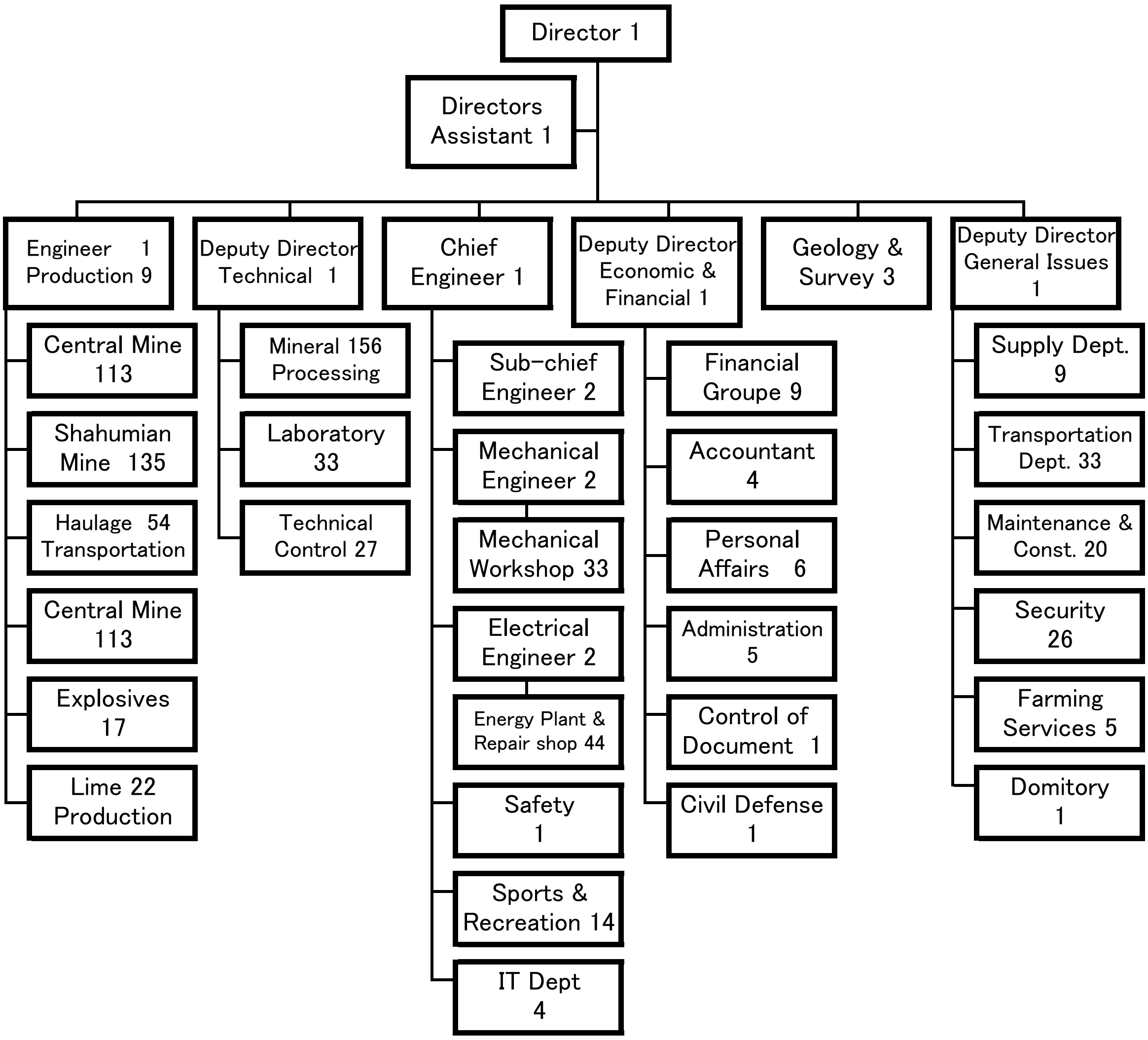
Appendix 3-2



N.B.1. "Haulage Transportation" includes ore and shaft transportation at the Central Mine
2. The personel for "environment" are included in "Production".
3. Dump trucks in the Open Pit are included in the "Transportation Dept.".

Organization Chart of the Kapan Mining Complex

Appendix 3-3

Main Mining Machinery

Mmachine	Type	Number		
		Cen'l U/G	Shahumian	Open Pit
0.25m^3 Rocker shovel	PPN-1	6	12	-
Scraper	LC-30,LC-55,LC-17	2	5	-
Long-hole driller	HKP-100M	3	5	1
Trolly locomotive	7KP,10KP,14KP	3	5	-
Mine car	VG-5,VG-4,VG-22	20	40	-
Vibrating feeder	LK-25	4	-	-
Jackhammer	PR-30,PP-54,PT-63	4	6	-
Stoper		3	4	-
Drilling machine	BTS-150	-	-	2
Cable shovel	A1001	-	-	3
Dump track	BELAZ(24t)	-	-	3
Bulldozer	DZ-132,Komatsu	-	-	2

Appendix 3-4

Kapan Mining Operations

1. Central Mine

Many ore deposits has been excavated since 1925. The current operation is in the Central Vein 6 and Stockwork 7～10 by underground methods as well as the Kavart Vein by open pit. An organization chart of the Central Mine is shown in Fig. 1. The Central Mine has two shifts (8 :00 ～14:00, 14:00～20:00) and works 6 days a week. Underground and open pit operations are described as follows.

1-1 Underground Operation

The main vertical underground structure in the Central Mine consists of the Central Shaft which connects the surface (1009 m Level) and 805 mL and No. 9 Shaft which connects 1095 mL and 805 mL. The horizontal main structure consists of the Main Adit on 805 mL and other main levels on 845 mL, 885 mL, 927 mL, 969 mL, 1009 mL, 1048 mL and 1095 mL, which are spaced at approximately 40 m intervals. The current mining area in the Central Mine is between 820 m～885 mL near the No.9 Shaft. Main machines for mining are jackhammers and rocker shovels driven by compressed air of 8 kg/cm^2, which are provided through ϕ220- mm steel pipes by a compressor located on the surface. In the Central Mine, there are many and very complex old drifts in mined-out areas just the same as other old mines.

Waste from development is backfilled in the mined stope so it does not have to be transported to the surface for the past 5 years.

The main fan installed at the entrance of the ventilation adit 1205 mL exhausts the air to the 1009 mL. The Mine has 6 small fans and uses them for local forced ventilation like development headings.

The main shaft has a double drum hoist with a man cage and counterweight for a maximum load of 7 t. Transportation of materials and miners is by the cage. Mined ore is dumped into two ore passes (OP) near the No.9 Shaft and drawn at 805 mL to be transported 7 km to the plant on the surface. The rail is 33 kg/m with a rail gauge of 750 mm. One train load with electric locomotive has 10 tippler-type mine cars with a capacity of 2.5 m^3 or 4.0 m^3 and one round trip requires one and half hours.

Water is discharged naturally with a current volume of 491,961 m^3 per year which is equivalent to 936 l /m.

1-2 Open Pit

The Open Pit is located near by the Central Shaft, some 2 km apart from the underground mining area. The ore deposit named Kavart was explored in 1964, and the mining operation began in 1965. But the operation was stopped in 1985 because of its low grade and some obstructions to mining like residences and a warehouse. Nevertheless the open pit operation was restarted in 2000 because of compensation for decreased production from the underground as well as the obstructions were removed.

The elevation of the pit is 1090 mL and the bottom is 930 mL. The bench height is 10 m.

Current mining levels are between 970 mL and 930 mL with 3 benches. The vein is excavated along the east-west direction. Two drills BTC-150 are used to drill 150-mm diameter holes 12 m long to prepare for 10-m high benches. Loading and transporting operation is carried out by the combination of three cable shovels A1001 with capacity of 1 m^3 and four 27 t dump trucks Belaz. Mined ore is transported and dumped to the OP some hundreds of meters apart from the pit and drawn at 805 mL to be transported to the plant by trolley locomotives.

The current mining site shows simultaneous blasting on 2 to 3 benches without separation between ore and waste so dilution seems to be considerably high. The JICA Team thinks that quantity is emphasized more than quality at the open pit due to a shortage of production from the underground.

The stripped waste was only 6,318 t in 2001, because the stripping ratio is 1:0.05, which is very small. It is the result of the low production amount compared with the pit size and poor dilution control.

2. Shahumian Mine

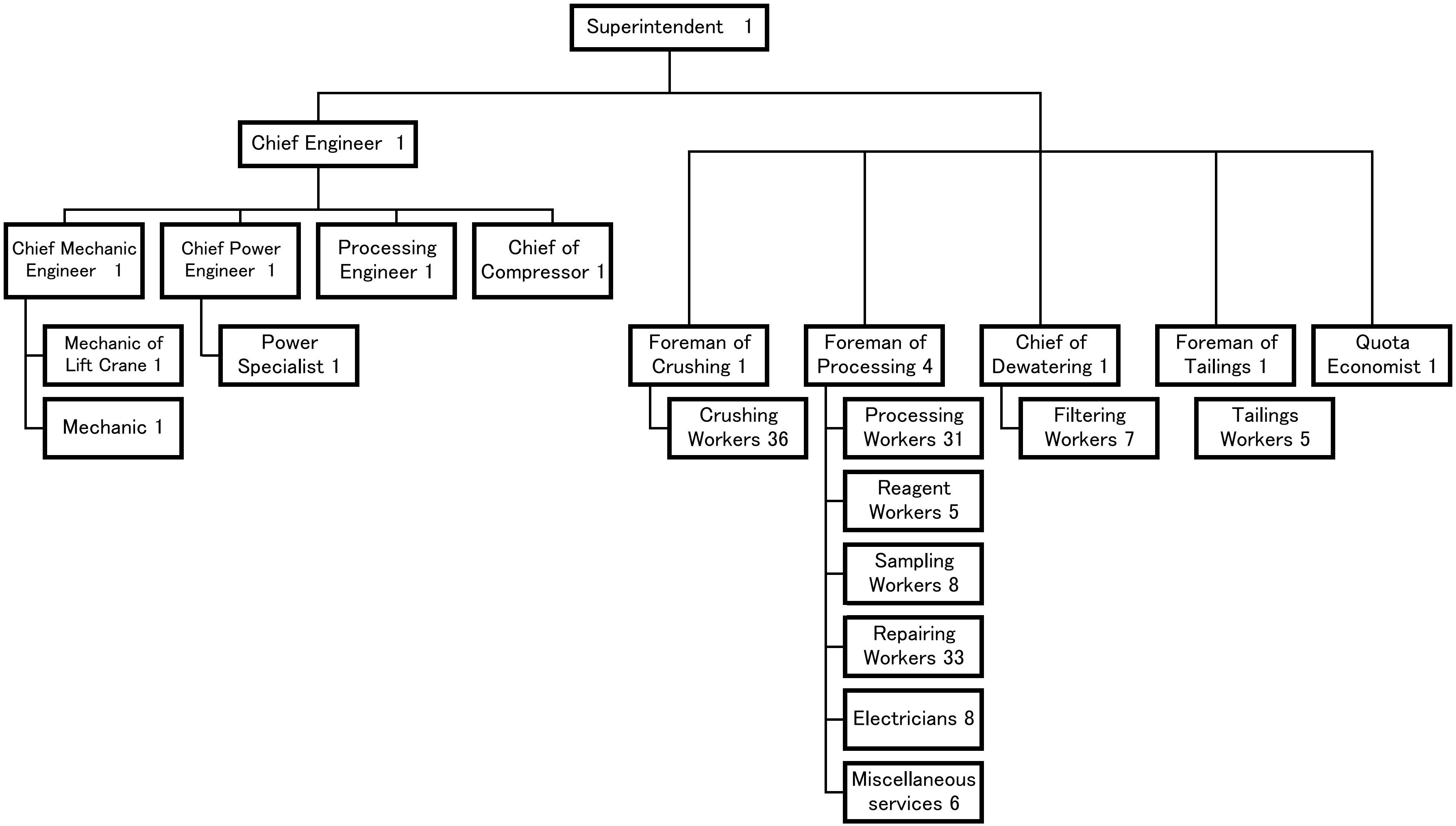
Until the 1920's, mining was carried out at only the Central Mine. The Shahumian polymetallic deposit containing copper, zinc, lead, gold and silver was discovered in the early 1930's. This deposit was mined until 1943. After the operation was suspended, further exploration was restarted during the 1980's including the sinking of two small shafts and mining of numerous drifts. Following the suspension resulting from the collapse of the former Soviet Union, the mine was reopened and further explored between 1995 and 1997. A decision was made to develop the mine and prepare the process to recover zinc and copper from the ore.

An organization chart for the Shahumian Mine is shown in Fig. 2. The Shahumian Mine has four shifts (8:00～14:00, 14:00～20:00, 20:00～2:00, 2:00～8:00) for 6 days a week. The Shahumian Mine operation is described as follows.

The underground structure of the Shahumian Mine is comparatively simple because it reopened recently. The developed levels are 780 mL and 820 mL, and there are several man-raises connecting these two levels in each mining block. The 780 mL in the Shahumian Mine is the same level as the 805 mL in the Central Mine, namely the mine level indicates the altitudes for each main mining area. The mined ore is loaded directly into mine cars by rocker shovels at the haulage 780 mL in sublevel and shrinkage mining blocks except for some sublevel stoping blocks where the ore is drawn by a scraper in a scraper drift driven along the vein 5 m above the 780 mL and loaded into mine cars through a chute. The 780 mL level is a main haulage tunnel with a maximum distance of 2 km to the processing plant. The rail is 24 kg/m with a rail gauge of 750 mm. One train load with a electric locomotive has 7 to 8 tippler-type mine cars with a capacity of 2.2 m^3 or 2.5 m^3 and one round trip requires half a hour. The waste produced underground is loaded into mine cars at the headings of drifts, transported in same manner as ore, stored in a waste chute on the surface and transported to a waste dump 5 km apart from the chute. Machines and compressed air pressure system are the same as the Central Mine.

The main axial fan VOD-30 installed at the entrance of the main adit 780mL exhausts the underground air to the opposite entrance on the same level. The Shahumian Mine has 8 small fans and uses them for local forced ventilation like development headings.

Water discharge is currently 190,000 m^3 per year, which is equivalent to 361 l /m. It is about one-third of the Central Mine due to its simple structure and discharged naturally at 708 mL. A ten-million-ton ore reserve is proved between 780mL and 380mL. The profitability of its development is said to have been calculated, but the cost for lifting water must be taken into prudent consideration.



Organization Chart of the Kapan Processing Plant

Appendix 3-6

Copper Processing Results

Year	Unit	1996	1997	1998	1999	2000	2001
Ore treated	t	295,989	178,996	188,846	108,570	88,937	181,441
Cu grade in crude ore	Cu %	0.86	0.79	0.75	0.69	0.58	0.55
Gold grade in crude ore	Au g/t						
Silver grade in ore	Ag g/t						
Cu conc. Production	t	10,073	6,158	5,262	3,135	1,686	3,561
Moisture in conc.	%	10-12	12	12	12	12	14
Cu grade in conc.	Cu %	23.59	21.58	25.1	22.03	22.5	22.83
Au grade in conc.	Au g/t	1.2	1.3	1.1	1.2	1.5	1.5
Ag grade in conc.	Ag g/t	48	50	40	45	50	50
As grade in conc.	As %	0.3	0.3	0.3	0.3	0.65	0.65
Cu recovery	%	93.35	93.98	93.75	92.19	73.54	81.47
Au recovery	%						

Appendix 3-7

Polymetallic Processing Results

Year	Unit	1996	1997	1998	1999	2000	2001
Ore treated	t	37,796	45,935	37,851	63,084	56,746	83,179
Cu grade in crude ore	Cu %	0.33	0.32	0.38	0.3	0.31	0.3
Zn grade in crude ore	Zn %	1.92	1.76	2.84	1.99	1.3	1.29
Pb grade in crude ore	Pb %	0.12	0.13	0.16	0.2	0.31	0.21
Au grade in crude ore	Au g/t	3.08	2.6	2.9	2.09	1.74	1.56
Ag grade in crude ore	Ag g/t	35.22	38.26	49.55	33.48	28.35	26.88
Cu conc. produced	t	566	613	631	921	804	1127
Mouisture in Cu conc.	%	10	14	16.6	14.5	15.4	16.7
Cu grade in Cu conc.	Cu %	15.64	16.55	17.17	14.79	14.79	15.18
Au grade in Cu conc.	Au g/t	62.5	51.92	79.13	67.66	56.78	62.69
Ag grade in Cu conc.	Ag g/t	973	944	1207	1180	1172	1269
As grade in Cu conc.	As %	0.3	0.3	0.3	0.3	0.3	0.3
Pb grade in Cu conc.	Pb %	2.8	2.8	2.9	6.5	5.5	4.5
Zn grade in Cu conc.	Zn %	4.62	5.89	6.81	6.5	6.91	5.93
Cu recovery in Cu conc.	%	70.97	69.02	74.93	71.96	67.57	68.56
Au recovery in Cu conc.	%	30.39	26.65	45.49	47.21	46.32	54.38
Ag recovery in Cu conc.	%	41.35	32.94	40.61	51.44	58.55	63.97
Zn conc. produced	t	1048	1120	1441	1687	971	1332
Mouisture in Zn conc.	%	8.6	11	11.6	13	13.5	13
Zn grade in Zn conc.	Zn %	53.1	54.44	57.38	52.23	54.39	55.93
Au grade in Zn conc.	Au g/t	18.75	17.63	20.89	20.86	15.67	18
Ag grade in Zn conc.	Ag g/t	327.3	322.7	375.2	327	269.7	317
Cd grade in Zn conc.	Cd g/t	3800	3600	4100	4100	4000	4100
Zn recovery in Zn conc.	%	71.03	75.42	76.95	69.74	71.46	69.66
Au recovery in Zn conc.	%	16.88	16.58	27.42	25.69	15.44	18.44
Ag recovery in Zn conc.	%	25.77	20.56	28.82	26.24	16.28	18.92

Appendix 3-8

Analysis Results of the Concentrate

Element	Unit	Central Cu conc.	Shahumian Cu conc.	Shahumian Zn conc.	Shahumian Pb conc.
Copper	%	22–26	14–16	1.5–2.0	2.07
Zinc	%	4.5	4–6	52–56	2.15
Lead	%	1.2–1.5	3.1	1.1	40
Gold	g/t	3.5–5.0	60–80	20	77.6
Silver	g/t	50–100	950–1200	320–370	1804
Cadmium	g/t	100＞	600	4100	541
Selenium	g/t	90–110	42–60	48	637
Bismuth	g/t	20–40	100–150	40–48	76
Tellurium	g/t	25–48	1200–1500	20	5026
Fluorine	%	–	–	0.11	–
Arsenic	%	0.4–0.7	0.3	0.02	0.4
Antimony	%	0.06–0.15	–	0.06	–
Sulphur	%	33	33	31.3	38
Alumina	%	–	–	0.8	3
Iron	%	30	25	2	30
Silica	%	6–8	2.5	3	2.5
Calcium	%	1	–	0.8	–
Chlorine	%	0.01	–	0.01	–
Cobalt	g/t	0.06	–	30	–
Mercury	g/t	5	–	2＞	–
Manganese	%	0.019	–	0.1	–
Nickel	%	0.01	–	–	–
Magnesium	%	0.8–1	–	–	–
Moisture	%	12	8–10	8	8–12

Appendix 3-9

Main Machinery for Processing

Name of machine	Type	Number	
		Copper	Polymetallic
Jaw Crusher	SHDK 900×1200 110kW	1	1
Primary cone crusher	KCD-2200A 250kW	1	0
Primary cone crusher	KCD-1750 160kW	0	1
Secondary cone crusher	KMDT-220T 250kW	1	0
Apron feeder	PPT-1	1	1
Belt conveyer		3	2
Rod mill	MCTS-2700×3600 400kW	2	1
Ball mill	MShP-2700×3600 400kW	2	1
Ball mill	MShP-2700×2100 315kW	0	1
Ball mill	MShTs-2700×3600 400kW	1	0
Ball mill (lime plant)	MShP-1500×1500 55kW	1	1
Spriral classifier	IKCH-24	2	1
Cyclone	GTs-50	4	4
Cyclone	GTs-35	0	4
Pneumatic flotation machine	AFM-2.5	48	0
Pneumatic flotation machine	FP-25pp	4	0
Flotation machine	FM-1.2	12	0
Flotation machine	FMP-3.2	6	0
Flotation machine	FM-0.4	1	24
Thickener	P-24	1	2
Thickener	Ts-9M	0	1
Thickener	Ts-4M-1	0	1
Drum vacuum filter	BOU-40-3	2	3
Drum vacuum filter	BOU-10	0	1
Blower	1200×25×3	1	0
Reagent feeder	PREW-3-4	20	48
Conditioning tank	KCh-3.15	0	2
Conditioning tank	KCh-6.3	0	2
Slurry pump	GRAK 400/40 350/40	3	2
Slurry pump	GRAK 160/38	5	0
Sand pump	5PS-10	6	2
Slurry pump	PB-63/25,63/22.5	4	4
Vertical pumps	PKPV 63/2275	8	4
Tailings slurry pumps	GRAK 400/40 350/40 450/67	10	0
Reagent pumps	X-20/18 or X-65-50-125	0	10
Pumps	3K-90-85		
Blower	TV-80	1	0

Appendix 3-10

Kapan Processing Operations

1. Copper Circuit Processing

A flow sheet for copper processing is shown in Fig.1.

Crushing

Electric locomotives transport copper ore from the Central haulage adit into a 360 t storage hopper. The mine cars are unloaded by means of a tippler. Crushing is carried out in three stages.

Ore is fed from the hopper by a apron feeder and conveyor into a 900×1200 mm jaw crusher. The crushed product is conveyed to a KSD-2200 secondary cone crusher set at 30 mm. The product gravitates to a KMDT-2200 tertiary cone crusher set at 10-12 mm. The crushed product is conveyed by means of two conveyors to a 5,000-t capacity fine ore bin.

Screens, which were previously incorporated in the circuit, have been bypassed due to blockages caused by clayey ore from the open pit. Product size is, therefore, relatively coarse at 80% passing 20-25 mm.

The crushing section is operated for six days a week in two shifts of 6 hours each.

Grinding

The crushed ore is fed from the fine ore bin by two belt feeders and conveyers operating two parallel sections. Primary grinding was designed to be carried out in two 3.6 m ×2.7 m rod mills at 16 rpm using 80 mm diameter rods. However, rods have been substituted by 100 mm balls recently due to a lack of finance for new stock of rods.

Secondary grinding takes place in two 3.6 m×2.7 m ball mills in a closed circuit with the two 2.4 m×9.0 m spiral classifiers. The classifier overflow gravitates to 2.7 m×2.7 m ball mills for secondary milling and is pumped back to the former spiral classifier. The classifier underflow is pumped to a cyclone, and the cyclone under is fed back to secondary milling and the cyclone over is fed to the copper flotation.

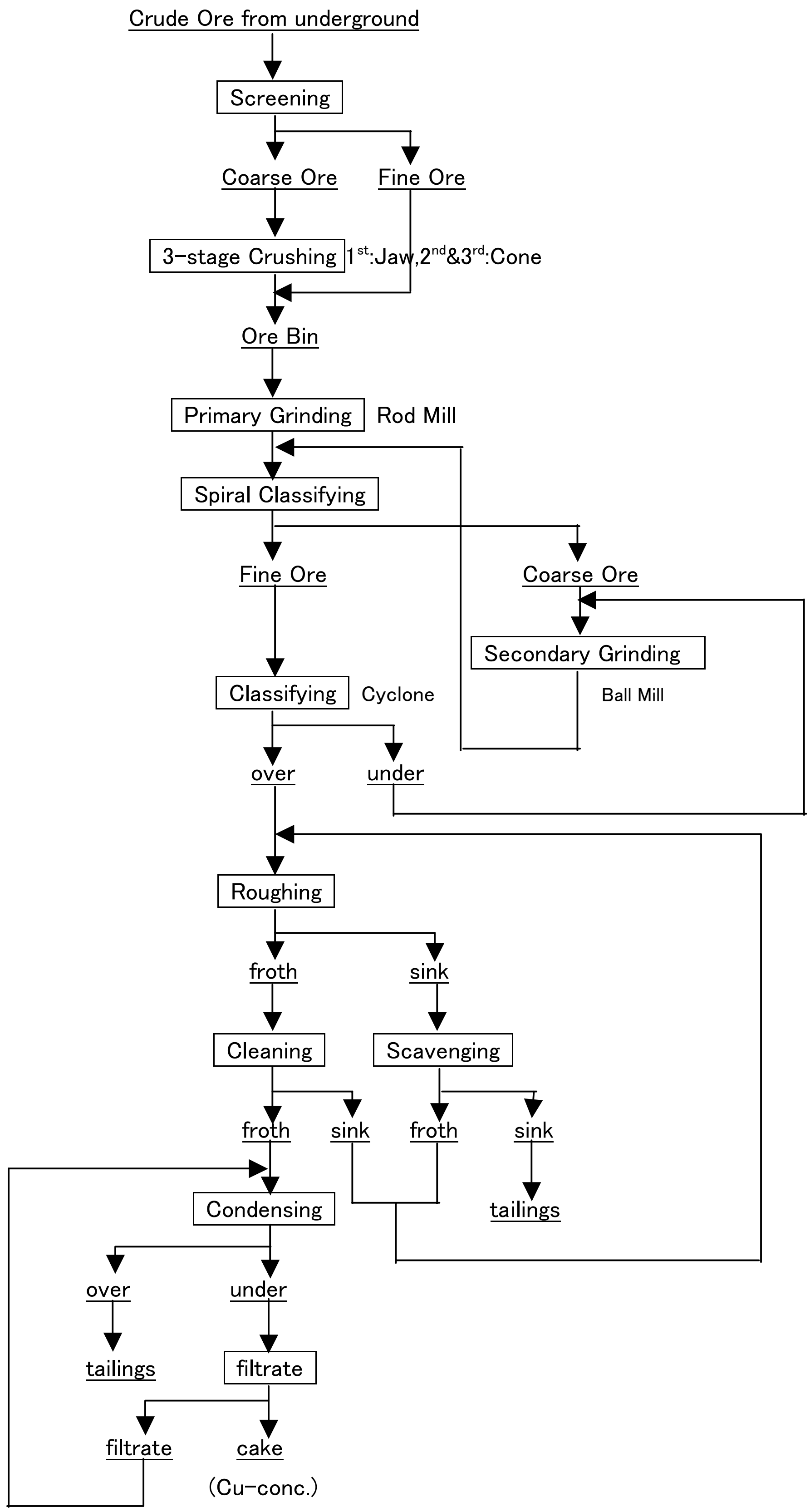


Fig.1 Flowsheet for the Central Copper Circuit

Flotation

Table 1 shows the reagent regime consumption for copper flotation.

Table 1 Copper Circuit Flotation Reagent Comsumption

Reagent	Point of addition	Dosage(g/t)
Potassium butyl xanthate	Roughing	13
MIBC or T80 frother	Roughing, cleaning	68
Lime	Roughing, scavenging	8500

The rougher flotation is carried out in two parallel banks of twelve 2.5-m^3 flotation cells while scavenger flotation is carried out in identical banks of cells. The scavenger tailings gravitate to one of two concrete channels, which carry tailings to Pump House No.1. Rougher flotation froths are pumped to a conventional cleaning circuit. Cleaner tailings are combined with the scavenger froth and fed back to the roughing. The cleaner froth form the final copper concentrate and gravitate to the thickener P-24.

Thickening and Filtration

The copper concentrate is thickened to 65 to 75% solid prior to filtration on two BOU-40 drum vacuum filters. Filtrate is pumped back to a thickener, which cleans the overflow from all other thickeners prior to discharge to the tailings pump house. Filter cake moisture is designed to be 10 to 12%, and the product is stored under a cover. All concentrate produced at the Kapan Mining Complex is transported to Iran.

2. Polymetallic Circuit Processing

A flowsheet for the polymetallic circuit is given in Fig. 2.

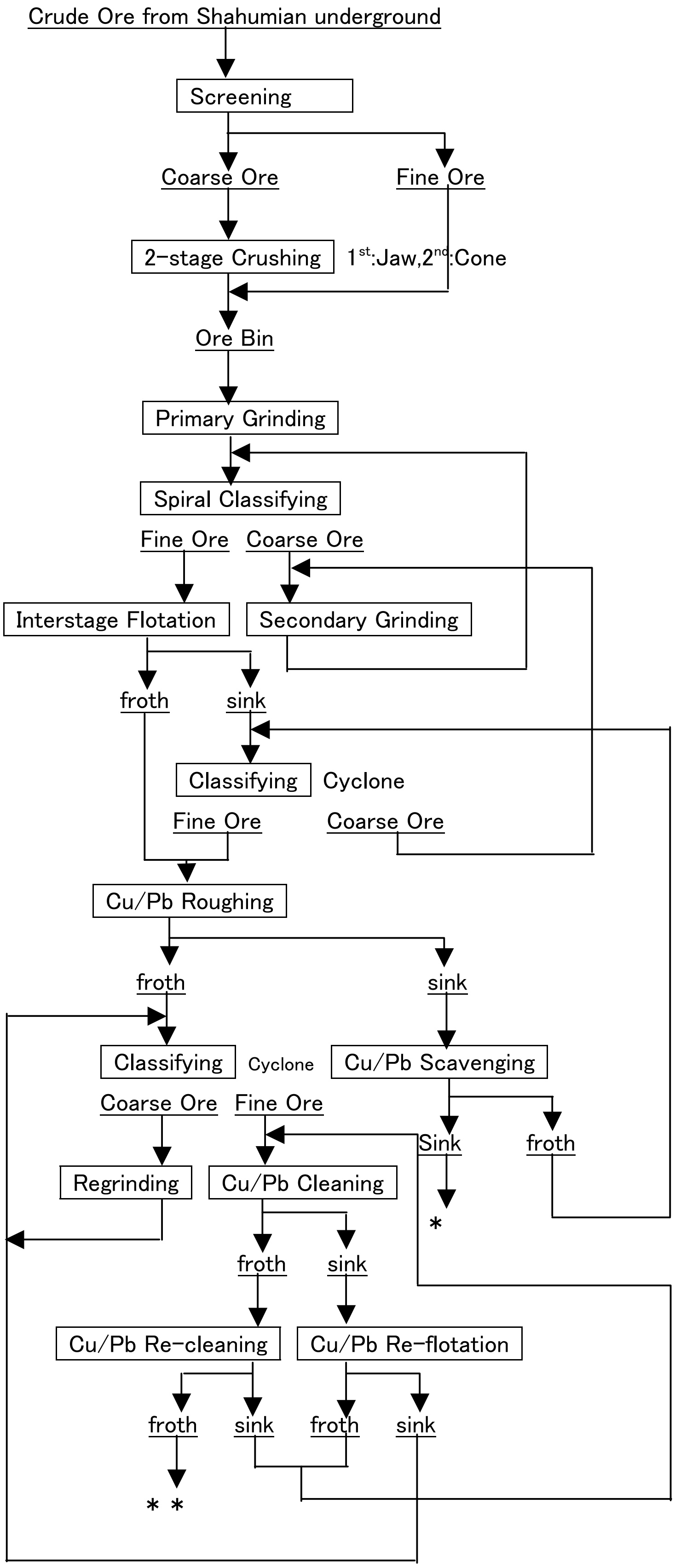
Crushing

The ore from mine cars is tipped into a 900×1200 mm jaw crusher which discharges into a KSD-1750 cone crusher. The secondary crushed product is conveyed to a 2,000-t capacity polymetallic fine ore bin that is located adjacent to the copper fine ore bin.

Grinding

The polymetallic ore is fed from the fine ore bin by manually adjusted feeders and conveyed to a 2.7 m×3.6 m rod mill. The rod mill discharges to a spiral classifier, which is in a closed circuit with a 2.7 m×3.6 m ball mill.

After a spiral classifier, the fine ore is fed to interstage flotation, and its sink is pumped to two 500-mm cyclones for final classification. The cyclone underflow returns to the ball mill while the overflow is sent to the copper-lead rougher flotation with the froth from the interstage flotation.


Crude Ore from Shahumian underground
Screening
Coarse Ore
Fine Ore
2-stage Crushing
1st:Jaw,2nd:Cone
Ore Bin
Primary Grinding
Spiral Classifying
Fine Ore
Coarse Ore
Interstage Flotation
Secondary Grinding
froth
sink
Classifying
Cyclone
Fine Ore
Coarse Ore
Cu/Pb Roughing
froth
sink
Classifying
Cyclone
Cu/Pb Scavenging
Coarse Ore
Fine Ore
Sink
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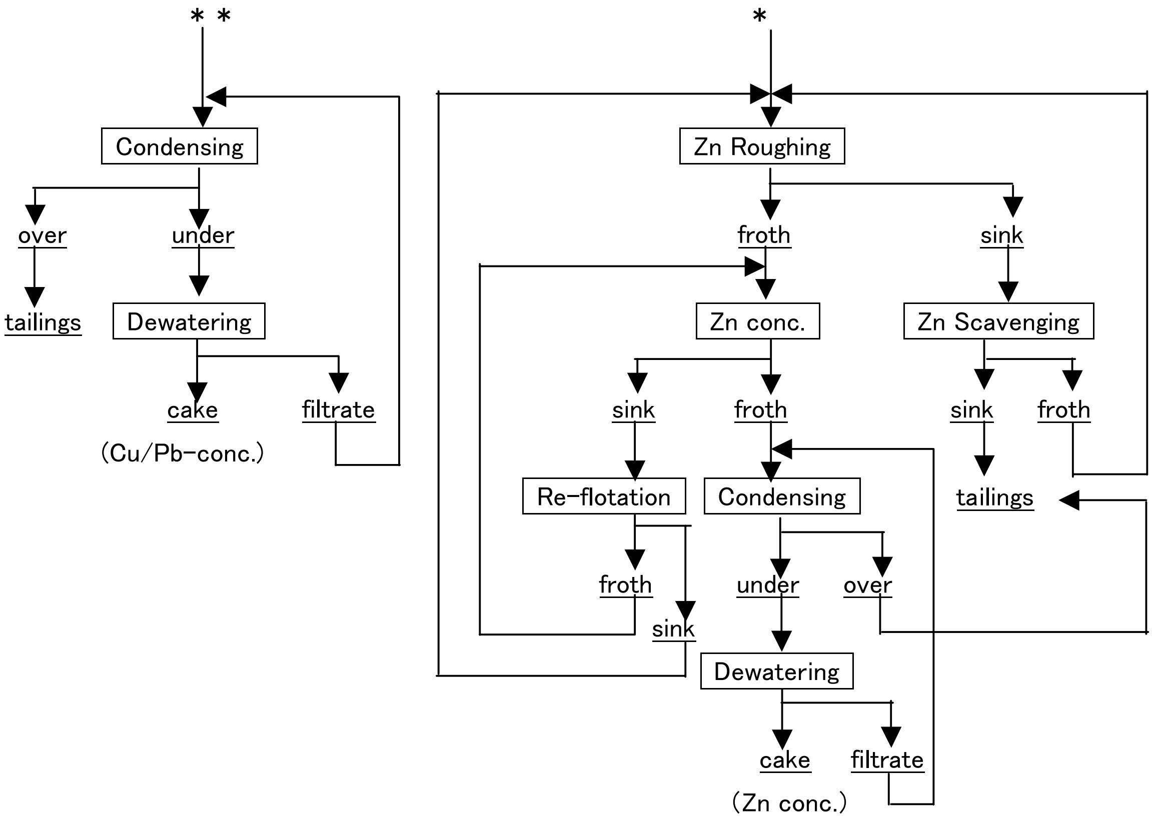


Fig.2 Flowsheet for Polymetallic Circuit

Copper–Lead Flotation

The copper–lead rougher flotation takes place in twenty 1.2–m^3 flotation cells. Rougher tailings are scavenged in nine similar cells with the scavenger froth feeding back to the 500–mm cyclone classifying. The scavenger sink forms the feed to the zinc circuit. The rougher froth is classified by a cyclone, and the under of the cyclone is sent back to a closed circuit of a 1.6 m × 1.6 m ball mill while the over of the cyclone is fed to eight cells for cleaning. The cleaning froth is a bulk copper–lead concentrate after re–cleaning. The cleaning sink is sent to re–flotation cells and its froth is fed back to the cleaning process with the re–cleaning sink. The re–flotation sink is combined with the re–grinding ore and sent to a closed circuit. A ball mill for re–grinding was not used owing to a shortage of balls when the JICA Team visited the site.

Zinc Flotation

Copper–lead scavenger flotation tailings are conditioned with lime and copper sulphate in three 1.2–m^3 flotation cells. Zinc rougher flotation takes place followed by zinc scavenging. The scavenger concentrate is returned to the rougher without regrinding while scavenger tailings form the final tailings. The zinc rougher concentrate is cleaned in three stages.

The reagents consumed in flotation are as follows.

Table 2 Reagent Consumption for Polymetallic Flotation

Reagent	Point of addition	Dosage(g/t)
Potassium butyl xanthate	Roughing, Cu/Zn flotation	125
MIBC or T80 frother	Cu/Pb roughing, cleaning	170
Lime	Roughing, Zn cleaning	11900
Zinc sulphate	Roughing, Cu cleaning	2000
Sodium sulphide	Cu/Pb flotation	50
Soda ash	Cu/Pb flotation	350
Copper sulphate	Zinc flotation	750
Flocculent	Thickening	10

Lead Flotation (planned)

Copper–lead separation has not been carried out in the past, but a bank of cells is installed. The planned method is to thicken the copper–lead concentrate and heat it to 60–70° C at which point galena is depressed. All necessary equipment was already purchased except a steam producer.

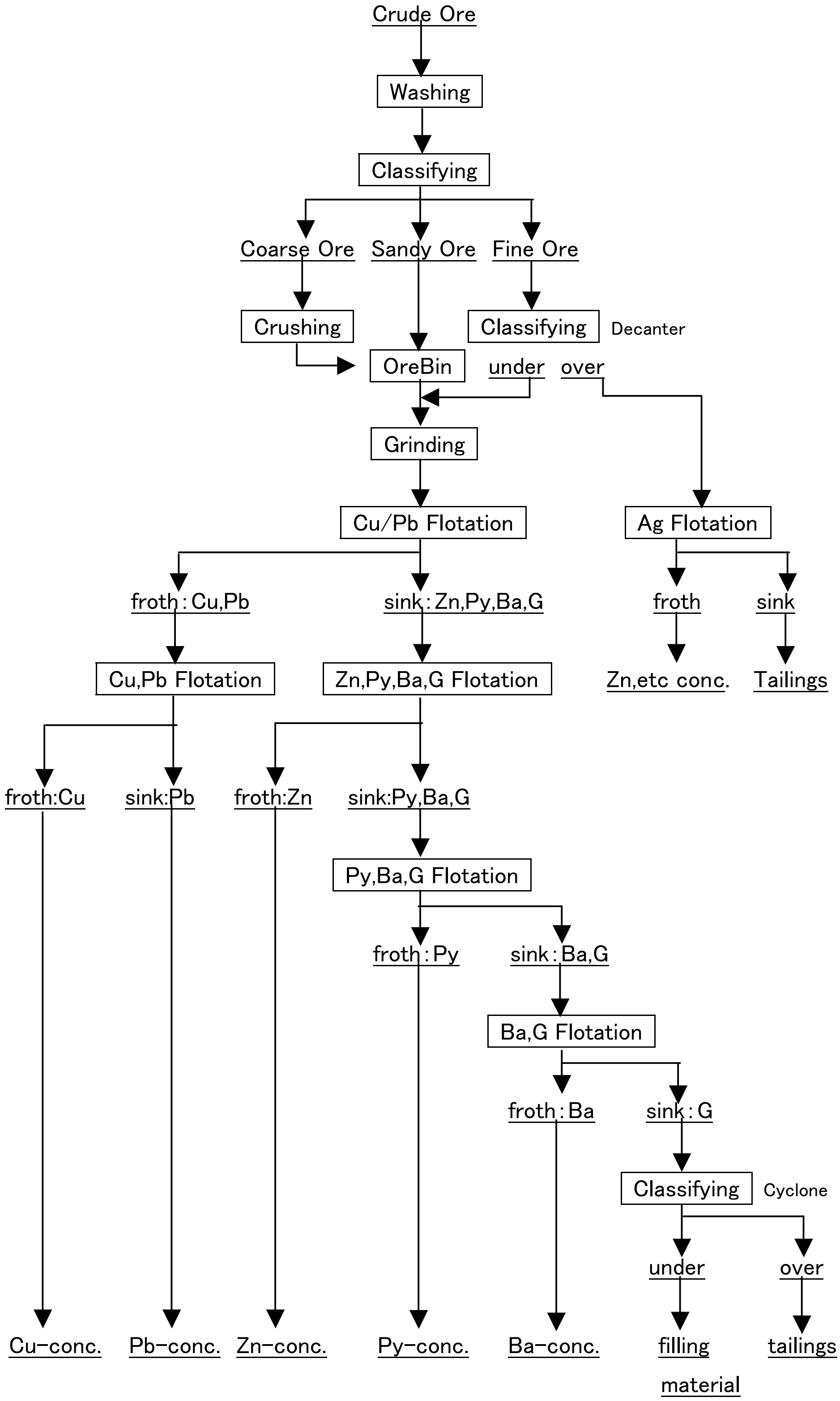
Japan has experience of the same copper–lead separating operation of "kuro–ko" by heat flotation at the Hanaoka Mine.

Thickening and Filtration

Gold bearing copper concentrates are thickened in a dedicated thickener and filtered on a single vacuum filter.

Zinc concentrate is thickened and filtered on two drum filters.

Appendix 3-11



One Example of Flowsheet for "Kuro-ko" in Japan

Appendix 3-12

Transition of Mine Workers' Number

Year	1996	1997	1998	1999	2000	2001
Administrative	189	167	160	165	150	155
Principal	279	210	196	208	202	232
Supplementary	507	431	379	391	353	386
Others	*25	*25	*25	*25	*25	25
Total	1,000	833	760	789	730	798

NB) 1. Administrative : upper post above engineer

2. Principal : foreman, drilling, loading, blasting, timbering, transporting, repairing track, crushing, grinding, adding reagent, filtering, lime producing, explosives producing, cable-shoveling, dump truck driving

3. Supplementary : mechanic, electrician, welding, lathe, blacksmith, shaft hoisting, shaft service, underground service, geological assistant, survey assistant, compressor operator, car driver, chemical analyzer, ventilation service, clothes- keeper, working wear washer, cap-lamp keeper, sweeper, Technical Dept. assistant

4. Others : other workers (Only a 2001 figure was obtained, so numbers of other years are estimated as same as 2001)

Appendix 3-13

Workers' Monthly Salary (in US$)

Year	1996	1997	1998	1999	2000	2001	Average
Central U/G miner	82.93	58.36	54.21	54.73	38.96	49.38	56.43
Central U/G transporter	84.79	59.98	55.18	54.78	50.47	54.27	59.91
Central O/P miner	–	–	–	67.89	47.57	52.02	55.83
Shahumian miner	92.66	60.24	52.96	61.16	51.32	55.32	62.28
Miners average	86.79	59.53	54.12	59.64	47.08	52.75	58.61
Processing workers ave.	62.63	46.01	39.93	38.73	35.01	37.51	43.30
Lime producer	–	–	–	–	45.68	52.01	48.85
Technical Control D. Assistant	51.98	34.74	31.4	32.47	28.13	34.92	35.61
Analyzer	44.15	31.54	30.51	28.49	23.98	29.38	31.34
Compressor operator	54.50	40.26	37.90	38.58	32.89	35.00	39.86
Explosives producer	–	–	59.52	54.84	47.24	46.84	52.11
Electrician	57.33	42.48	38.24	38.31	34.46	36.64	41.24
Mechanic	59.70	41.98	39.17	39.43	40.33	47.19	44.63
Car driver	58.23	43.66	38.31	39.17	39.30	47.00	44.28
Assistant of construction	57.54	39.69	34.41	35.81	33.71	35.93	39.52
Clerk	30.21	23.45	21.38	19.74	19.26	17.77	21.97

Appendix 3-14

Production Cost

Kind	Item	Unit	1996	1997	1998	1999	2000	2001
Central	Production	t	297,801	177,325	189,269	114,810	26,592	52,901
U/G	Mining cost	$	2,128,314	1,225,853	853,137	660,251	304,314	454,703
【variable】	Unit cost	$/t	7.15	6.91	4.51	5.75	11.44	8.60
Central	Production	t	0	0	0	1,832	57,320	128,109
O/P	Mining cost	$	0	0	0	3,264	118,332	217,846
【variable】	Unit cost	$/t	–	–	–	1.78	2.06	1.70
Shahumian	Production	t	37,765	48,421	44,074	71,747	52,689	87,534
Mine	Mining cost	$	370,987	361,197	257,987	469,531	378,796	488,809
【variable】	Unit cost	$/t	9.82	7.46	5.85	6.54	7.19	5.58
Cu-circuit	Ore	t	295,989	178,996	188,846	108,570	88,937	181,441
processing	Process cost	$	816,271	518,302	518,799	308,964	288,324	486,373
【variable】	Unit cost	$/t	2.76	2.9	2.75	2.85	3.24	2.68
Polymetallic	Ore	t	37,796	45,935	37,851	63,084	56,746	83,179
processing	Process cost	$	377,752	391,860	314,044	362,776	370,369	474,219
【variable】	Unit cost	$/t	9.99	8.53	8.3	5.75	6.53	5.70
Various cost	Ore	t	333,785	224,931	226,697	171,654	145,683	264,620
processing	Process cost	$	504,117	338,394	149,687	206,024	228,195	260,185
【variable】	Unit cost	$/t	1.51	1.50	0.66	1.20	1.57	0.98
Indirect cost		$						
【fixed】		$	23,058	19,682	19,372	214,934	12,335	5,320
Total treated ore – base	Total	t	333,785	224,931	226,697	171,654	145,683	264,620
	Total cost	1000$	4,220	2,855	2,113	2,226	1,701	2,387
	Unit cost	$/t	12.64	12.69	9.32	12.97	11.68	9.02
Total metal-base	Total	t	2,465	1,430	1,429	827	498	984
	Total cost	1000$	4,220	2,855	2,113	2,226	1,701	2,387
	Unit cost	$/t	1712.1	1996.0	1478.5	2692.2	3414.2	2425.7

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Cash Flow Analyses

1. Cash Flow Analysis for the Central Underground

Production of the Central Underground is assumed to be 100,000 t. The crude ore grade is assumed to be 0.80%, same as 2001. The concentrate grade and recovery are 25.10% and 93.78%, respectively in 1998 for values before the mixed treatment of the open pit ore.

Cost Assumptions

The unit mining cost is adopted from the results of 1996 when the Central underground operation worked normally. The unit processing and miscellaneous costs related to processing are adopted from the 2001 results. The main current production consists of two combination systems, Central Mine－copper process circuit and Shahumian Mine－polymetallic process circuit. The Central Mine consists of the underground and open pit. Therefore the indirect cost is assumed to be one-fourth of the 2001 cost. Accordingly, the assumed costs are shown in Table 1.

Table 1 Cost Assumption for the Central Underground

Item	Cost	Note
Unit mining cost	$7.15/t	1996
Unit processing cost	$2.68/t	2001
Unit miscellaneous costs in processing	$0.98/t	2001
Indirect cost	$1,330	1/4 of 2001

The analysis is listed in Table 2, and its result is a deficit of US$486,000. For the current metal price, it is difficult for the Central Underground to continue operating profitably unless a drastic cost reduction is done, which seems to be almost impossible.

Next, a cut-off ore grade was calculated with the same conditions as the above calculation to make the profit zero. The cut-off grade is 1.453%, which is too high to attain by stricter dilution control as shown in Table 3.

The minimum copper price was also calculated for the profit to break even. It shows a price of US$2,155/t as indicated in Table 4. It may take many years for the price to recover up to this level.

Table 2 Economic Simulation for the Central Underground

1	Item	Unit	2002
2	**Central Underground Production**		
3	1 Crude ore	000' t	100
4	2 Cu grade in crude ore	Cu %	0.80
5	**★Mining Costs for Central Underground**		
6	Unit mining cost for Central Underground	$/t	7.15
7	Total mining costs for Central Underground	$000's	715
8	**Central Underground Concentrate Production**		
9	3 Crude ore treated	000't	100
10	4 Cu grade in crude ore	Cu %	0.80
11	5 Cu recovery	%	93.78
12	6 Cu grade in concentrate	Cu %	25.1
13	7 Cu concentrate Produced	tons	2,989
14	8 As grade in concentrate	As %	0.3
15	9 Sb grade in concentrate	Sb%	0.01
16	**★Processing Costs for Central Underground**		
17	Unit processing cost for Central Underground ore	$/t	2.68
18	Unit miscellaneous cost in processing	$/t	0.98
19	Total processing costs for Central Underground ore	$000's	366
20	**Total Operating Cost for Central Underground**		
21	Total processing costs for Central Underground ore	$000's	1,081
22	Unit operating cost for Central Underground ore	$/t	10.81
23	**★Cost for Non-Production**		
24	**Total Cost for Non-Production**	$000's	1.33
25	Unit cost for non-production	$/t	0.01
26	**Total Cost for Central Underground**	$000's	1,082
27	Unit cost for Central Underground	$/t	10.82
28	**★Capital Costs**		
29	12 Mining equipment	$000's	0
30	13 Processing equipment	$000's	0
31	14 Ancillary equipment	$000's	0
32	15 Working capital	$000's	0
33	**Total Capital Cost**	$000's	0
34	**Total Costs including Capital**	$000's	1,082
35	**Central Underground Concentrates Prices Calculation**		
36	**☆Copper Concentrate Net Value**		
37	16 Moisture content	%	11
38	17 Copper price	$/t	1479.6
39	18 Unit deduction	% Cu	1.0
40	19 Percentage payable	%	100
41	20 Treatment cost	$/t	80
42	21 Refining cost	$/lb.	0.065
43	22 Penalty for As	$/0.1%	2.5
44	25 Transportation cost	$/wet t	30
45	26 Revenue per ton concentrate	$/t	357
46	27 Treatment charge per t concentrate	$/t	80
47	28 Refining charge per t concentrate	$/t	35.97
48	29 Penalty for As per t concentrate	$/t	7.50
49	32 Transportation cost per t concentrate	$/t	33.71
50	33 **Cu net value per t concentrate**	$/t	199.40
51	34 **Revenue for Central U/G Cu concentrates**	$000's	596.01
52	**Total Revenue**	$000's	596
53	**Total Cost**	$000's	1,082
54	**Net Revenue Before Tax**	$000's	-486

Table 3 Cut-off Grade Calculation for the Central Underground

1	Item	Unit	2002
2	**Central Underground Production**		
3	1 Crude ore	000' t	100
4	2 Cu grade in crude ore	Cu %	1.45
5	**★Mining Costs for Central Underground**		
6	Unit mining cost for Central Underground	$/t	7.15
7	Total mining costs for Central Underground	$000's	715
8	**Central Underground Concentrate Production**		
9	3 Crude ore treated	000't	100
10	4 Cu grade in crude ore	Cu %	1.45
11	5 Cu recovery	%	93.78
12	6 Cu grade in concentrate	Cu %	25.1
13	7 Cu concentrate Produced	tons	5,429
14	8 As grade in concentrate	As %	0.3
15	9 Sb grade in concentrate	Sb%	0.01
16	**★Processing Costs for Central Underground**		
17	Unit processing cost for Central Underground ore	$/t	2.68
18	Unit miscellaneous cost in processing	$/t	0.98
19	Total processing costs for Central Underground ore	$000's	366
20	**Total Operating Cost for Central Underground**		
21	Total processing costs for Central Underground ore	$000's	1,081
22	Unit operating cost for Central Underground ore	$/t	10.81
23	**★Cost for Non-Production**		
24	**Total Cost for Non-Production**	$000's	1.33
25	Unit cost for non-production	$/t	0.01
26	**Total Cost for Central Underground**	$000's	1,082
27	Unit cost for Central Underground	$/t	10.82
28	**★Capital Costs**		
29	12 Mining equipment	$000's	0
30	13 Processing equipment	$000's	0
31	14 Ancillary equipment	$000's	0
32	15 Working capital	$000's	0
33	**Total Capital Cost**	$000's	0
34	**Total Costs including Capital**	$000's	1,082
35	**Central Underground Concentrates Prices Calculation**		
36	**☆Copper Concentrate Net Value**		
37	16 Moisture content	%	11
38	17 Copper price	$/t	1479.6
39	18 Unit deduction	% Cu	1.0
40	19 Percentage payable	%	100
41	20 Treatment cost	$/t	80
42	21 Refining cost	$/lb.	0.065
43	22 Penalty for As	$/0.1%	2.5
44	25 Transportation cost	$/wet t	30
45	26 Revenue per ton concentrate	$/t	357
46	27 Treatment charge per t concentrate	$/t	80
47	28 Refining charge per t concentrate	$/t	35.97
48	29 Penalty for As per t concentrate	$/t	7.50
49	32 Transportation cost per t concentrate	$/t	33.71
50	33 **Cu net value per t concentrate**	$/t	199.40
51	34 **Revenue for Central U/G Cu concentrates**	$000's	1082.50
52	**Total Revenue**	$000's	1,083
53	**Total Cost**	$000's	1,082
54	**Net Revenue Before Tax**	$000's	0

Table 4 Break-even Copper Price Calculation for the Central Underground

1	Item	Unit	2002
2	**Central Underground Production**		
3	1 Crude ore	000' t	100
4	2 Cu grade in crude ore	Cu %	0.80
5	**★Mining Costs for Central Underground**		
6	Unit mining cost for Central Underground	$/t	7.15
7	Total mining costs for Central Underground	$000's	715
8	**Central Underground Concentrate Production**		
9	3 Crude ore treated	000't	100
10	4 Cu grade in crude ore	Cu %	0.80
11	5 Cu recovery	%	93.78
12	6 Cu grade in concentrate	Cu %	25.1
13	7 Cu concentrate Produced	tons	2,989
14	8 As grade in concentrate	As %	0.3
15	9 Sb grade in concentrate	Sb%	0.01
16	**★Processing Costs for Central Underground**		
17	Unit processing cost for Central Underground ore	$/t	2.68
18	Unit miscellaneous cost in processing	$/t	0.98
19	Total processing costs for Central Underground ore	$000's	366
20	**Total Operating Cost for Central Underground**		
21	Total processing costs for Central Underground ore	$000's	1,081
22	Unit operating cost for Central Underground ore	$/t	10.81
23	**★Cost for Non-Production**		
24	**Total Cost for Non-Production**	$000's	1.33
25	Unit cost for non-production	$/t	0.01
26	**Total Cost for Central Underground**	$000's	1,082
27	Unit cost for Central Underground	$/t	10.82
28	**★Capital Costs**		
29	12 Mining equipment	$000's	0
30	13 Processing equipment	$000's	0
31	14 Ancillary equipment	$000's	0
32	15 Working capital	$000's	0
33	**Total Capital Cost**	$000's	0
34	**Total Costs including Capital**	$000's	1,082
35	**Central Underground Concentrates Prices Calculation**		
36	**☆Copper Concentrate Net Value**		
37	16 Moisture content	%	11
38	17 Copper price	$/t	2155
39	18 Unit deduction	% Cu	1.0
40	19 Percentage payable	%	100
41	20 Treatment cost	$/t	80
42	21 Refining cost	$/lb.	0.065
43	22 Penalty for As	$/0.1%	2.5
44	25 Transportation cost	$/wet t	30
45	26 Revenue per ton concentrate	$/t	519
46	27 Treatment charge per t concentrate	$/t	80
47	28 Refining charge per t concentrate	$/t	35.97
48	29 Penalty for As per t concentrate	$/t	7.50
49	32 Transportation cost per t concentrate	$/t	33.71
50	33 **Cu net value per t concentrate**	$/t	362.17
51	34 **Revenue for Central U/G Cu concentrates**	$000's	1082.54
52	**Total Revenue**	$000's	1,083
53	**Total Cost**	$000's	1,082
54	**Net Revenue Before Tax**	$000's	0