenum (Table 2-2-2(6)).

Table 2-2-2(6) **Mill Performance of Aktogay Ore**

Metal	Cu	Mo	Au	Ag
Copper Grade	15.0%	0.02%	0.675g/t	23.7g/t
Concentrate Recovery (%)	90.0	4.2	50.5	50.7
Moly. Grade	2.0%	22.0%	0.84g/t	27.9g/t
Concentrate Recovery (%)	0.2	74.8	0.8	0.7
Smelting & Refinery				
Grade(%)	99.99			
Recovery	97.8		95.2	
Cement Copper				
Cu Recovery by Leaching: 80%				
Cu Recovery in Cement Copper: 98%				
Cu Grade of Cement Copper: 73.5%				

3) Development and Operation Plan

Open pit mining is planned for the Aktogay Deposit. In addition to a large quantity of low grade ores, its shape, namely, the form of a truncated elliptical overturned cone is good for the open pit. As a result, the stripping ratio is low (0.32m³/t).

Dimensions of the open pit are as follows.

Length and width of surface: 2,720m and 22,20m

Length and width of bottom: 560m and 275m

Elevation of top and bottom: 450m and -140m above sea level

Overall angle of pit: 30-38°

Total of Waste: 485.7 million m³ 1.236 million tons

Waste Ration(waste/(sulphide)oxide): 0.318m³/t 0.827t/t

Reserve of mineable oxide ore: 82 million tons

Reserve of mineable sulfide ore

: 1,430 million tons at a grade of 0.374% Cu

Total of waste: 480 million m³

Annual product: oxide ore 8.1 million tons,

sulfide Ore 36.0 million tons

4) Progress of Development and Construction

In 1995, the feasibility study of the Aktogay Mine reported that the pay back period for investment is 10.6 years and the internal rate of return is 12.6 % per year, and concluded that there are internal reserves available that can reduce the negative influence of actual microeconomic factors under conditions of risk and uncertainty.

Nevertheless, there has been no progress of development and construction at the Aktogay project.

5) Economic Assessment

As described above, an economic assessment was carried out in 1995. This study was made to determine the feasibility of construction of a combine comprising a large-scale open pit and a concentrator with associated facilities including a cement copper production unit treating oxide ores.

In this report, brief comments are present for principal parameters used in the feasibility study. The principal parameters are other than above.

Table 2-2-7(7) Principal Parameters Used in Feasibility Study for Aktogay Development

a) Annual Output of Ores and Concentrates

Year	Sulphide Ores (Kt)	Cu (%)	Cu Concentrates	Cu in Conc. (Kt)
1				
2				
3				
4	9,000	0.42	233.8	35.08
5	9,000	0.42	233.8	35.08
6	18,000	0.46	514.5	77.17
7	18,000	0.46	514.5	77.17
8	18,000	0.47	527.3	79.1
9	18,000	0.47	523.3	79.1
10	27,000	0.42	701.6	105.2
11	27,000	0.42	701.6	105.2
12	36,000	0.42	925.5	138.8
and onward	36,000 (to Year 50)	0.371 (to year 39)	801.6 (to year 39)	120.2 (to year 39)

b) Construction Period

Annual Feed (1,000 tons)	Construction Period (year)
9,000	4
18,000	6
27,000	10
36,000	12

c) Capital Cost (1,000 US$)

Land Preparation/Site Improvement	10,689
Open Pit Preparation	53,079
Concentrator/Cement Copper Facilities	163,988
Power/Water Supply, Sewage, Service Facilities	89,128
Transportation and Communication	48,173
Construction of Base Camp	32,823
Civil Construction	76,030
Others	145,344
Total	619,254
Working Capital	42,000
Grand Total	661,254

d) Number of Employees and Salaries and Wages (US$/Year)

	Number	Salary/Wage
Engineers	578	3,600
Workers	4,059	2,400
Office Staff	105	1,800
Others	68	-
Total	4,810	Av.2,525

e) Operating Cost (per ton of ores)

Mining	1.704
Ore Dressing	2.889
Administration	0.643
Others	0.260
Total (Ex-Concentrator)	5.496

f) Metal Prices

Cathode Copper US$/ton:	3,000
Copper in Cu, Concentrate US$/ton:	2,100
Copper in Cement Copper US$/ton:	2,600
Molybdenum in Molybdenite Anhydride US$/ton:	11,000
Gold in Cu, Concentrate US$/kg:	6,674
Sulphuric Acid US$/ton:	6

g) Other Parameters

Interest Rate: 8% per Annum

Income Tax Rate: 30%

h) Results (Excluding Profit at the JSC "Balkhashmed"

Cash Flow for the Entire Operation Period

at the Discount Rate of 10 % per Annum Million US$ 743.8

at the Discount Rate of 10 % per Annum Million US$ 9.8

Internal Rate of Return 9.9 %

The feasibility study has estimated the total cash flows at US$743.8 million and -9.8 million for the entire operation period of the Aktogay Project (50 years) at the discount rates of 5 and 10 % per annum respectively with the internal rate of return of 9.9 %. This result indicates that the Aktogay project is economically feasible although its rate of return is modest.

The Aktogay deposit, a porphyry-copper type, contains a large amount of resources amenable to open-pit operations. However, its recoverable value for a unit quantity is low in comparison with those of other deposits of similar scale in other parts of the world. Table 2-2-2(8) shows tonnages and ore grades of ore deposits which have been recently exploited or will be developed within a few years. The ore deposits in Philippines and Canada, quoted in Table 2-2-2(8) are low in copper content but each contains an appreciable amount of gold which raises the total ore value considerably.

Table 2-2-2(8) Comparison of Ore reserves and Grades of Aktogay Deposit

Country	Name of Mine	Ore Reserves	Ore Grade Cu(%)	Mo(%)	Au(g/t)	Annual Mine Production* (Kt)	Capital Cost** (MUS$)	Start-up Year
Chile	El Abra	410,000	0.74			35,000	1,000	1998
	Escondida	2,120,000	1.31			70,000	835	1991
	La Conderalta	354,000	1.14			12,500	500	1994
Philippines	KingKing	248,000	0.434		0.443	9,000	191	FS
	Taysan	257,000	0.32		0.38	18,000		FS
Canada	Mount Milligan	298,400	0.22		0.45			Exploration
	Fish Lake	870,000	0.23		0.43			Exploration
	Hushamu	173,250	0.27	0.01	0.34			Exploration
Kazakhstan	Aktogay	1,430,000	0.374	0.008	0.029	36,000	620	FS

Note: *Estimated based on annual output of copper **Initial Capital Investment

The cut-off grade of 0.2% Cu for estimating mineable ore reserves is approximately comparable to the operating cost of US$ 5.496 for a ton of ore, assuming the copper price is US$ 3,000 for a ton of cathode and the Cu recovery for ore dressing is 90%. However, the cut-off grade should be raised to nearly 0.3% Cu, if the value of a ton of copper in concentrates is assumed at US$ 2,100. Among other technical parameters, the concentrate grade of 15 % Cu is much lower than those achieved in current operations elsewhere in the world. It may be possible to raise the concentrate grade to the order of 20 to 25% Cu for ores comprising chalcopyrite and pyrite as major ore minerals.

The amount of the capital investment estimated US$ 620 million appears to be reasonable, including all the costs for purchasing necessary machinery and equipment and for constructing the mine, the concentrator and the associated facilities such as access railways and roads, power, heat and water supply systems, residential sites and so forth. Comparison of the capital and the operating costs is made with those for the standard model in North America and is shown in Table 2-2-2(9). The operating cost for producing concentrates has been estimated in the Feasibility Study at US$ 5.496 for a ton of ores on the basis of the actual operation results at the JSC "Balkhashmed". Both capital and operating costs are comparable to those for the North American standard.

Table 2-2-2(9) Comparison of Capital and Operating Cost of Aktogay Deposit

for North American Standard and Aktogay

	North American Standard				Aktogay		
	Mine (w/o=1)		Concentrator				
Capital Cost	Daily (t)	Annual (Kt)	Daily (t)	Annual (Kt)		Daily (t)	Annual (Kt)
Production /Conc.Feed	40,000	14,000	40,000	14,000	Mine Output(w/o=0.89)	100,000	36,000
Capital Cost(US$)	52,840,000		180,738,000				
Total(US$)	233,578,000					620,000,000	
Ore and Waste(per daily tons)	US$ 660						
Feed(per daily tons)	US$ 4,520						
Operating Cost(Cost per ton of Ore, US$)							
Supplies and Materials	0.98	3.01			Mining		1.704
Labor	0.53	0.32			Milling		2.889
Administration	0.20	0.10			Administration		0.643
Sundries	0.17	0.34			Others		0.260
Total	1.88	3.77			Total		5.496
	5.65						

Capital Cost for Daily 100,000 tons Ore, 200,000 tons Ore+Waste
(Annual 36 million tons Ore)
(w/o=1) Mine Output=Conc. Feed
Capital Cost(US$): 660x200,000+4,520x100,000=584,000,000

The value of copper in concentrates has been discounted to US$ 2,100 for a ton of contained copper from US$ 3,000 for a ton of cathode in the summary report. This discount seems to be unreasonable from the view point of the international metal trading business and favours the JSC "Balkhashmed" in terms of profit. Sales terms and conditions should be decided according the agreement between the seller(mine-concentrator), and the buyer(the smelter) of concentrates, because concentrates are traded in the international market at prevailing prices. Current smelter-refinery charges range between US$ 0.20 and 0.25 for a pound of copper(or US$ 440 and 550) in concentrates. Meanwhile, the price of US$ 3,000 for a ton of cathode is considered to be optimistic for a long-term projection. The advantage of the Aktogay ore deposit is its low waste-to-ore ratio, being less than one, and therefore its inexpensive mining cost for a ton of recoverable ores. It takes 12 years, according to the Feasibility Study, to bring the mine production into full scale of 36 million tons a year. The construction period appears to be too long and may possibly be reduced. The aspect of feasibility may change, possibly toward the favorable side, by reducing the period. Detailed review of the feasibility report is necessary before making a final decision regarding development.

The Aktogay Deposit has been licensed to a joint venture between a Kazkhstan and a U.S. firm for its exploitation on the condition that the products (Cu concentrates) should be supplied to the JSC "Balkhashmed".

(4) Others

Copper projects in pre-development stages except for the three above are the Chatyrkul, Zhaisan, Koksay, Zhaman-Aibat, Zhilandinskaya and Samasky.

1) Chatyrkul Project

The ore deposit of the Chatyrkul is located at the latitude of 43° 37'N and the longitude of 74° 16'E in the Dhambur Province. Access to the 50 km road east from the railway town of Chu. The nearest concentrator and smelter at Balkhash, some 450km by railway.

The road from Chu to the deposit is not completely paved, but it is wide and in relatively condition. The journey takes about one hour.

It is a dry, steppe area having a continental climate. The yearly rainfall is 330 mm which is and comparatively high for Kazakhstan. Vegetation is therefore lusher than in other areas of the country and wheat is cultivate. The temperature during the summer months is +43℃, while during the winter months is -41℃.

The altitude of the deposit area is 880-960 m above sea level. The topography shows relief of gentle slope and depressions.

The ore deposit is of a vein type with quartz in granite and granodiorite. It has two veins, Main Vein and West Vein. The Main Vein has a strike of NNE-SSW and a dip of 60-90N and is 1800 m in length, 3-15m in width and 900 m deep. Its reserves amount to 85 % of the reserves of Chatyrkul Deposit. The West Vein has a strike of N-S and a dip of 30-50W and its reserves amounts to 15 % of the total deposit.

Major ore minerals are bornite, chalcopyrite and molybdenite. Gangue minerals are quartz and calcite.

The Chatyrkul Deposit was mined by small pits. New exploration started in 1950 and geophysical surveys, geochemical surveys, drilling and underground work were carried out in 1951-1976. Development started in 1976 but stopped after six months. There are around 500 drillholes with a total length of around 100,000 m.

The geological ore reserve is 27 million tons (B+C1+C2) with an average grade of 3.47 % Cu (Table 2-2-2(10)).

Table 2-2-2(10) Reserve of the Chatyrkul Deposit (as of 1979)

Category	B	C1	C2	B+C1+C2	P1
Ores (Mt)	1.814	15.846	9.393	27.053	21
Copper (%)	3.59	3.58	3.27	3.48	3.35
Metal (Kt)	65.2	568.2	307.4	941.4	1701
Molybdenum (%)		0.02	0.02	0.02	0.02
Gold (g/t)				0.79	
Silver (g/t)				7.2	

Cut Off Grade 0.8% Cu Commercial Grade 1.8% Cu

Minimum Width of Ore 0.8m Sulphide Density 3.1t/m^3

Underground mining methods are planned for which a dilution of 20 % and a loss of 5 % is estimated. As a result:

Copper grade of commercial ore: 2.78 %

Mineable ore reserve: 32 million tons

Other characteristics of the mining plan are as follows,

Maximum production rate: 2million tons

Pre-production period: 1-2 years

According to the results of Ore dressing test (Table 2-2-2(11)),

Grade of concentrate: 28 %

Recovery of copper: 94%

In 1975 and 1995, detailed economic studies of the deposit were done.

Table 2-2-2(11) Recovery of the Concentrate of the Chatyrkul(As of 1975)

Name	Recovery (%)	Cu (%)	Mo (%)	Au (g/t)	Ag (g/t)
Copper Conc.	94	28	0.01	4.1	35.8
Moly. Conc.	68	6	21	1.1	245

The results of the 1995 study are as follows:

Metal price: Cu 2,850 US$/t, Au 12.5$/g, Ag 0.161$/g

Total capital cost: 300 mil.US$(not including exploration cost)

Operating cost: 34 US$/ton(not including tax)

Internal rate of return: 31% with a value added tax of 20%

42% without a value added tax

The Geological License of Chatyrkul and Zhaisan is under the Zhaisan Corporation which is a joint enterprise of Kazahkstan Corp. and 3K Corp. of England. At present, 3K Corp. is drilling the West Vein.

If the deposit is exploited, 3K must for all exploration costs already spent (12 mil.$=9 mil.$ for Chatyrkul+3 mil.$ for Zhaisan) with an interest of 15 % for 7 years or 5 % for 20 years.

2) Zhaisan Project

The ore deposit of the Zhaisan is located at the latitude of 43° 32' and the longitude of 74° 24' in Dhambur Province. It is 17km to the southeast of Chatyrkul by straight line. It can be reached by road for a distance of about 60km to the East of the town of Chu which has the railway station. The nearest concentrator and smelter, are at Balkhash, about 450 km by railway.

The road from Chu to the Deposit is not completely paved, but is wide and in good condition.

The climate and mineralization are the same as for Chartyrkul.

The altitude of the deposit area is 1040-1100 m above sea level. The topography shows relief with a gentle slope and depressions. The orebody distributes along small valleys oriented in the ENE-WSW direction.

The ore deposit is a vein type with quartz in granite and granodiorite, similar to the Chartyrkul Deposit. It has three veins, the South Vein, Middle Vein and North Vein. All three veins have almost same strike of ENE-WSW and the dips of 60-80N. The South Vein is the richest and has a length of 1800m, a width of 1-5 m and a depth of 600m. Its reserve amounts to 65 % of that of the Zhaisan Deposit (Table 2-2-2(12)).

Table 2-2-2(12) Geometrics of Zhaisan

Unit Orebody	Length(m)*	Width(m)	Depth(m)	Strike	Dip
North Vein	900-1300	0.3-5.4	400	N60E	60-70N
Middle Vein	800-1400	1.0	500	N65E	70N
South Vein	1800-1800	1.0-5.0	600	N60-65E	75N

Length* the first number shows the length used in the calculation of ore reserves

Zhaisan was originally mined by small pits. New exploration started two years after that at Chatyrkul, in 1952. Almost all, the same surveys were done.

The geological ore reserve is 10 million tons (C1+C2) with an average grade of 3.03 % Cu (Table 2-2-2(13)).

Table 2-2-2(13) Ore Reserve of Zhaisan(as of 1979)

Category	C1	C2	C1+C2	Mineable
Ores (Mt)	7.051	2.892	9.943	
Copper (%)	2.92	3.32	3.03	
Metal (Kt)	205.6	96.1	301.7	
Molybdenum (%)	0.01	0.00	0.01	
Gold (g/t)		0.12		
Silver (g/t)		4.1		

Cut Off Grade: 0.8% Cu Commercial Grade: 1.8% Cu

Minimum Width of Ore: 0.8m Sulphide Density: 3.1t/m^3

Detailed operating and economic study of the Zhaisan Project has not yet been completed. The reason is as follows.

Almost all of the conditions are the same as for the Chartyrkul Deposit, However the Chartyrkul orebody is better than the Zhaisan. The distance between these two projects is only 15-20 km with a good road. So, if the Chartyrkul is exploited, then the Zhaisan can also be exploited.

3) Koksay Project

The ore deposit of the Koksay is located at the latitude of 44° 29'N and the longitude of 78° 28'E in Taldy Kurgan Province. It is located at a distance of about 40km by straight line to the ENE of the railway station of Sary-ozek. There is an arterial road, Route 353, from Sary-ozek to the nearest village of Krasnogovka for a distance of 50 km. The project can be accessed by an unpaved and corrugated road for a distance of 20 km. A four-wheel drive vehicle can reach the site in about one hour .

The nearest concentrator is at Tekeli, a distance of about 200 km by road.

It is a steppe area having a continental climate and a yearly rainfall of 350-400 mm which is comparatively high due to the proximity of mountains higher than 2000 m. Vegetation is dense than in other areas of Kazakhstan and the relief is steeper due to heavier erosion.

The temperature during the summer months is +35°C, while that during the winter is -39°C.

The altitude of the deposit area is 1250-1400 m above sea level. The topography shows slightly steeper relief with valleys.

The ore deposit is of a hydrothermal network type in a granodioritic intrusive in contact with Silurian limestone and conglomerate. It shows a plate-like shape with a strike of N60W and a dip of 70N on hanging and 80S on foot. It is 1800 in length, 300 m in width and 870 m deep.

Ore minerals are chalcopyrite, bornite and a few molybdenite and pyrite. Quartz, chlorite, sericite and pyrite show zoning structures(Fig.2-2-2(4)).

Koksay was discovered in 1930'. Exploration started in 1956 and ore reserves of 400 thousand tons with a grade of 0.45 % Cu was certified in 1964. More exploration work was done in 1968-1975.

Reserves of oxidized ore is 10 million tons with 0.50 % Cu. Reserves of sulphide ore in the open pit is 320 million tons (B+C1) with an average grade of 0.51 % Cu (Table 2-2-2(14)).

Table 2-2-2(14) Reserve of the Koksay(as of 1978)

Category	B+C1	C2
Ores (Mt)	320	288
Copper (%)	0.509	0.466
Metal (Kt)	1.63	1.341
Molybdenum (%)	0.005	0.004
Gold (g/t)	0.12	
Cut Off Grade: 0.2% Cu	Commercial: Grade 0.34% Cu	

Minimum Width of Ore: 5m Sulfide Density: 2.7 t/m^3

B+C1 is in the open pit, C2 is out of the open pit

Open pit mining is planned in which dilution and loss are both 4 %. The following parameter are expected:

Copper grade of commercial ore: 0.489 %

Minable ore reserve: 320 mil tons.

Maximum production rate: 12 million tons.

According to the results of ore dressing test (Table 2-2-2(15)),

Grade of concentrate: 16 %

Recovery of copper: 89 %.

Table 2-2-2(15) Recovery into the Concentrate of the Koksay

Name		Cu	Mo	Au	Ag
Copper Conc.	Grade	16%	0.03%	2.4g/t	30.6g/t
	Recovery	89.5%	7%	48%	55%
Moly. Conc.	Grade	2%	24%	5g/t	
	Recovery	65%	0.5%		

In 1977, a detailed economical study for the deposit was done. The results are as follows.

Metal price Cu cathode: 68 Ruble/year

Total capital cost: 156 million Ruble

Operating cost: 5.67 Ruble/ton

Mining cost: 1.26 Ruble/ton

Dressing cost: 1.29 Ruble/ton

The geological license of Koksay was under a Kazahk-Austrian Corporation which is a joint enterprise of Kazahkstan Corp. and an Australian company. The company didn't do any exploration works, so their license was revoked.

4) Zhaman-Aibat

Zhaman-Aibat Ore Deposit is located about 180 km southeast of Zhezkazgan City, Zhezkazgan Province, or geographically at a point of Latitude 46° 50'North and Longitude 68° 54'East.

It is a dry, steppe area having a continental climate. The rainfall in the summer is a low and the snowfall in the winter is a few centimeters. The yearly rainfall is between 140 and 150 millimeters. The average temperature during the summer months is +33°C, while the average temperature during the winter is -33°C. The vegetation consists of several kinds of dryness-resisting rice plants at a level of sparse growth.

Ore deposits are of stratiformed copper type. They occur exclusively in gray sandstones within Red Sandstone Formation that ranges from the middle to late Carboniferous and the early Permian.

In the area, about 800 holes have been drilled, of total length of 585,000 m. Three ore bodies ,the East, Central and North, have been identified. These orebodies are distributed within an area 12.5 km from east to west and 5 km from south to north, and the depths of the orebodies are in the range from 400 m to 500 m in the eastern part, getting deeper toward the west and in the range from 700 m to 750 m in the western part of central ore body.

The total of ore reserve is 119 million tons with an average of 1.94 % Cu (Table 2-2-2(16)). Reserves of each ore bodies are as follows.

Eastern: 117 million ton 1.36 % Cu

Central: 35 million ton 1.71 % Cu

Table 2-2-2(16) Reserve of the Zhaman-Aibat (as of January 1, 1993)

Category	C1	C2	C1+C2	Prospective reserve
Ores (Mt)	48.02	70.73	118.55	230.86
Copper (%)	1.99	1.90	1.94	1.54
Metal (Kt)	954.3	1,343.4	2,297.7	3,563.9
Lead metal (thou. T)	-	264.0	264.0	364.0

Cut Off Grade: 0.4 % Cu

Minimum Thickness of Ore: 3 m Maximum thickness of Holerock: 4 m

Specific Gravity: 2.6t/m^3

Ore minerals from these deposits are chalcocite, bornite, chalco- pyrite, galena, sphalerite and pyrite.

Since the Zhaman-Aibat Ore Deposit is located 180-200 km away from the Zhezkazgan Mine, it is

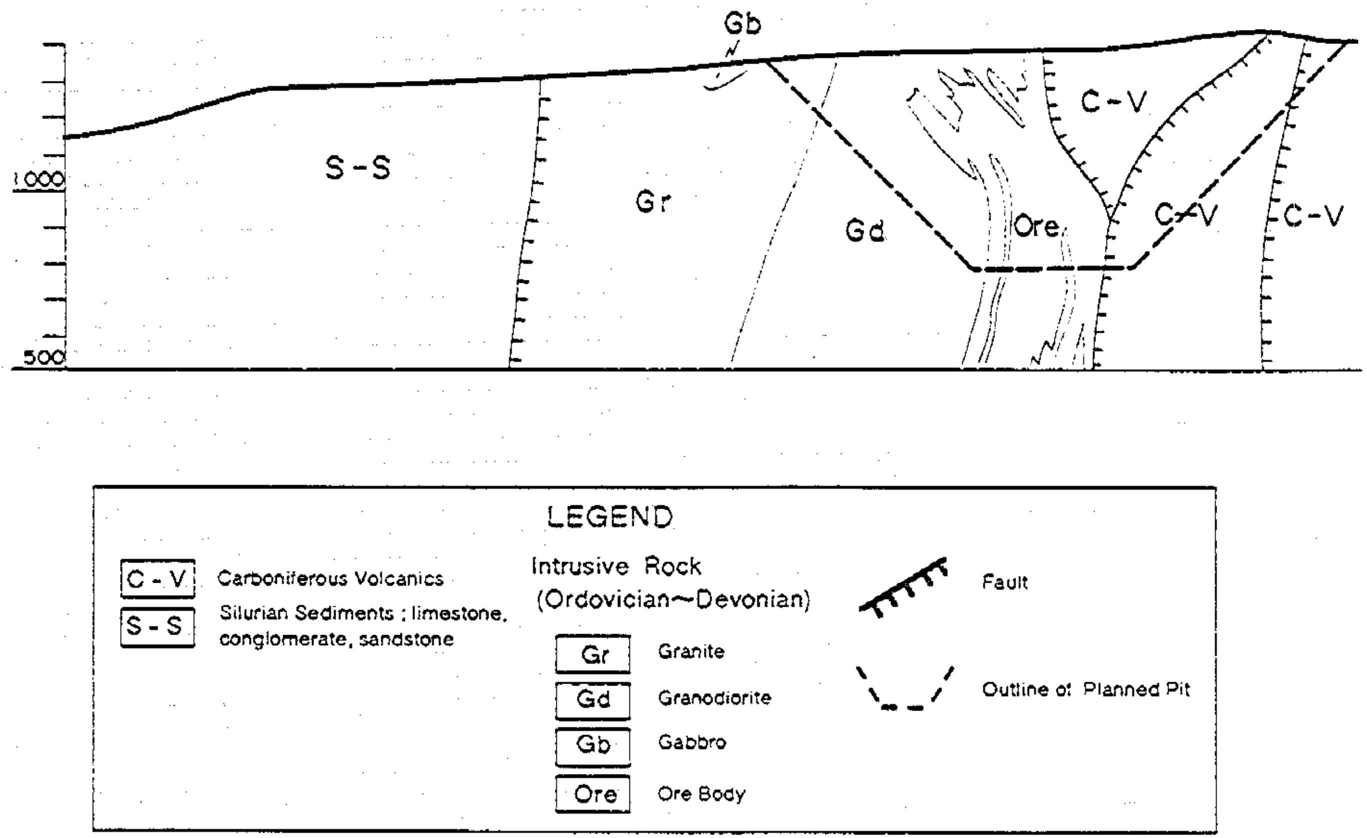

Fig.2-2-2(4) Schematic Cross-Section of Koksay (1:2,000) necessary for development to take into account costs for constructing housing, power supply and water supply facilities as well as costs for transportation of ores.

Underground mining will also be essential for development, as the depth of the ore deposit is 400-750 m. Higher costs are required because mass disposition of underground ores is considered more difficult compared to the open-pit method.

5) Zhilandinskaya

The ore deposits of the Zhilandinskaya Mine are located approximately 60 km north-northwest of the town of Zhezkazgan and are planned to supply raw materials to the JSC "Zhezkazgantsvetmet".

The ore deposit is of a stratiform copper type, comprising six ore bodies of Itaus, West Saryoba, East Saryoba, Kipshakpay, Karashoshak and Dzhartas. There are six horizons with stratum thickness of 0.1-20 m, making the average thickness of 35 m. Thickness of wall rocks is 3-30 m. The Itaus orebody extends in the direction of north to south, having nearly vertical inclination and continuous mineralization down to the depth of 1,000 m. Other orebodies are running in the direction of nearly north to south and are inclined 30-50° to the south, having the thickness of about 800 meters continuously.

The ore deposit comprises the oxidized zone (0-40 m) on the top, the secondary sulphide-enriched zone (40-100 m) in the middle and the primary sulphide-enriched zone (deeper than 100 m) at the bottom.

Ore minerals are chalcocite, bornite, chalcopyrite, galena, sphalerite and native copper, but malachite, azurite and native copper are also available in the oxidized zone.

The total ore reserve is 168 million tons with an average of 1.37 % Cu (Table 2-2-2(17)). Reserves of each ore bodies are as follows.

the Itaus	58 million tons	1.08 % Cu
the West Saryoba	37 million tons	1.56 % Cu
the East Saryoba	34 million tons	1.47 % Cu
the Kipshakpay	23 million tons	1.40 % Cu
the Karashoshak	9 million tons	1.44 % Cu
the Dzhartas	7 million tons	2.09 % Cu

Table 2-2-2(17) Reserves of Zhilandinskaya

Category	B	C1	C2	B+C1+C2
Ores (Mt)	24	97	47	168
Copper (%)	1.36	1.38	1.38	1.37
Metal (Kt)	327	1,336	643	2,306

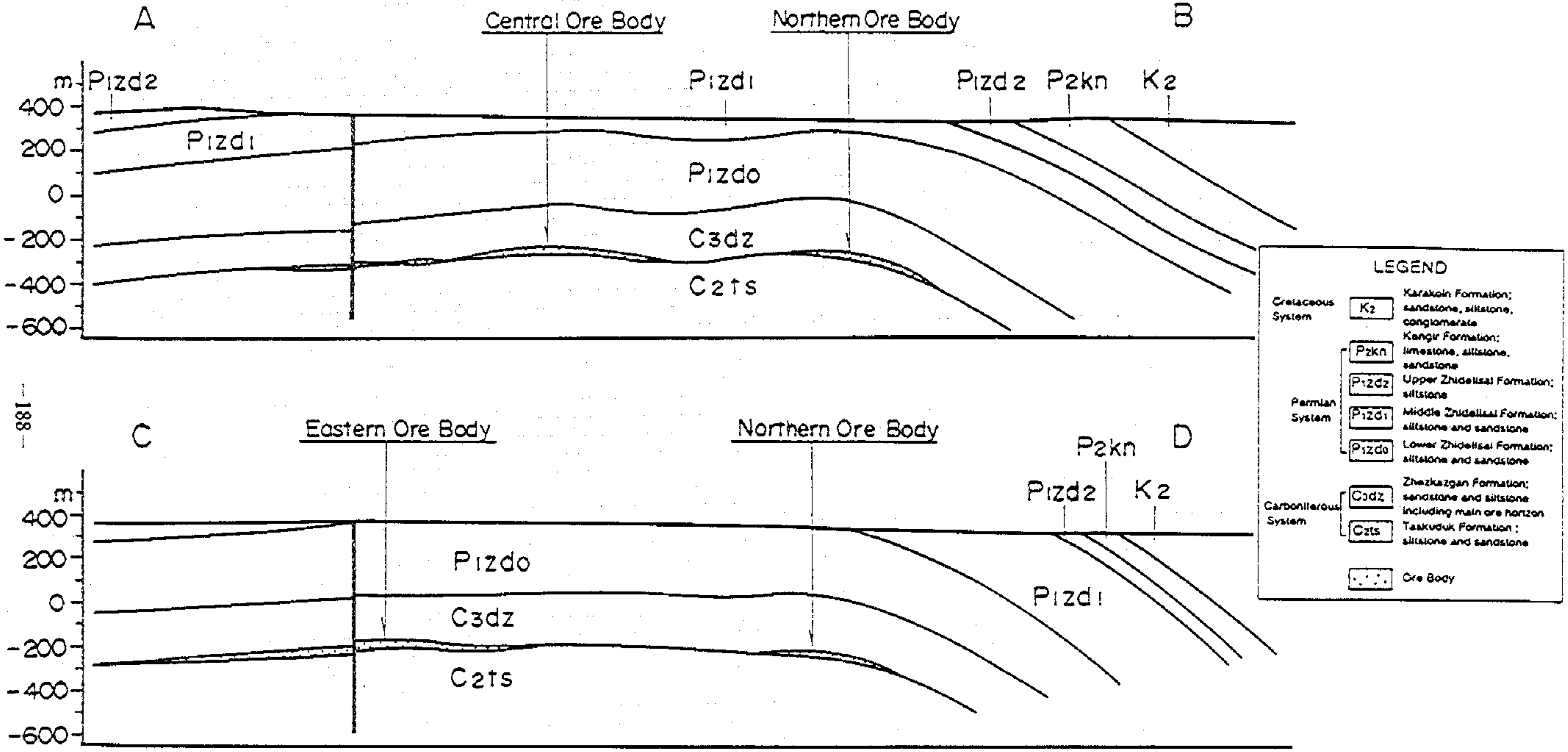

Fig.2-2-2(5) Cross-Section of Zhaman-Aibat (1:25,000)

The Zhilandinskaya Ore Deposit is located about 30-40 km north of the Zhezkazgan Mine which is now in operation and the geological setting and mining conditions are similar.

Though the Cu grades are rather low, infrastructure such as smelting works, sorting works and houses for Zhezkazgan are partially available, thus allowing the investment to be minimal.

Mining areas of these ore deposits have already been transferred to private enterprises, and their developments are going on at present.

6) Samarsky

Samarsky Ore Deposit was sold to a private enterprise in 1995 and its exploitation is still continuing, but data collected after 1995 is not available. Therefore, data up to 1994 will be used here.

The Samarsky Ore Deposit is located 35 km north of Karaganda City and 10 km north of Temirtau Town in Karaganda Province. There is an arterial road Route 36 near Samarsky Deposit. The nearest railroad station is at Aktau located about 10 km northeast of the ore deposit.

The average temperature during the summer months is +23℃ and the average temperature during the winter months is -18℃. The yearly rainfall in this district does not exceed 250 millimeters in general.

The vegetation in this district is similar to that of Zhaman-Aibat, having sparse growth of various kinds of driness-resisting rice plant during the summer period.

This ore deposit comprises two different types of deposit, namely porphyry Cu-Mo type and Au-polymetallic type. In this area, quartz diorite of the early Devonian Period penetrate andesite basalt lava and pyroclastics of the same period, and then granodiorite porphyry intruded into the center of breccia pipes. Their cataclasite and sedimentary rocks have been replaced with the matrix of breccia pipe formed by activities of quartz diorite porphyry. The porphyry type of Cu-Mo mineralization occurs in the breccia pipe and its adjacent area.

The oxidized zone can be recognized to depths of 30 to 50 meters from the ground surface.

Ore minerals from this deposit are mainly chalcopyrite accompanied by a small quantity of chalocite and bornite. As the secondary minerals, malachite and a small quantity of azurite are available.

The Au-polymetallic type of ore deposit is distributed in the crush zone developed above a number of thrust faults running nearly south to north from the northwestern part to the western part of the porphyry type of Cu-Mo, and is composed of gold-polymetallic quartz vein and veinlets.

Ore minerals include galena, sphalerite, chalcopyrite, pyrite, tetrahedrite and native gold.

A systematic geochemical exploitation has been commenced from the early 1950's and more than 30 thousand samples have been collected. Various kinds of exploration were commenced in the 1960's in the geochemically anomalous zone and prospecting by drilling has been taking place since 1989.

As this deposit is still at the stage of exploration, ore reserves by category can not be calculated. According to data available up to 1994, ore reserves of the central deposit calculated by Karagandageologiya are 112 million tons with a grade of 1.24 % Cu (Table 2-2-2(18)).

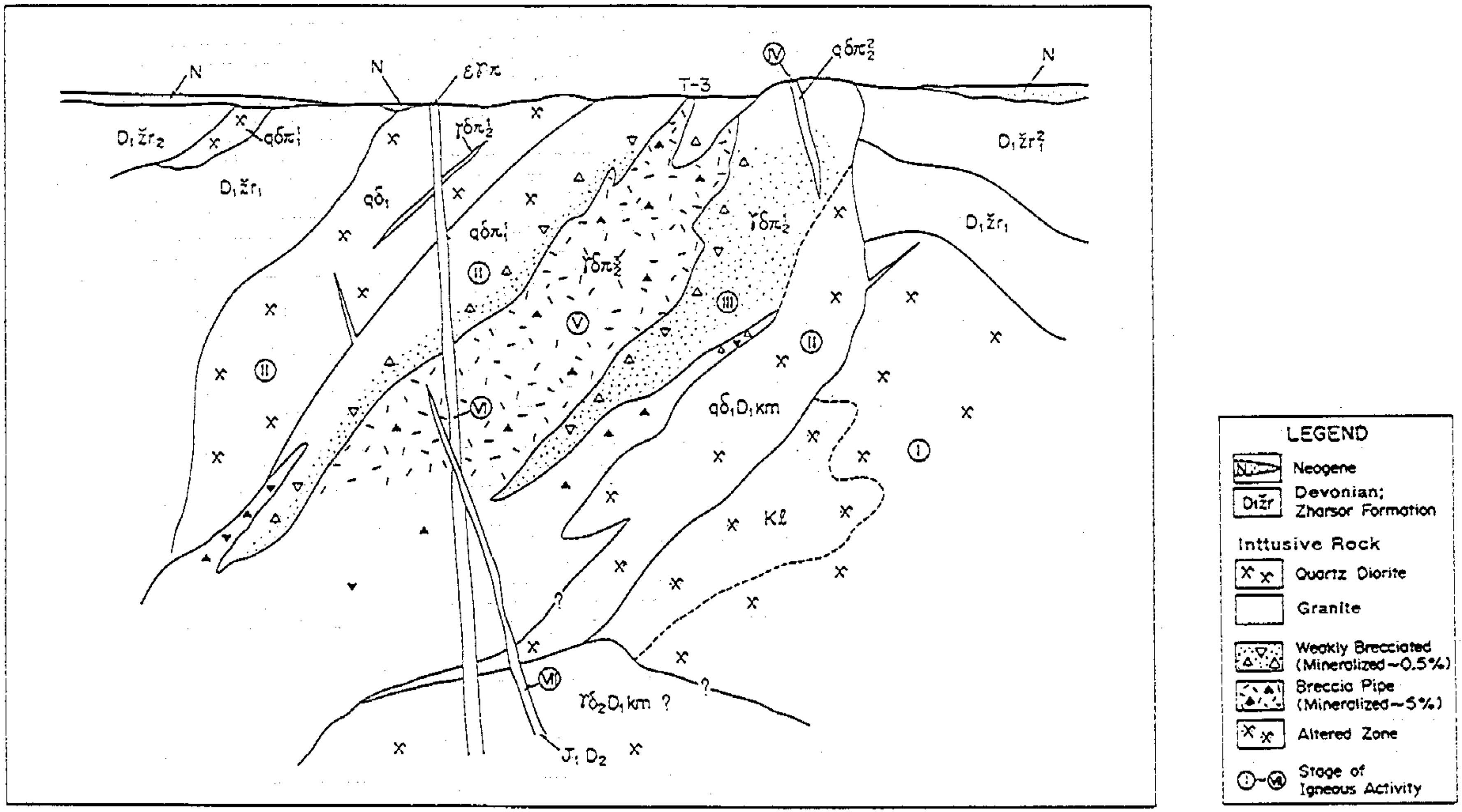

Fig.2-2-2(6) **Schematic Cross-Section of Samarsky**

Table 2-2-2(18) Reserves of Samarsky

Category	C2
Ores (Mt)	112
Copper (%)	1.24
Metal (Kt)	1,394
Gold (g/t)	0.48
Silver (g/t)	2.46

The forecast mining outputs are likely to be increased by further exploration, and further developments may be feasible according to the grade of ores.

As the deposits are located comparatively close to Karaganda City, costs for building houses and power facilities can be restrained but transportation costs should be taken into account, if the ores are to be transported to JSC "Balkhashmed".

2-2-3 Deposits Under Exploration

(1) Central Kazahkstan

The Central Kazakhstan Department of the Ministry of Geology and Underground Resources Conservation is responsible for three administrative regions, namely; Karaganda, Akmolinskoya and Zhezkazgan. Its head office is located in the city of Karaganda.

Exploration of underground resources in Central Kazakhstan is being carried out by Karagandageologia of Karaganda and Zhezkazgangeologia of Zhezkazgan.

1) Satpaevskoye (Cu, Mo, Au)

The Satpaevskoye ore deposit is located 160 km northeast of Karaganda City, and 90 km from the Samarsky ore deposit, Temir-tau Town and Karaganda Metallurgical Works respectively. Available infrastructure include railroads, power supply and roads.

The ore deposit is of the porphyry copper type and is occurs in volcanic rocks brecciated with monzonitic diorite. Exploration of the crushed zone of 40 km^2 was carried out by drilling to the depth of 100 to 500 m.

Ore minerals are chalcopyrite, calcocite, bornite and molybdenite. The quantity and grade of category P2 metals are 2 million tons of Cu and 40 tons of Au, comprising 0.55 % Cu, 0.01 4% Mo and 0.2 g/t Au.

The ore grade is low, but the reserves are so large that mass production by open pit mining might be possible. Cost factors are favorable in general.

Obtaining detailed exploration data and further surveys seems necessary.

2) Uzunzhal

This deposit is located about 200 km WNW of the Balhkash Concentrator and 20 km northeast of Kiik railway station. Available infrastructure include railroads and power plants.

The deposit is a hydrothermal metasomatic ore deposit. Mineralization of lead and zinc are recognized in limestones of Permian age. Ore bodies are lenticular and steeply inclined. The size of ore deposit is 4 km in length, 200-400 m in width and 4-90 m in thickness.

Ore minerals are galena, sphalerite, lead and silver sulfate, etc.

Their average grades are as low as 2.73 % Pb and 1.25 % Zn. In spite of favorable infrastructure, development of ores with such low grade will be economically handicapped. It should be reviewed for ores of higher grade.

3) Zhangeldy

The Zhangeldy ore deposit is located 70 km northwest of Agadyr railway station and 30 km southeast of Akchatau Mine. Infrastructure such as railway, power stations and roads are in relatively good condition.

Mineralization of porphyry copper is related to granitic rocks intruded into the crushed zone and three orebodies are identified. Orebodies in the north and the central regions are rich in Cu, Mo and Au, while an orebody in the southeast is rich in Cu, Mo and Bi. Main minerals available here are pyrite, chalcopyrite and calcocite. Metal reserves of category P2 are 3 million tons of copper and 20 tons of gold. This deposit is situated close to a working mine and infrastructure availability is favorable. Although the ore grade is rather low, mining may be feasible if mass production by open pit mining is taken into account. Review of exploration data and the further surveys are believed to be necessary.

4) Zhekeduan

This ore deposit is located 18 km north of Akchatau Mine and 8 km north of Akzhal Mine. Infrastructure such as power stations and roads are available in the region. The ore deposit is of a porphyry copper type and the area of mineralization is 10-15 km².

Main ore minerals are pyrite, chalcopyrite, calcocite, molybdenite. The metallic reserves of category P2 are 1.5 million tons of copper (1.5 % Cu) and 20 tons (5 g/t) of gold.

As this ore deposit is relatively close to a working mine, similar to the Zhangeldy deposit, so infrastructure availability is good. Mining is considered feasible, if mass production by an open pit mining could be adopted. A review of the exploration data and further surveys will be required.

5) Kumola Syncline

This ore deposit is located 25 km west of the Zhezkazgan ore deposit and 50 km from the JSC "Zhezkazgantsvetmet". Paved roads run through the deposit area and an electrial power supply network exists.

The ore deposit is of a stratiform type in sandstone. The main ore minerals are chalcopyrite, calcocite, bornite and pyrite. The reserve is not certified at the present stage, but the horizon of ore deposit is supposed to be the same as that of the Zhezkazgan ore deposit. A higher grade ore deposit can be anticipated.

6) Dyusembey

This deposit is located 100 km WNW of the Zhezkazgan ore deposit and 120 km from the JSC "Zhezkazgantsvetmet". Infrastructure is not developed yet.

The ore deposit is of a stratiform type. Eight prospective areas have been identified as a result of exploration of polymetals in an area of 33.8 km².

Main ore minerals are sphalerite, galena and chalcopyrite. The metal reserves of category P1 are 1.9 million tons of lead, 3.3 million tons of zinc and 678.7 tons of silver. Although total reserves are relatively large, grades are extremely low (1.04 % Pb and 1.81 % Zn). Development of this deposit is therefore not feasible. Further studies to identify higher grades of ore are required.

7) Symatas

This ore deposit is located 130 km northeast of city of Zhezkazgan. Existing infrastructure is not good. In Symatas district, copper mineralization with quartz veins and networks of quartz veinlets have been identified in the hydrothermal alteration zone.

Main ore minerals are chalcopyrite and pyrite. Metal reserves of category P2 are 2.1 million tons of copper and 2.8 tons of gold. In consideration of the fact that the average grade of copper is 1 % and infrastructure is not developed.

8) Karatasskaya

The Karatasskaya ore deposit is located 100 km west of Balkhash City, Zhezkazgan province and 45 km southwest of Sarkum railway station connecting Balkhash City and the village of Moyynty. The ore deposit is a skarn deposit and comprises three ore bodies of namely Karatasskaya 1, 2, and 4, which are 200-800 meters apart.

The geology comprises mainly terrigenous carboniferous metamorphic rocks of Proterozoic age, and various intrusive rocks are widely distributed. Mineralization of Cu-Mo is related to porphyritic igneous rocks of Upper Carboniferous age to Lower Permian.

The Keratasskaya 1 ore deposit is formed in the contact between terrigenous carbonate rock and granodiorite. The skarn minerals are garnet, garnet-pyroxene and epidote. The size of the orebody is 800 m in length, 150 m in width at the central part and 350 m in depth. It dips 70-80° . Molybdenum is rich in the central part, while copper is rich in the lower part of the skarn.

Ore minerals are chalcopyrite, molybdenite, magnetite and a small volume of pyrite and pyrrhotite. The ore reserves of category B+C are 38.6 million tons containing 0.34 % Cu, 0.02 % Mo and 5.86 % Mt, Mo-Cu ore. It is certified 0.28 % Cu, 0.336 % Mo and 2.96 % Mt with the same category of Cu-Mo ore.

Karatasskaya 2 is located 400 m northeast of Karatasskaya 1. Its minerals are the same as Karatasskaya 1. The mineralized area is 900 m in length 100-150 m in width and has ten orebodies. The principal orebody is 165-350 m in length and 14-45 m in thickness. Ore reserves of category B+C are 24.7 million tons containing 0.36 % Cu and 0.01 % Mo.

Karatasskaya 4 is located 200 m northeast of the Karatasskaya 2. The ore deposit is situated in the granodiorite which contacts with granulite-like stocks. High mineralization can be recognized in the brecciated granodiorite, which is of a cone shape and has dimensions of 300×200 m near the ground surface and 200×240 m at depth of 300 m. Four orebodies are included and they are crescent-shaped on a horizontal plane, having lengths of more than 400 m and an average thickness of 17.4 m.

The average content in Cu-Mo ore is 0.56 % Cu and 0.286 % Mo, while the average content in Mo-Cu ore is 0.14 % Cu and 0.054 % Mo. It also includes 0.01-0.02 g/t of gold and 2.0-6.7 g/t of silver (Table 2-2-3(1)).

Table 2-2-3(1) Ore reserves of Karatasskaya

Ore Body		1	2	4	Total
Ores	mil.t	38.6	24.7	14.2	77.5
Copper	th.t	130.0	89.6	34.8	254.4
Molybdenite	th.t	9.5	2.3	15.8	27.6
Magnetite	th.t	2,260	5,134	-	7,394
Copper	%	0.34	0.36	0.24	0.33
Molybdenite	%	0.02	0.01	0.11	0.036
Magnetite	%	5.86	20.8	-	9.5

Category B+C1

This ore deposit is located comparatively close to a railway station and transportation of ores to the Balkhash Smelter is relatively easy. Ore reserve is 77.5 million tons, but grades are rather low (0.33 % Cu, 0.036 % Mo). Taking into account that many skarn ore deposits form lenticular bonanza in general, review of the reserve and grade of respective orebodies is desired.

9) Other Ore Deposits

The Zhartas ore deposit is 15 km northeast of the Zhezkazgan ore deposit and 35 km northwest of the town of Zhezkazgan. The grade of copper is 1.93 % and the scale of the ore deposit is small, but further feasibility studies will be necessary, because it is close to the JSC "Zhezkazgantsvetmet".

The Bayskoye and Ozernoye ore fields are within 20 km of the Karagaily Mine and both have good infrastructure. Though the grade of porphyry copper is rather low, further review will be necessary because of the possible existence of bonanza zones.

Other ore deposits are either small in scale or low in grade.

(2) Other Regions

1) Prioskoe

The ore deposit of Prioskoe is located at the latitude of 50° 33'N and the longitude of 59° 00'E, at a distance of 10 km to the northwest of the Koktau Project in Aktubinskaya Province. The Priorikoe has the same geological and geomorphological situation as the Koktau.

It is a dry, steppe area having a continental climate. The altitude of the deposit is 230-240 m above sea level. The topography shows gentle rolling hills cut by the River Orb, which flows all year round and which is dammed.

The ore deposit is a Cupriferous Iron Sulphide and a Massive Sulphide. It is in the boundary between metamorphosed basic rocks of Silurian and an acidic rock, sericite silicified dacite.

The orebody is separated into two kinds of ore layers. The upper one is rich in chalcopyrite and lower one is rich in pyrite. The size of the orebody is 410 m in length, 120 m in width and 570 m thick.

The ore reserve of the Prioskoe is 38 million tons (C1) at average grades of 0.99 % Cu, 3.59 % Zn and 13g/t Ag.

2) Aralcha

The ore deposit of the Aralcha is located at the latitude of 50° 39'N and the longitude of 59° 28'E, a distance of 32 km to the northeast of the Koktau Project in Aktubinskaya Province. The orebody of the Aralcha is on the boundary with Russia and almost half of the reserve belongs to Russian.

The altitude of the deposit area is 270-280 m above sea level. The topography consists of planes and includes the River Aralcha.

The ore reserve of the Aralcha in Kazakhstan is 8 million tons at average grades of 2.30 % Cu, 2.83 % Zn, 0.2 g/t Au and 14 g/t Ag.

3) Avangard

The ore deposit of the Avangard is located at the latitude of 50° 37'N and the longitude of 59° 11'E, a distance of 17 km to the NNE of Koktau Project in Aktubinskaya Province.

The altitude of the deposit area is 270-315 m above sea level. The topography is principally rolling hills. The copper reserve of the Avangard is 191,000 tons.

4) Alaygy

The ore deposit of the Alaygyr is located a distance of 80 km to the southeast of Karaganda in Zhezkazgan Province. The area of the Alaygyr can be reached by road and is a distance of 60-100 km from the nearest railways.

The altitude of the deposit area is 600-800 m above sea level.

The ore deposit is a bedded ore type interlayered in rhyolite and continental sediments. It has three kinds of ores; oxide, the sulphide, the mixed. The main ore mineral is galena.

The ore body is separated into two ore layers. The upper one is rich in chalcopyrite and lower one is rich in pyrite. The size of the orebody is 410 m in length, 120 m in width and 570 m in thickness.

The ore reserve of the Alaygyr is 13 million tons at average grades of 5.9 % Pb, 70.4 g/t Cd, 28.3 g/t Ag and 622 g/t Sb.

It is planned to develop the Alaygyr deposit by underground mining with the following parameters.

Annual production of ore: 1 million tons

Capital cost: 160 million US dollars

2-3 Corporate Management and Data Base

2-3-1 Corporate Structure

The Non-ferrous Metals Industry of Kazakhstan had been centrally controlled by the administrative offices of the former USSR. before its break-up in December, 1991. The Government of the Republic of Kazakhstan, as a local government, did not have any appropriate offices to manage the Industry and formed a public corporation by restructuring the Ministry of Industry and Trade. The public corporation was further reformed to the National Joint Stock Company "Kazakhstan Tusti Metaldari" in August, 1992 in the course of privatization of industrial sectors as National Policy. The National Joint Stock Company rallied five subordinate enterprises under its management, as shown in Fig. 2-3-1(1). All combines producing copper, lead and zinc were placed in this organization. Despite the efforts of the Government, the non-ferrous metals industry did not attract many private investors in the following year. The sudden privatization put the combines into a critically difficult situation due to the lack of working capital and reduced their output sharply. In early 1994, the Government introduced a management contract scheme, in which management of the combines would be entrusted, on a contract basis for a limited period (3 to 5 years), to any private company that was able to take over the combines accumulated debts. At the present time, the management of major combines have been transferred to foreign or domestic firms as listed in Table 2-3-1 (1).

Table 2-3-1-(1) Combines Under Management Contract

Name of JSC	Manager Company	
	Name	Country
Zhezkazgantsvetmet	Samsung Deutchland	Germany (Korea)
Zhezkent MCC	Nova Resources	Switzerland
Zyryanovsk Lead Combine Leninogorsk PC UK Pb-Zn Combine	Ridder Investment (Kazmetal Export (Amlo Bank (Gerald Metals (Glencor	Kazakhstan Kazakhstan) Kazakhstan) USA) Switzerland)
EKCChC	Durlex	Russia

After the management was transferred, these combines virtually became independent of the Joint Stock Company "Tusti Metaldari". Meanwhile the Joint Stock Company was dissolved on January 20, 1996.

The corporate management system in Kazakhstan is believed to principally follow the system which was established in the era of the former USSR., and to be highly bureaucratic. The bureaucratic corporate structure in general has the following characteristics; (1) the function of every position of the structure is clearly and strictly defined, (2) functions are performed within a limited authority and hence within a limited responsibility as defined

(3) there is an authoritative hierarchy in which the upper orders the lower (4) instructions are transmitted in writing and performances are recorded in documents, (5) workers must be specifically trained for designated positions (6) trained workers are assigned to specific positions. The bureaucratic system used to be highly appreciated for its clear and strict definition with respect to every position of the corporate structure thereby eliminating conflict between positions, impulsive actions and personal relations in a corporate activity . Therefore, the system was expected to be highly reliable in allowing companies to successfully perform their activities and to achieve their expectations. In fact, this system is still considered suitable for corporations in the steel, non-ferrous metals or other industries which produce a large amount of a limited number of products.

However, a highly bureaucratic corporation will become extremely rigid and loose its ability to respond to changes in market needs or in other circumstances because it seeks ultimate job standardization and fine definition of authority and responsibility of every position. In recent years, the market of the non-ferrous metals industry has diversified into various industries which require products with a variety of specifications. In addition, competition is becoming more severe than ever because a number of mines have been developed and new smelters have been constructed at various locations in the world. A non-ferrous metals firm will certainly loose its market if it fails to swiftly respond to these changes. Accordingly, the firm is required to be flexible in its management system.

Corporate structures (organization charts) of major combines are shown in Appendix-##. They appear to be rather complicated and are hierarchically broken down into a number of divisions, departments or sections, probably according to a firm definition of their responsibilities and authorities. In a hierarchical corporate structure, firm orders are transmitted from top to bottom but it tends to be difficult to laterally communicate between divisions, departments or sections related to each other. Lack of lateral communication of this kind has often been observed in the courses of the current investigation. Raw data collected at operation sites are stored in the sections concerned. These data are integrated periodically and are reported upward to the higher levels of the hierarchical structure according to its rule. However, no exchange of data between sections appears to be carried out. The present management system of combines as above mentioned appears to be inefficient in terms of its ability to maximize production performance. Review and reform of the present corporate structure and management system are necessary improvements.

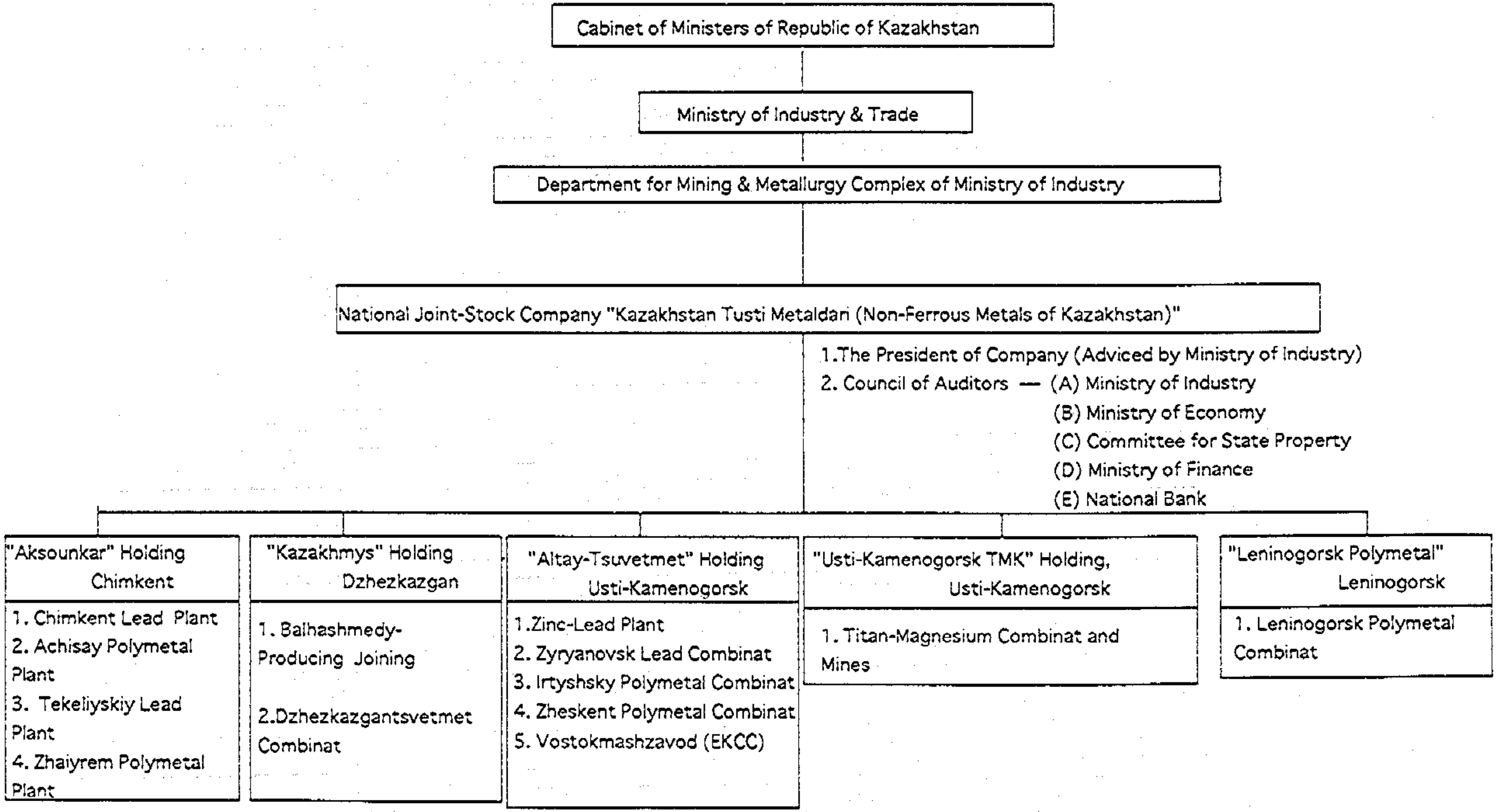

Fig 2-3-1 (1) Structure of Joint Stock Company 'Tusti Metaldari'

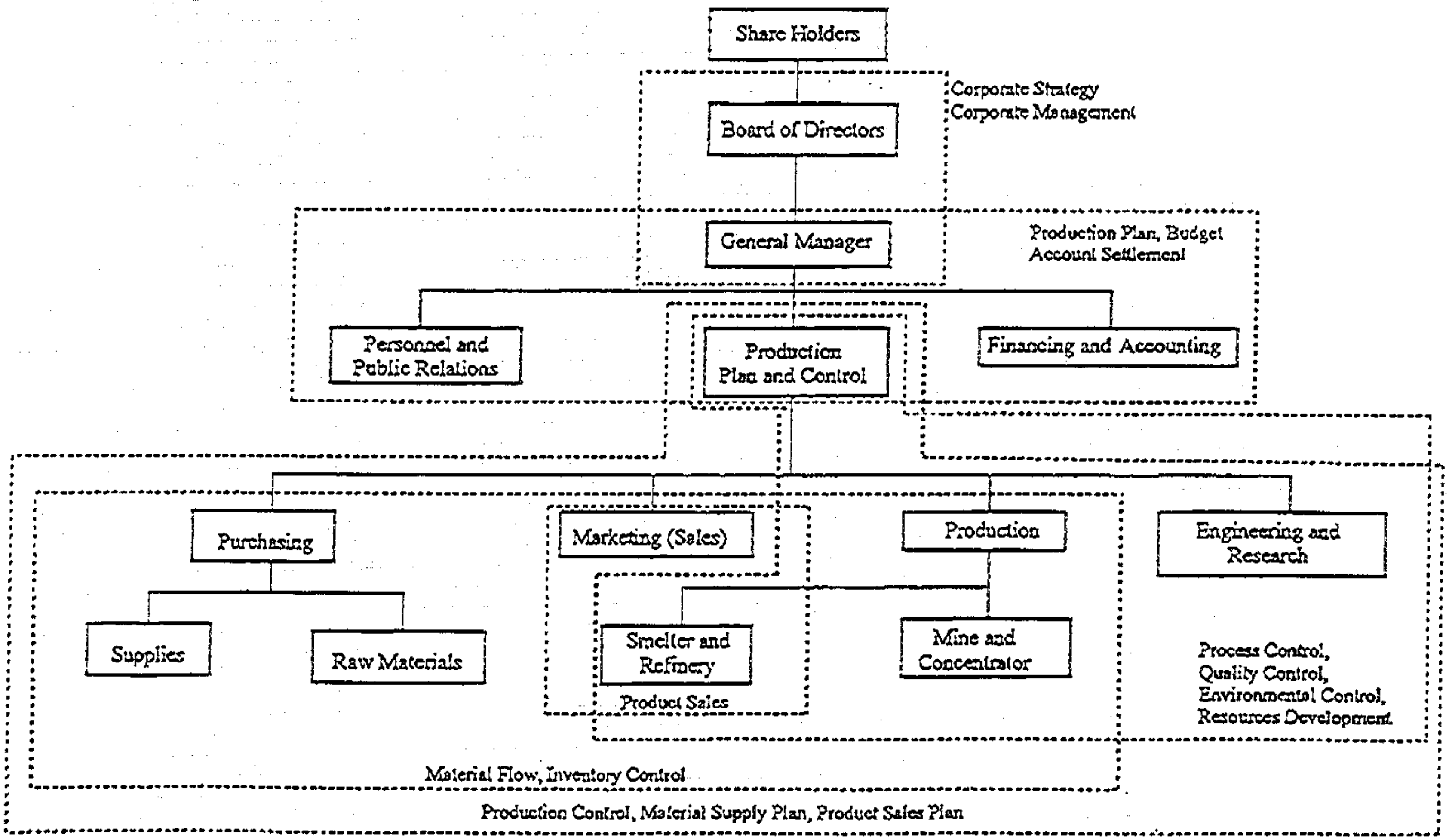

Fig. 2-3-1(2) Simplified Organization Chart of A Corporation

2-3-2 Management Practice

(1) Corporate Strategy

There is a fundamental difference between the corporate management system under the controlled economy and that under the free trade economy; the former is orientated to production or to employment, and the latter to profit or to product market. A production plan is determined according to national or social needs rather than corporate profit or product market. Although Kazakhstan is making an effort to shift towards the free trade economy, Kazakhstan's enterprises still keep this tradition to some extent in their management practice. Production plans which were determined a priors in the era of the former USSR., are now forced to be considerably reduced at most combines due to financial difficulty, obsolete facilities and equipment, insufficient supplies, shortage of raw materials and so forth. Table 2-3-2(1) indicates recent decline of metal production in the major combines.

Table 2-3-2(1) Metal Production 1990-1995 (Thousand Tons)

		Capacity	1990	1991	1992	1993	1994	1995
Copper								
	Zhezkazgantsvetmet	200	202	203	201	179	141	
	Balkhashmed	200	163	130	127	138	135	
	Irtysh (Blister)	60	32	37	31	30	26	N.A.
	Total (Excel. Blister)	400	365	333	328	317	276	
Lead								
	Ust-Kamenogorsk	150	93	107	97		48	
	Shymkent	150	134	135	153	124	81	
	Total	300	227	242	250		129	
Zinc								
	Ust-Kamenogorsk	300	178	151	155		118	
	Leninogorsk	140	87	90	117		55	
	Total	440	265	241	272		173	

Table 2-3-2 (2) Raw Material Sources of the JSC "Shymkent Lead Plant" and JSC "Balkhashmed"

	1992				1994			
	Sources	Material	Pb Content T.T.	Proportation %	Sources	Material	Pb Content T.T.	Proportation %
JSC "Shymkent Lead Plant"	JSC "Achpolymetal"	Conc.	33.5	21.2	JSC "Achpolymetal"	Conc.	2.5	3.2
	JSC "Zhezkazgantsvetmet"	Conc.	15.0	9.5	JSC "Tekeli Pb-Zn Combine"	Conc.	7.4	9.5
	JSC "Tekeli Pb-Zn Combine"	Conc.	2.0	1.3	JSC "Zezkazgantsvetmet"	Dust	4.4	5.7
	JSC "Akshatau Ken-Baiytu Combinaty"	Conc.	2.0	1.3				
	Others	Slag	2	1.3				
	Total Domestic		54.5	34.5	Total Domestic	0	14.3	18.4
	Almalik	Conc.	44.0	27.8	Uzbekistan	Conc.	16.4	21.2
	(Uzbek)	Slag	8.0	5.1	Tazikistan	Conc.	0.1	0.1
	Kansai	Conc.	30.0	19.0	Other Import	Conc.	46.7	60.3
	Adrasman	Conc.	14.0	8.9				
	(Tazik)							
	Other C.I.S.	Conc.	7.5	4.7				
	Total Import		103.5	65.5	Total Import		63.2	81.6
Total Raw Material			158.0	100	Total		77.5	100.0

	1992				1994			
	Sources	Material	Cu Content T.T.	Proportation %	Sources	Material	Cu Content T.T.	Proportation %
JSC "Balkhashmed"	Own	Conc.	39.1	20.0	Own	Conc.	29.6	23.8
	JSC "EKCChC"	Conc.	10.0	5.1	JSC "EKCChC"	Conc.	7.4	6.0
	JSC "Zhezkent MCC"	Conc.	17.0	8.7	JSC "Zhezkent MCC"	Conc.	14.0	11.3
	JSC "Leninogorsk PC"	Conc.	8.0	4.1	JSC "Leninogorsk PC"	Conc.	0.8	0.6
	JSC "Zyryanovsk Lead Combine"	Conc.	3.0	1.5	JSC "Zyryanovsk Lead Combine"	Conc.	2.8	2.3
	JSC "UKPb-Zn Combine"	Blister	31	15.8	JSC "UKPb-Zn Combine"	Blister	19.7	15.9
	Total Domestic		108.1	55.2	Total Domestic		74.3	59.9
	Erdenet	Conc.	55.5	28.3	Erdenet	Conc.	40.0	32.3
	Chuquicamata	Conc.	14.6	7.5				
	Escondida	Conc.	13.2	6.7	Escondida	Conc.	9.3	7.5
	Others	Conc.	4.5	2.3	Iran	Conc.	0.4	0.3
	Total Import		87.8	44.8	Total Import		49.7	40.1
Total Raw Material			195.9	100.0	Total		124.0	100.0

This JSC "Shymkent Lead Plant" was founded as a custom smelter to principally treat lead concentrates from the Almalik Combine in Uzbekistan and other sources in near by CIS countries. Similarly the JSC "Balkhashmed" treats a substantial amount of concentrates from sources other than its own mines, the Kounrad and Sayak, because outputs of these mines have considerably declined. Raw material sources of these combines are shown in Table 2-3-2(2). Raw material supplies to the smelters of both combines were considerably reduced both from domestic and foreign suppliers within the two years quoted in the table. Accordingly, these combines have been placed into critical situations in their productivity and hence in their economic viability. Securing raw material supplies is the most crucial and urgent subject of the corporate strategies of these combines.

The combines in East Kazakhstan which comprise mines and concentrators only, have been designated to supply raw materials either to the Ust-Kamenogorsk Lead and Zinc Smelters or to the Leninogorsk Zinc Smelter. Some of these combines are apparently unprofitable as aforementioned. Taking closure of unprofitable mines into consideration, alternative raw material supply sources must be reviewed for these lead and zinc smelters.

Among others, product marketing, environmental protection, public relations with associated communities and financing for investment and debt repayment are included in the major subjects of corporate strategy. It is believed that management practices common in the free trade economy are being adopted in those combines whose management has been transferred to foreign firms. However, no comprehensive corporate strategy has been indicated for the future of these combines.

(2) Production and Cost Control

Production rates used to be set taking little account of economic parameters. Cut-off grades in mining ores are also set at a certain level and are not revised in spite of significant changes in metal prices. Concentrate grades in Kazakhstan's concentrators appears to be substantially lower than those in the western operations, though the Zhezkazgan Concentrator produces high grade concentrates because of its mineralogy (chalcocite). The concentrate grade is very important in terms of transportation costs. Balances between mine outputs, concentrator feeds, concentrate production rates and smelter feeds are also important factors. Over production in one production line will increase inventory in others, which costs unnecessary expenses. Economic parameters should be continuously monitored to maintain optimum production quantity and quality.

Some combines, such as JSCs "Leninogorsk PC", "Balkhashmed" and "Zhezkazgantsvetmet", consist of mines, concentrators and smelter-refinery. Although these production sectors are included in a single entity, their performance should be assessed separately. Clear settlement of account must be placed at least between the mine-concentrator sector and the smelter-refinery sector, because, concentrates, intermediate products, are traded on the basis of international trade terms and conditions. Overheads, such as head office, internal transportation, public relations and other indirect costs, should be shared by each sector according to the degree of benefit it receives. This practice appears to be uncommon among Kazakhstan's enterprises. For example, the JSC "Balkhashmed made an operating profit as a whole combine in spite of apparent losses in the mine and concentrator sectors. In other word, the Balkhash Smelter bought more expensive raw materials from its own source than from other sources.

This cannot be justified from the management point of view in the free trade economy.

Each section of production lines is eager to achieve its own assigned tasks but tends to pay little attention to neighboring sections in terms of operating costs. Over production in one section will cause increase in inventory of intermediate products in the next section, while shortage of products in the upper section in the production lines will idle the operations in the lower section. Both cases will cost unnecessary expenses. This is a simple example of adverse effect caused by lack of communication between sections. It is necessary to improve inter-sectional or inter-departmental communication in order to achieve balanced performance in very section of production lines.

Transportation costs appear to have been ignored in Kazakhstan's non-ferrous metals operations, possibly because transportation charges, particularly for railways, have been traditionally inexpensive in Kazakhstan. For example, the Sayak ores, worth only about US$12 per ton, are transported by rail for a distance of some 200km to the Balkhash Smelter. There are other examples of this kind. However, it is reported that transportation costs are increasing recently as privatization progresses. Transportation is one of the important areas that the management should take into account in terms of operating costs. Similarly, recent increases in electricity charges are considerable as utility companies are being privatized. The worst case was the Tekeli Combine which was forced to cease its operation by stoppage of electricity supply due to accumulated unpaid bills. Transportation and utility services used to be provided by the Government but are in the course of privatization. No assessment has been made to date for appropriate pricing systems for transportation and electricity from economic points of view. It may become necessary in future for some combines to alter the present production facilities if the transportation and electricity charges drastically increase.

2-3-3 Data Base and Corporate Management

Elements directly related to productivity and production costs are controlled by each section of production lines. As aforementioned, raw data are collected on shift-to-shift or day-to-day basis and stored in each section of production lines. The raw data are periodically integrated and are reported to an administrative section of the department concerned. In each combine, raw data appear to be collected for most of the necessary items controlling operations in each section although instrumention is not necessarily appropriate for collecting adequate operational data. However, data are neither fed-back to production lines from administrative sections nor exchanged among sections or departments related to each other. Therefore, there is virtually no system to control production lines as a whole. Day-to-day operations are being carried out by following manuals which define operation procedures in extreme detail. These manuals have been prepared by specialized institutions who designed specific production lines. Therefore, when an operation faces difficulty, it is often necessary to consult with these institutions. Most of them are, unfortunately, located in Moscow or other locations beyond the international borders at the present time. Each section of production lines are intent only on assigned tasks but pay little attention to improvement. Failure in performance tends to be attributed to lack of spare parts or other materials due to insufficient budget and the real causes are often looked over. Needs of customers for qualities and prices are neglected. No attention is paid to efficient material flow and ultimately to maximum profit.

Although raw data are routinely collected on items necessary for production and cost control, there is no system for efficient utilization of the collected data. Therefore, it is necessary to construct an appropriate data storage retrieval system for achieving maximum efficiency in production lines. The roles of data bases in a corporate structure are schematically illustrated in Fig.2-3-3(1). Necessary information is exchanged between departments in order to achieve corporate performance as a whole.

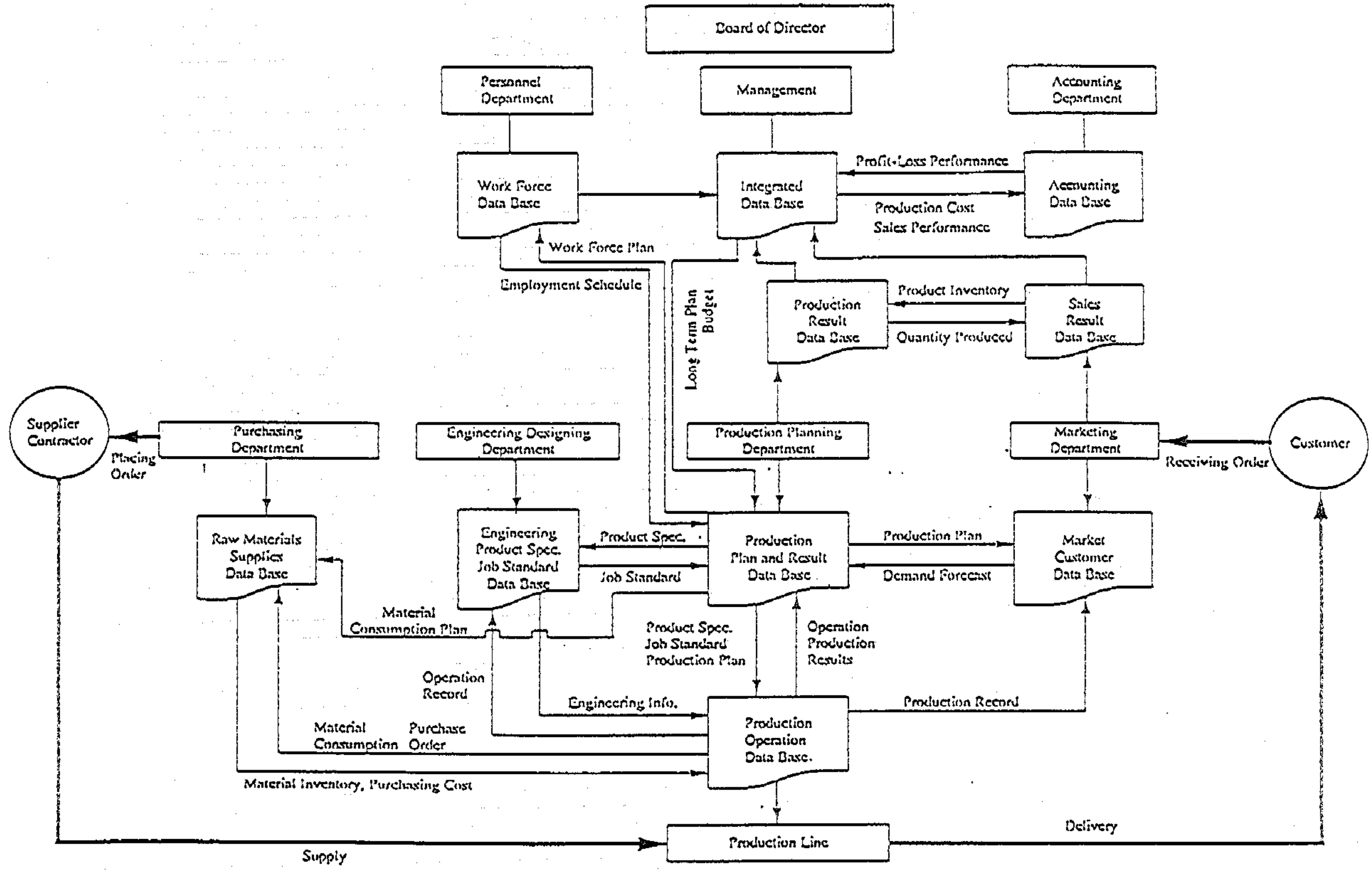

Fig. 2-3-3(1) Corporate Structure and Use of Data Base

3. Product Market

3. Product Market

3-1 Copper, Lead, Zinc and By-Products

3-1-1 Trend of Kazakhstan base metals (copper, lead, and zinc) production and trade

Introduction

Kazakhstan which became independent due to a collapse of the USSR at the end of 1991 is rich in useful mineral resources including non-ferrous metal and precious metal as well as fuel resources such as oil and gas and has attracted Western enterprises' attention immediately after its independence. There is no doubt that an exploitation of these resources at an early stage through capital participation of Western countries will greatly affect the international commodity market. However, exploitation of non-ferrous metal resource of this country is not necessarily going smoothly. There are many reasons for that. One reason is that Kazakhstan is a landlocked country without an access to the sea so that it is difficult to transport exploited resources and the transportation involves a heavy outlay. The supply system of raw material and equipment formed in the framework of the former USSR failed to function properly and the metal production is decreasing due to a shortage of raw material. However, exports to Western countries are increasing amid a decrease in production.

1. Trends in production and trade

The share of base metal production of the former Soviet Union by republic in 1990 is as shown in Table 3-1-1(1). As for copper ore and metal, Kazakhstan accounted for 32% and Uzbekistan accounted for 8%. As for lead, Uzbekistan, Russia, and Kazakhstan made up 15%, 20%, and 63% of the ore production, respectively. Russia and Kazakhstan accounted for 10% and 90%, respectively in terms of metal production.

It is noteworthy that Kazakhstan has a market share of 90% in metal. As for lead, Kazakhstan has a market share of 55% and Uzbekistan 6% in ore and Kazakhstan 46% and Uzbekistan 19% in metal. The above-mentioned shows that Central Asia, particularly Kazakhstan, among the former USSR, has a very large share of the base metal production. Trends for metal production and consumption in each country are described later. The non-ferrous metal industry in Kazakhstan, which has a great influence on an international commodity market of non-ferrous metal in the Central Asia, has a lot of problems such as a shortage of raw material and an increasing production cost. The operating rate of production facilities is about half and the production has sharply decreased as shown in Table 3-1-1(2).

Table 3-1-1(1) Production share of base metal in the former USSR by republic in 1990

(Unit: %)

	Copper		Lead		Zinc	
	Ore	Metal	Ore	Metal	Ore	Metal
Former USSR	100	100	100	100	100	100
Russia	58	60	20	10	38	33
Kazakhstan	32	32	63	90	55	46
Uzbekistan	8	8	15	-	6	19

(Source) D. Humphreys, "Mining and Metals in the CIS" (RILA, London, 1994)

Table 3-1-1(2) Transition of base metal production in Kazakhstan

(Compared to the previous year: %)

	1988	1989	1990	1991	1992	1993	1994
Copper	103.3	95.8	82.5	90.0	98.8	96.85	87.7
Lead	100.5	99.6	91.0	91.1	91.95	104.9	54.0
Zinc	102.3	96.5	92.8	92.8	87.9	103.0	72.3

(Source) Economy and Market Relation Research Center attached to Ministry of Economy in Republic of Kazakhstan

(1) Copper

As for copper production and consumption trends, the copper production of Kazakhstan in 1992 accounted for 3% of the world total production, which is not a small percentage at all. However, afterwards, the production slowed down and its share of world production declined to 2.5% in 1994. The consumption sharply decreased compared to a rate of decrease in production, and the domestic copper consumption in Kazakhstan, which was 115,000 tons in 1992, went down to 72,000 tons in 1994, nearly a 40% decrease. It is noteworthy that the Russia's consumption is decreasing more sharply than that of Kazakhstan. Sluggish demand caused by a domestic economic depression may be one of the major reasons for a decrease in consumption in both countries.

Export of Kazakhstan's copper to the Western countries amounted to 210,000 tons in 1994 when the production dwindled, about a 60% increase compared to the previous year because of a decrease in demand both in this country and CIS (See Table 3-1-1(3)~(6)). The other reason why the proportion of export to the Western countries to the production was increasing is that acquisition of foreign currencies became a number one priority for producing companies which were in such needy circumstances that they did not even have enough working capital. In Kazakhstan the Executive Order requires that only national foreign trading enterprises handle exports of non-ferrous metal. The authorities stated that a handling ratio of these enterprises was only 57 to 65%. This means that it is quite possible that Kazakhstan's exports of copper greatly exceed the number shown in Table 3-1-1(5).

In any case, at the present stage it can be said that Kazakhstan's copper has considerable influence in the international commodity market in terms of quantity. However, since exploitation of new mines is carried forward in various countries, mainly in South America, there is a prospect that copper will be over-supplied from now on in the global point of view. Therefore, it is quite possible that Kazakhstan's copper loses competitiveness in international markets unless the country can secure raw material or modernize its production facilities to a sufficient degree.

Table 3-1-1(3) Transition of copper production in the former USSR

(Unit: 1,000 tons)

	1990	1991	1992	1993	1994	1995
Former USSR	1,260.0	1,120.0	732.7	936.1	914.8	922.6
Kazakhstan			337.0	318.0	283.0	288.0
Russia			620.7	537.1	551.8	554.6
Uzbekistan			75.0	81.0	80.0	80.0

(Note) Metal production. The value of the former USSR in and after 1992 shows a total of the listed countries.

(Source) "World Metal Statistics" (Feb., 1996)

Table 3-1-1(4) Transition of copper consumption in the former USSR

(Unit: 1,000 tons)

	1990	1991	1992	1993	1994	1995
Former USSR	1,000.0	880.0	603.1	423.3	353.7	261.5
Kazakhstan			115.0	113.0	72.0	54.0
Russia			403.1	219.3	191.7	140.2
Ukraine			5.0	5.0	5.0	3.6
Uzbekistan			75.0	81.0	80.0	60.0
Others			5.0	5.0	5.0	3.7

(Note) The value of the former USSR in and after 1992 shows a total of the listed countries.

(Source) "World Metal Statistics" (Feb., 1996)

Table 3-1-1(5) Trends in exports of copper and zinc from Kazakhstan to Western countries

(Unit: 1,000 tons)

	1993	1994	1995
Copper	134.3	211.4	188.9
Zinc	84.2	106.1	118.3

(Source) Compiled by National Committee of Statistics and Analysis in Republic of Kazakhstan
"Kazakhstan's social and economic conditions, 1993" (Almaty, 1994)
"Kazakhstan's social and economic conditions, Jan., through Dec., 1994" (Almaty, 1995)
"Kazakhstan's social and economic conditions, Jan., 1996" (Almaty, 1996)

Table 3-1-1(6) Trends in exports of smelted copper and unprocessed copper alloy from Kazakhstan to Western countries in 1993

Trading partner	Exports (1,000 dollars)
Total	238,111
Breakdown	
Australia	9,311
England	24,907
Liechtenstein	19,323
Holland	31,189
Korea	22,058
Turkey	10,247
Finland	5,933
Germany	41,065
Switzerland	49,529

(Source) "Foreign economic activities in CIS countries in 1993" compiled by CIS Statistics Committee (Moscow, 1994)

(2) Lead

As for trends in lead production and consumption, it was described above that Kazakhstan has a share of 90% of the production of metal in the former USSR. As shown in Table 3-1-1(7), Kazakhstan, among the former USSR countries, has maintained an overwhelming share of the production since 1992 although it failed to amount to 90%. The lead production in the world in 1990 was 5,460,000 tons and the former USSR accounted for 7.5%, which was considerably high. However, its proportion decreased to 5.9% in 1992 and 1993. The proportion of Kazakhstan in these years were 4.5% and 4.6%, respectively.

Afterwards, the proportion of the former USSR in 1994 and 1995 declined to 3.5% and 3.6%, respectively, and that of Kazakhstan decreased to 2.7 and 2.9%. On the other hand, the domestic consumption in Kazakhstan was 30,000 to 35,000 tons, which was not large compared to the production, but that in Russia was 215,000 tons in 1992, which was considerably large. However, the domestic lead consumption in Russia has greatly decreased in these years and went down to 108,000 tons in 1994. Not much data is available on exports of lead from Kazakhstan to the Western countries.

The Research Center on Economy and Market attached to the Ministry of Economy in Kazakhstan stated that exports of smelted lead to Western countries in 1994 was about 10,000 tons.

Secondary recovery accounts for as high as 50% of the lead production from the global point of view. Even in this context, it is not likely that the Kazakhstan's presence will be greatly enhanced in the international commodity market.

Table 3-1-1(7) Transition in lead production in the former USSR

(Unit: 1,000 tons)

	1990	1991	1992	1993	1994	1995
Former USSR	410.0	360.0	318.4	319.9	193.6	193.3
Kazakhstan			242.5	255.0	150.3	150.3
Russia			37.9	44.9	34.3	34.0
Ukraine			38.0	20.0	9.0	9.0

(Note) Metal production. The value of the former USSR in and after 1992 shows a total of the listed countries.

(Source) "World Metal Statistics" (Feb., 1996)

Table 3-1-1(8) Transition of lead consumption in the former USSR

(Unit: 1,000 tons)

	1990	1991	1992	1993	1994	1995
Former USSR	380.0	310.0	260.0	221.1	148.5	111.4
Kazakhstan			35.0	30.0	30.0	22.5
Russia			215.0	181.1	108.5	81.4
Ukraine			-	-	-	-
Uzbekistan			-	-	-	-
Others			10.0	10.0	10.0	7.5

(Note) The value of the former USSR in and after 1992 shows a total of the listed countries.

(Source) "World Metal Statistics" (Feb., 1996)

(3) Zinc

As for trends in zinc production and consumption, as mentioned above, in 1990 Kazakhstan and Uzbekistan had a share of 46% and 19% of the former USSR's production in terms of metal, respectively. As shown in Table 3-1-1(9), although in both countries the production greatly declined in 1994, Kazakhstan has also maintained almost the same share since 1992 while the share in Uzbekistan declined to about 10%.

On the other hand, as shown in Table 3-1-1(10), the consumption in Uzbekistan was 10,000 tons in and after 1992 and there was no change. However, although the rate of decrease in consumption was smaller than that in production in Kazakhstan in 1994 when the production declined, the consumption also declined to 66,000 tons, a decrease of 20% compared to the previous year. Judging from these figures, it is thought that Kazakhstan has a larger surplus of supply capacity to overseas markets than Uzbekistan. The zinc production in Kazakhstan in 1993 accounted for 3.4% of the world total production and it can be said that this figure was considerably high. However, afterwards, the production remained low and the share of the world production declined to 2.4% in 1994 and 1995. The trends in exports of zinc from Kazakhstan to Western countries are as shown in Table 3-1-1(11). The production is greatly declining in Kazakhstan while exports to Western countries are increasing, and exports amounted to 118,300 tons in 1995.

As a whole, it can be said that trends in production, consumption, and exports of zinc in Kazakhstan are the same as those of copper in this country. From now on, if enough raw material is secured by such means as consignment smelting, Kazakhstan will continue to have a certain influence in the international commodity markets.

Table 3-1-1(9) Transition of zinc production in the former USSR

(Unit: 1,000 tons)

	1990	1991	1992	1993	1994	1995
Former USSR	640.0	540.0	511.1	517.5	364.5	393.6
Kazakhstan			231.7	238.5	172.6	172.6
Russia			186.4	204.0	137.9	167.0
Ukraine			13.0	5.0	14.0	14.0
Uzbekistan			80.0	70.0	40.0	40.0

(Note) Metal production. The value of the former USSR in and after 1992 shows a total of the listed countries.

(Source) "World Metal Statistics" (Feb., 1996)

Table 3-1-1(10) Transition of zinc consumption in the former USSR

(Unit: 1,000 tons)

	1990	1991	1992	1993	1994	1995
Former USSR	640.0	520.0	428.0	389.1	308.2	229.0
Kazakhstan			83.0	83.0	66.0	49.5
Russia			260.0	216.1	157.2	115.7
Ukraine			75.0	80.0	75.0	56.3
Uzbekistan			10.0	10.0	10.0	7.5

(Note) The value of the former USSR in and after 1992 shows a total of the listed countries.

(Source) "World Metal Statistics" (Feb., 1996)

Table 3-1-1(11) Trends in exports of unprocessed zinc from Kazakhstan to Western countries in 1993

Trading partner	Exports (1,000dollars)
Total	70,064
Breakdown	
Australia	3,600
Cyprus	398
North Korea	14,646
Holland	2,838
Slovakia	1,576
Turkey	7,178
Germany	11,785
Switzerland	16,689
Japan	4,910

(Source) "Foreign economic activities in CIS countries in 1993" compiled by CIS Statistics Committee (Moscow, 1994)

3-1-2 Market for the Products

(1) Chief Domestic Demand Field and Current Situation

Under the former central plan, Kazakhstan was given the role as base metal producers. The country's metal production was made domestically. The manufacturing industry will remain a restricted field.

Most of the metal from the smelters was shipped to Russia and Ukraine for their processing industry. After their independence in 1991, the domestic consumption for the secondary processed goods finally occurred. However, there is not much demand for the secondary processed goods.

① Copper

There is not much comparison between the amounts of copper consumption and production. There is activity for the wire rod at Dzhezkazgan, copper plate at Balkhash, enamel wire processing factory was built. Furthermore, Dzhezkazgan is building a 50,000 ton per year capacity wire rod factory that will be completed in 1997. Finland, US, Turkey, etc., are becoming interested in the manufacturer. Modern, new and powerful US equipment is in one part of the activity. These products are sold by Samsung Deutsche, which is owned by Korean capital, received management trust from Dzhezkazgan. Therefore, there is not much domestic sales of these products.

These semi-finished goods are shipped to the US, Europe and Asia.

② Lead

In 1994, the State ordered about 10,000 tons of lead. Lead consumption is most often for lead batteries for cars. Lead batteries for trucks are made by Taldy-Kurgan enterprise located near Tekeli. The maximum domestic metal consumption for truck lead batteries is 30,000 tons per year. Originally the lead batteries were for cold area use, for example, Russia, which consumes a considerable amount of lead. The normal consumption quantity in Western countries is 10 kg per battery depending on the car make. However, the lead consumption here is 26 kg for a large battery. In addition, Ust-Kamenogorsk and Shymkent have plans for the construction for a lead battery plant. In the past, lead batteries were produced for the military but now it is produced for the public demand. Kazakhstan's neighboring countries, China, are also located in many cold areas. The lead battery made in China has poor properties for low temperatures so if Kazakhstan could produce a good lead battery for these conditions, it would be able to sell its batteries in China.

In advanced countries, the lead battery has changed from antimony to calcium so the recycling of old battery is complicated. There are many problems concerning the import of lead batteries from the West which influences the operation of the smelter. The lead plant that MIT is developing depends on Shymkent, Ust-Kamenogorsk and Leninogorsk. These three combines will produce 2 million batteries per year if this plan is adopted. It is highly likely that this area will be developed.

③ Zinc

The consumption of zinc generally depends on the demand of the steel industry. If the iron consumption increases, the zinc consumption will increase. Now, the zinc coating industry in Kazakhstan is making plans but nothing has been decided. There is hope to develop the zinc coating industry because of increasing domestic zinc consumption. Leninogorsk and Ust-Kamenogorsk Lead-Zinc smelting plants produce coatings, anti-corrosion zinc and pellets used in dry batteries.

(2) Present Condition of Foreign Market

Before 1990 Kazakhstan traded in the former USSR but after its collapse, Kazakhstan could sell directly to Western countries. In 1994, Kazakhstan had markets in Switzerland, Netherlands and Turkey. In the base metal field, both countries lack of hard currency so almost all the trade is by barter to the CIS. In the case of barter, generally the sales price is 20% less than the market price. On the other hand trade with Western countries, the accounting is done by hard currency and the sales are at discounted prices. In the case of selling to North Korea, there are many problems in the accounting system but sales price is higher than other countries.

① The Copper Concentrate

From the early part of the 1980's the domestic production is trending down. Copper concentrate is imported from the Erdenet Mine in Mongolia. Originally, the Erdenet Mine was developed by a joint venture between the USSR and Mongolia. Since Mongolia does not have a smelter, it supplies copper concentrate to Russia and Urals. However in the 1990's, international trader, Marc Rich of Switzerland sent the Erdenet copper concentrate to the Balkhash smelting plant for tolling. In 1992, the Balkhash Smelting plant's concentrate supply of 170,000 tons came from the Erdenet Mine, Chile's Escondido and Chiquiquamata mines, etc., for tolling. The concentrator lacked domestic copper concentrate so it compensated by importing from Chile and Mongolia. However, these imported copper concentrates have a high concentration of arsenic. A small amount of this concentrate is used by blending it with other concentrates. Over a long period of time, these imported concentrates have piled up. As mentioned above at the JSC "Balkhashmed" after 1992, more than one-half of its concentrate supply was imported on a tolling basis. This imported concentrate had a high quantity of arsenic so plants at other countries were not able to accept it. The JSC "Balkhashmed" does not have special treatment technology for these concentrates. Under the free competition, these concentrates with high arsenic would have a high smelting cost. However, Balkhash uses the usual low price tolling agreement so it would not be aa fair trade under the free competitive system and trading can not continue only on the spot market. Since the condition of the tolling contract is changed by the gold and/or silver content and the copper market price, Balkhash was offered very severe terms. In 1992, the copper spot treatment charge was $0.37/lb but the actual tolling cost $0.249/lb (costs for freight, managing trading company and discount from the LME price) makes the net profit about $0.12/lb. The use of tolling helps maintain a high plant operating rate but the combinat is not able to earn a large profit. Therefore, smelting operations using tolling are unstable unless there is an exceptional supply demand balance at the world's smelters.

③ Unfinished Copper Products

Generally, the Kazakhstan unfinished products of the non-ferrous metals have a high content of gold and silver and other precious metals so it is not practicable to recover these metals when its prices are high.

The gold and silver production data was not disclosed yet so there is little available data. Blister produced at Irtysh Combine is exported Armabile of Uzbekistan. This trading is unusual so it is done on a case by case basis.

③ Refined Copper (Cathode)

The refined copper cathode produced in Kazakhstan is not registered as LME grade A. The cathode is shipped to the CIS and Europe. International trader,Marc Rich now Glencore, is involved in this trade. Therefore, there are large amounts of cathode exported to Switzerland. The Japanese trading company, Tomen, traded copper products from Dzhezkazgan. Now Samsung Group, which has a management contract with the enterprise, exports these products to Southeast Asia via Europe. Many small Russian capital traders sell cathode but the details of the trading are unclear.

④ Lead

Shymkent and Ust-Kamenogorsk smelting plants were importing over half of its raw materials. In 1992, the imported concentrate which contained 130,000 tons of lead metal from Uzbekistan, Turkmenstan and Russia. The domestic production of lead concentrate decreased and it is not expected to increase in the near future. There is only a small quantity of lead concentrate imported from the West indicating that it is difficult to receive lead concentrate from the CIS so it imports from the west. The drastic decrease of imports from the CIS is due to the lack of capital so one must pay before the concentrate is received.

On the other hand, the tolling of lead concentrate when the price is low, the increase of freight, handling cost, tax and electricity makes tolling not a good policy. Therefore, it is necessary to review the original strategy.

⑤ In 1994, the zinc concentrate supplied 97.3% of the smelting capacity, the production of zinc concentrate was stable and the country was able to be self-sufficient. The zinc concentrate was imported from China to JSC "UK Pb-Zn Combine" and JSC "Leninogorsk PC". Conversely, export of zinc concentrates were sent to Russia, Ukraine and Uzbekistan from JSC "Dzhezkazgantsvetmet" and Kentau Combinat. The zinc concentrate is freely traded depending on the location of each combinat. The export of zinc metals is for CIS countries, Europe and other Western countries.

3-2 Sulphur Market

3-2-1 Sulphur Supply and Demand in Kazakhstan

Sulphur must be dealt with one way or another in non-ferrous metals smelters because they treat sulphide minerals and emit sulphurous acid gases which are environmentally hazardous. In an ordinary procedure, sulfurous acid gases are fixed as sulphuric acid. Therefore, the market for sulphuric acid is one of the important factors which are studied for conditions of smelter location. In Kazakhstan, there is no industry, such as the heavy chemical industry, which consumes a large amount of sulphuric acid. Although statistical data obtained in the course of the current investigation are insufficient, a study is being made with respect to the domestic market for sulphuric acid.

The sulphuric acid supply and demand for the period between 1993 and 1995 is shown in Table 3-2-1(1).

Table 3-2-1(1) Supply and Demand of Sulphuric Acid in Kazakhstan

		1993	1994	1995
Supply	Smelters		552.9	493.7
	Copper		(215.1)	(183.6)
	Lead/Zinc		(337.8)	(310.1)
	Pyrite Combustion		240.0	240.0
	Elemental Sulphuric Combustion		240.0	240.0
	Import			57.9
	Total Supply	1179.0	1,032.8	1,031.6
Demand	Fertilizer	856.7	718.3	938.3
	Synthetic Fiber	1.5		
	Synthetic Rubber etc.	49.0	49.0	49.0
	Export		265.5	
	Total Demand	907.2	1032.8	987.3

The supply and demand are roughly balanced at around one million tons a year with a moderate surplus on the supply side. About one half of the total supply is accounted for by smelter production. Table 3-2-1(2) indicates annual capacities and productions at smelters. The annual production was recorded only at 552,927 tons in 1994 and at 493,748 tons in 1995, compared to the total capacity at 1,357,000 tons per annum. One of the major reasons may be attributed to reduction of smelter production as a whole due to reduced demand of sulphuric acid particularly in Russia.

Table 3-2-1(2) Sulphuric Acid Production Capacity of Smelters and their Actual Output

Smelter	Capacity	1994	1995	1996
Copper				
Zhezkazgan	350	126,661	101,804	120,000
Balkhash	240	88,456	81,792	84,000
Subtotal	590	215,117	183,596	204,000
Lead & Zinc				
Shymkent	125	40,284	11,521	10,000
Ust-Kamenogorsk	450	230,314	203,555	180,000
Leninogorsk	192	67,212	395,076	100,000
Subtotal	767	337,810	310,152	290,000
Total Smelter	1,357	552,927	493,748	494,000
Zhambyl Fertilizer	760	-	-	-
Aktubinsk Fertilizer	510	?	?	?
Akshatau Leaching Plant	-	-	-	-

According to the information obtained verbally in the course of the current investigation sulphuric acid produced by smelters was, in the past, consumed mainly for uranium leaching and that produced by combustion of imported pyrite ores was supplied to fertilizer plants in Kazakhstan. The users of sulphuric acid such as the fertilizer plants in Zhambur and Aktubinsk and the uranium leaching plant in Akshatau used to produce sulphuric acid for their own uses by combustion of imported pyrite or elemental sulphur. They are now forced to cease or reduce their sulphuric acid production possibly due to shortage of raw materials. The Ministry of Industry and Trade has estimated the forecast of fertilizer demand to the year 2000 as shown in Table 3-2-1(3). According to this forecast, demand for sulphuric acid will range between four to five million tons annually and will provide a sufficient market for sulphuric acid produced by smelters at their full production. In reality, however, there is a considerable discrepancy between the estimated demand at around 5 million tons and the actual consumption at approximately 940,000 tons in 1995. The forecast may be too optimistic.

Table 3-2-1(3) Forecast of Fertilizer Demand in Kazakhstan

Year	Total	Nitrogenous	Phosphorous	Potassium
1995	3,357	1,255	1,680	422
2000	3,475	1,310	1,723	442
2005	3,478	1,312	1,724	442
2010	3,499	1,319	1,732	448

In addition to the size of domestic market, there are some critical problems with respect to marketing of sulphuric acid as follows;

(1) It is reported that the sulphuric acid produced by smelters is high in impurity contents. The high impurity contents in fertilizer will lead to soil contamination, which is not environmentally desirable.

(2) Delivery of sulphuric acid to customers is not being made adequately in time and quantity by smelters because recycling of sulphuric acid carriers, is often refused by railway companies due to mounting unpaid bills for railway charges.

(3) Transportation costs are crucial for marketing of sulphuric acid with its low market price. Users, mainly fertilizer plants, are not necessarily located in the proximity of smelters and may look for other suppliers if the price of sulphuric acid including the transportation cost is too high.

3-2-2 Possible Uses of Sulphuric Acid in Industries Other than Fertilizer

Artificial gypsum is being produced from sulphuric acid at many smelters in the western world. While sulphuric acid is difficult to store because of its chemically reactive nature in liquid form, gypsum, having a solid form and chemically stable nature, can be stored outdoors without degeneration for a long period. It is commonly believed that artificial gypsum is not cost-competitive in Kazakhstan because there are many gypsum deposits which are being mined cheaply. However, sulphuric acid must be recovered in smelting sulphides from environmental reasons and, therefore, must be stored without causing any hazard to the environment if there is no market. Production of gypsum is an environmental issue rather than a matter of commercial interest.

Taking account of economic development of Kazakhstan, the following uses of gypsum are considered for potential markets.

(1) Gypsum is ordinarily mixed with cement up to 5% of total weight for adjustment of solidification time. As the requirement for construction work increases with economic development, consumption of cement, and hence of gypsum will also grow.

(2) Gypsum board is one of the most popular building materials. Although the present consumption of gypsum board for building materials is small, it is expected that the consumption will dramatically increase with a boom in building construction. Gypsum appears to be an ideal material for Kazakhstani style of building. For reference, the 1994 consumption of gypsum board per capita is recorded at 8.2m^2 in Canada and USA, 6.5m^2 in Sweden, 5.2m^2 in Finland, 2.8m^2 in Norway, France and U.K., 2.2m^2 in Germany and 4.6m^2 in Japan.

(3) Gypsum can also be used for improvement of alkaline soils in agriculture. It is reported in China that crop yield per unit area was significantly improved by mixing about 0.5% gypsum with alkaline soil containing sodium. A substance containing gypsum is being used in civil engineering. The substance is effective to harden soft ground for stabilizing bases of surface structures. It has been reported that a large amount of oxide ores are stockpiled at the Balkhash and Zhezkazgan Mine sites. Extraction of copper from the oxide ore is now being studied at the Balkhash Combine. A substantial amount of sulphuric acid will be consumed for extraction of copper by leaching.

3-2-3 Market Price

According to verbal communication at the JSC "Zhezkazgantsvetmet", the sales prices of sulphuric acid range from US$15 to 20 (occasionally upto 30) per ton, and are apparently much lower than the current prices in

Japan ranging between 12,000 and 19,000 yen per ton (approximately US$109 and 172 at the exchange rate of 110 yen for 1US$). Although price of goods are generally high in Japan compared to other countries, price difference of more than seven fold between the two countries appears to be unreasonable for producer's goods such as sulphuric acid. The low price in Kazakhstan may be inherited from the pricing system determined by the Central Government in the era of the former USSR. Pricing systems for producer's and consumer's goods in general appear to be still confused in Kazakhstan and will take some time to be stilled on the basis of supply and demand. The low price of sulphuric acid will discourage smelters from recovering sulphur in the course of smelting processes as much as possible, and may lead to further deterioration of the atmospheric environment.

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