REPORT I

THE MINERAL EXPLORATION

THE RAKAH AREA, SULTANATE OF OMAN

FINAL REPORT

WOLUME IN (MINE DEVELOPMENT)

FEBRUARY 1990

JAPAN INTERNATIONAL COOPERATIONAL AGENCY METAL MINING AGENCY OF JAPAN

MPN CR(3) 90-39

Na 35

REPORT ON THE MINERAL EXPLORATION IN THE RAKAH AREA, SULTANATE OF OMAN

.

FINAL REPORT

VOLUME II (MINE DEVELOPMENT)

FEBRUARY 1990

JAPAN INTERNATIONAL COOPERATIONAL AGENCY METAL MINING AGENCY OF JAPAN

PREFACE

In response to the Government of the Sultanate of Oman, the Japanese Government decided to conduct a Preliminary Feasibility Study for Mine Development Project in Rakah Area and entrusted the survey to Japan International Cooperation Agency (JICA) and Metal Mining Agency of Japan (MMAJ).

The JICA and MMAJ sent to the Sultanate of Oman a survey team for two field seasons from 1988 to 1989, headed by Mr. Takehiko Nagamatsu. The team exchanged views with the officials concerned of the Govenment of the Sultanate of Oman and conducted a field survey in the Rakah area. After the field survey, further studies were made and present reports have been prepared.

The reports consist of three volumes. The summary of the work, exploration results and the preliminary feasibility study for mine development are given in Volume I, II and III respectively.

We hope that this report will serve for the development of the project and contribute to the promotion of friendly relations between our two countries.

We wish to express our deep appreciation to the officials concerned of the Government of the Sultanate of Oman for their close cooperation extended to the team.

February, 1990

Kensuke Managija

Kensuke Yanagiya President Japan International Cooperation Agency

Gen-ichi Fukuhara President Metal Mining Agency of Japan

VOLUME III

CONTENTS

Chapte	r 1	Determination of operation size	1
1	-1	Determination of cut off grade	1
1	2	Selection of mining method	2
1	3	Maximum allowable stripping ratio	3
1	-4	Determination of optimum operation size	4
Chapter	r 2	Mining	9
2	2-1	Pit design	9
2	2-2	Minable ore reserve	9
2	2-3	Mine development	28
	2-3	P-1 Pre-stripping	28
	2-3-	8-2 Pre-stripping method	28
	2-3-	I-3 Selection of the mining equipments	28
	2-3-	8-4 Wadi diversion	28
	2-3-	-5 Mining construction cost	34
2	-4	Operating plan	34
	2-4-	-1 Mining production plan	34
	2-4-	-2 Mining method	34
	2-4-	-3 Operating cost	44
	2-4-	-4 Mining manning plan	44
Chapter	r 3	Mineral processing	46
3	-1	Metallurgical tests	46
	3-1-	-1 Outline of test works	46
	3-1-	-2 Characteristics of head samples	54
	3-1-	-3 Fundamental flotation tests results	58
	3-1-	-4 Overall flotation tests results	93
	3-1-	-5 Summary of the tests	99
3	-2	Mineral processing plant description	101
	3-2-	-1 Site consideration	101
	3-2-	-2 Fundamental conception of plant design	101
	3-2-	-3 Process design criteria	103
	3-2-	-4 Flowsheet description	103
	3-2-	-5 Operation	114

Chapter 4	Waste dump and tailing dam	118
4-1	Waste dump	118
4-2	Tailing dam	118
4-2	-1 Sclection of tailing dam site	118
4-2	-2 Topography and nature of ground	118
4-2	2-3 Dam	118
4-2	2-4 Drainage facility	122
4-3	Other facilities	122
Chapter 5	Supporting	126
Chapter 6	Organization and manning plan	127
Chapter 7	Infrastructure	134
7-1	Transportation	134
7-1	-1 Transportation of construction materials and operating supply	134
7-1	-2 Transportation of copper concentrate	134
7-2	Water supply	136
7-3	Electricity	136
7-4	Communicating system	136
7-5	Housing facilities	136
Chapter 8	Initial and additional investment, operating cost	140
Chapter 9	Overall evaluation	143
9-1	Financial evaluation	143
9-2	Economic evaluation	147
9-3	Sensitivity analysis	147
Chapter 10	Conclusion	150
Figures, Tal	າles	152

Chapter 1 Determination of operation size

1-1 Determination of cut off grade

The cut off copper grades for both open pit mining and underground mining methods have been determined prior to the selection of the most suitable mining method and the determination of optimum operation size on Hayl as Safil and Rakah deposits.

Tentative figures have been used for the determination.

(1) Cut off grade for underground mining method

As is shown in Table 1-1, the cut off grade for underground mining method is 1.25%.

Au price	(US\$/troz)	400	400	400	400	400	
Cu price	(US¢/lb)	80	90	100	110	120	
Ore grade		······································		_			
Copper	Gold	Net value (US ¢/ton ore)					
(%)	(g/t)						
1.15	0.646	594.00	- 374.95	- 155.90	63.15	282.20	
1.20	0.667	-528.27	- 299.69	71.12	157.45	386.03	
1.25	0.688	- 462.53	-224.44	13.66	251.76	489.85	
1.30	0.708	- 396.80	-149.18	98.44	346.06	593.68	

Table 1-1 Cut off grade determination for underground mining

Followings are the assumptions used in this calculation.

a. Direct operating cost

Mining cost	(US\$/t ore)	10.0
Concentrator	(US\$/t ore)	4.8
Cu-conc. transportation	(US\$/t conc.)	10.0
Supporting	(US\$/t ore)	1.8
b. Depreciation	(US\$/t ore)	5.7
c. Cu-concentrate		
Cu grade	(%)	22.0
Cu recovery	(%)	90.0
Au recovery	(%)	60.0

d. Smelter terms

Cu T/C	(US\$/t conc.)	65.0	
T/C	(US¢/lb)	8.5	
Recovery	(%)	96.0	
Au R/C	(US\$/troz)	6.0	
Recovery	$(g/t - 1.0) \times 98.0\%$		

(2) Cut off grade for open pit mining method

The pit design should be restricted by the maximum allowable stripping ratio which is described in the latter part of this section. The cut off grade here is the critical copper grade where the material turns to ore or to waste at the pit operation.

Therefore the mining cost and the depreciation cost have been eliminated at this calculation. The cut off grade is 0.35% which is shown in Table 1-2.

Au price	(US\$/troz)	400 400 400 400 400					
Cu price	(US¢/lb)	80	90	100	110	120	
Ore grade							
Copper	Gold	Net value (US ¢/ton ore)					
(%)	(g/t)						
0.25	0.086	- 344.87	- 297.25	- 249.63	202.01	- 154.39	
0.30	0.146	- 249.96	-192.82	- 135.67	-78.53	-21.39	
0.35	0.206	- 155.05	- 88.39	-21.72	44.95	111.61	
0.40	0.266	-60.15	16.04	92.23	168.43	244.62	

Table 1-2 Cut off grade determination for open pit mining

1-2 Selection of mining method

The open pit mining method has been selected for both Hayl as Safil and Rakah deposits. Followings are the reasons for this selection.

- (1) The ore bodies are situated in rather shallow place.
- (2) High grade portions are situated in the upper part of the deposits.
- (3) The average copper grade is relatively low and the ore reserve for the underground mining which exceeds the cut off grade is only 240,000t on the geological ore reserve basis whereas that for the open pit mining is as much as 10,000,000t or more.

- (4) The high grade portions of the stockwork ore which is the major part of the deposits are not consistently existing in the ore body. Therefore it is difficult to mine the high grade portions selectively by the underground mining method. Whereas open pit mining method doesn't have such a problem owing to its low cut off grade and nature of mining method.
- (5) The extremely low precipitation in the region is a suitable condition for the open pit mining method.
- (6) Wide locations for the waste dumps are available adjacent to the pits.
- (7) The pits can be designed within the maximum allowable stripping ratio.

1-3 Maximum allowable stripping ratio

The maximum allowable stripping ratio, one of the important parameters for open pit designing, has been determined. Table 1-3 shows the calculation results for the Hayl as Safil deposit. The assumptions used in here are average copper grade; 1.35%, gold grade; 0.63g/t, mining cost; 0.9 US\$/t and 5.7 US%/t for depreciation. Other conditions are the same as that of cut off grade calculation.

Table 1-3Maximum allowable stripping ratio for open pit mining
in Hayl as Safil

Au price	(US\$/troz)	400	400	400	400	400		
Cu price	(US¢/lb)	80	90	100	110	120		
Ore grade								
Copper	Gold	Net value (US ¢/ton ore)						
(%)	(g/t)							
1.35	0.630	505.07	762.21	1,019.36	1,276.50	1,533.65		
Maximum	allowable str	ipping ratio	10.19	36/0.90 = 11.	33			

Table 1-4 shows the maximum allowable stripping ratio for Rakah deposit. Average copper grade is 1.15%, gold grade 0.87 g/t, mining cost 1.3 US\$/t and the rest are the same as Hayl as Safil calculation.

Au price	(US\$/troz)	400	400	400	400	400	
Cu price	(US¢/lb)	80	90	100	110	120	
Ore grade			,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,				
Copper	Gold	Net value (US ¢/ton ore)					
(%)	(g/t)						
1.15	0.870	442.97	662.02	881.07	1,100.12	1,319.17	
Maximum	allowable str	ipping ratio	8.8107	/1.30 = 6.78			

Table 1-4Maximum allowable stripping ratio for open pit miningin Rakah

1-4 Determination of optimum operation size

The pit designs for Hayl as Safil and Rakah have been completed considering cut off grade, mining method and maximum allowable stripping ratio. The details of the pit design is described in the next section. Following the designing, two prototype operation plans, 2,000 TPD and 3,000 TPD, have been developed. The 2,000 TPD plan has 10 years mine life and the 3,000 TPD plan has 7 years mine life. An operation size which is larger than 3,000 TPD is too short in its mine life and the depreciation cost would be too heavy for the mine operation. Therefore such case has been eliminated from the determination. A financial evaluation of these prototype plans has been conducted on the range of 300 to 500 US\$/troz of gold price and 80 to 150 US ¢/lb of copper price. The comparison had shown that the FIRR (Financial Internal Rate of Return) of 7 years plan was always higher than that of 10 years plan. It is shown in Table 1-5.

Consequently, in this preliminary feasibility study, the operation size has been decided to be 3,000 TPD and the mine life is to be approximately 8 years. The mine life of 8 years is a result of the final ore reserve calculation.

Fig. 1 shows the General mine layout.

Copper Price (US¢/lb)	Gold Price (US\$/troz)									
	300	350	360	370	380	390	400	450	500	
80	-13.18	-11.83	-11.56	-11.30		-10.78	-10.52	9.26	-8.03	
90	-5.64	-4.53	- 4.31	-4.09	-3.87	3.66	- 3.44	- 2.38	- 1.35	
100	0.67	1.63	1.82	2.01	2.20	2.39	2.58	3.51	4.42	
110	6.19	7.06	7.23	7.40	7.57	7.74	7.91	8.75	9.58	
120	11.18	11.98	12.14	12.29	12.45	12.61	12.76	13.54	14.31	
130	15.78	16.52	16.67	16.81	16.96	17.11	17.25	17.98	18.70	
140	20.07	20.76	20.90	21.04	21.18	21.32	21.46	22.14	22.82	
150	24.11	24.77	24.91	25.04	25.17	25.30	25.43	26.08	26.73	

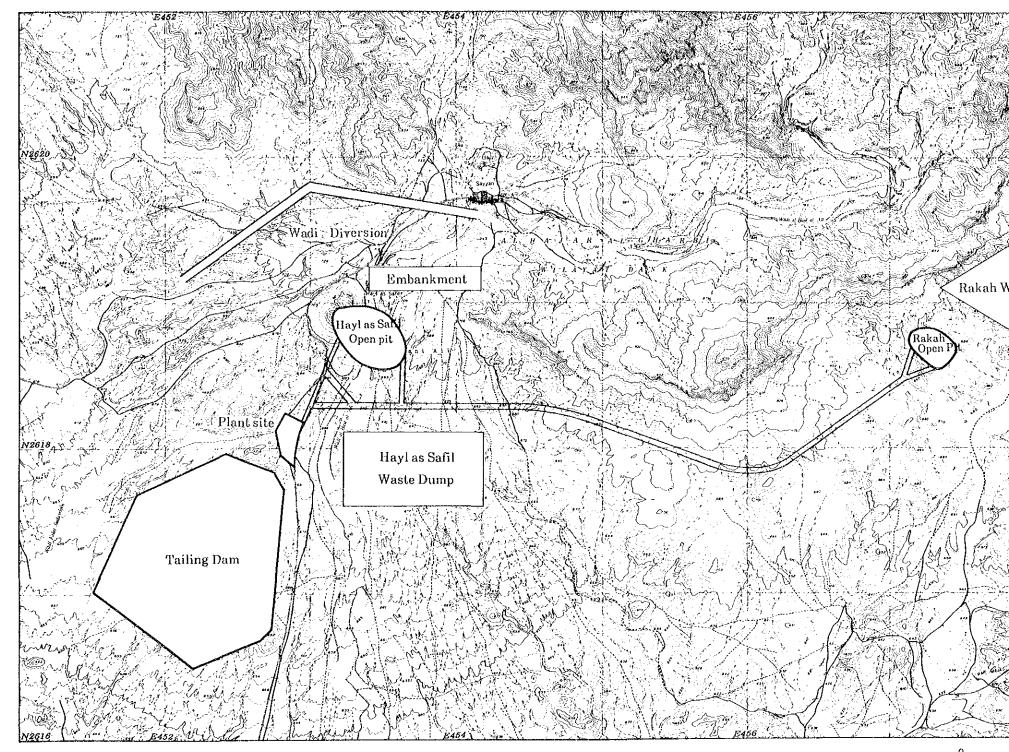
(1) IRR for 3,000 TPD, 7 YEARS PLAN

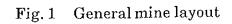
* IRR : Internal Rate of Return

(2) IRR for 2,000 TPD, 7 YEARS PLAN

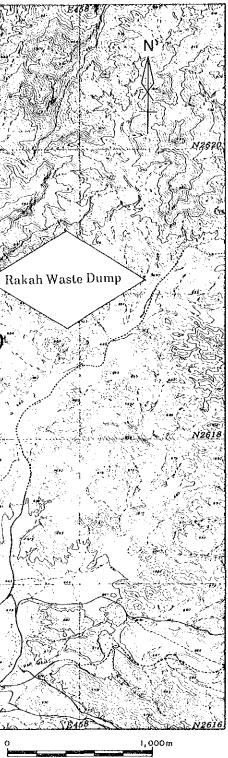
Copper Price	Gold Price (US\$/troz)									
(US¢/lb)	300	350	360	370	380	390	400	450	500	
80	17.74		-16.02	15.74	- 15.47	- 15.20	- 14.94	-13.67	12.47	
90	-10.12	-9.10	8.90	- 8.70	8.50	8.31	-8.12	-7.17	6.26	
100	-4.49	3.67	- 3.51	- 3.35	-3.19	3.03	2.88	-2.10	-1.35	
110	0.11	0.80	0.94	1.08	1.21	1.35	1.48	2.15	2.80	
120	4.06	4.68	4.80	4.92	5.04	5.16	5.28	5.87	6.45	
130	7.57	8.13	8.24	8.35	8.46	8.57	8.68	9.21	9.75	
140	10.76	11.27	11.37	11.47	11.57	11.67	11.77	12.27	12.76	
150	13.70	14.17	14.27	14.36	14.45	14.55	14.64	15.11	15.56	

This calculation has used tentative figures for the operating costs, therefore the results here do not agree with that of the financial evaluation in section 9 of this report.





.



Chapter 2 Mining

2-1 Pit design

The slope angle, 45°, is determined as a basic pit slope angle for the pit design considering extremely low precipitation, the rock strength and RQD values of the boring cores from Hayl as Safil and Rakah deposits.

The size, depth and profile of the pits have been designed so that the highest ore recovery and the lowest stripping ratio can be balanced.

The bench height has been designed to be 10m which is relatively low due to the size of heavy equipment proposed.

The stripping ratio of Hayl as Safil pit is 3.44 while its maximum allowable stripping ratio is 11.33. For Rakah pit, they are 4.17 and 6.78 respectively.

The cross sections of Hayl as Safil pit are shown in Fig. 2-1 (1) to (8). The cross section of Rakah pit are shown in Fig. 2-2 (1) to (8). The level sheets of Hayl as Safil and Rakah pits are shown in Appendix 1 and Appendix 2 respectively.

2-2 Minable ore reserve

The geological ore reserves are shown in below.

	Tonnage (t)	Cu (%)	Λu (g/t)
Hayl as Safil deposit	10,553,091	1.00	0.40
Rakah deposit	4,750,736	0.99	0.88
Total	15,303,827	0.99	0.55

Based on this result, minable ore reserve has been computed by accumulating the ore blocks within the pit limit and exceeding 0.35% in copper grade. At the same time, the tonnage of the waste inside the pit is also computed. Table 2-1 and Table 2-2 show the minable ore reserves and waste tonnage of Rakah and Hayl as Safil respectively. Appendix 3 and Appendix 4 are the detailed tables of all the minable ore blocks.

The massive ore of Rakah which has been proven to be very difficult in concentrator processing is treated as waste. In the actual operation, those massive ore is to be stockpiled separately.

T		Γ	Γ				-					T	T		-~			T	T					1	1	٦	1
							-											ł	- -					+		.~	
	}			-	-						╞			-}			$\left \right $	+-	+		-		-	+	┢	-	-
]	-	-						╞	+	╞	-			-	+.	┦	╡		 .	┢	+			
╞	┡	┢	$\left \right $		╞	┢				-		╀	╉	_			$\left \right $	-	╉	_			-	+	╀	-	
╞		-	┞━				-	_		-	<u> </u>	-	- -				-	-	-	- {	{			+-			
			┞	╞	ļ						_	-	╉	-	-			╞	╉		_		╞	-		_	
			-		-	 		-		5	┞	╞	-	_	-	 	ļ	+		_	_	_	-	-	+	-	
-			 							4 4.91	1_	+		_		! 			+	-			-			_	
				 					3 0.88	9 5.94	_		-										-	+	+		
									L	3 6.69	L	╞	\downarrow				 		-								
<u> </u>									0.87	5.9			_														
								L.	0.86						_												
							5.72	2.18	133 17																		
						1.50	6.02	2 01	0.91																		
			ſ		96.0	1.78	7.21	1.33	0.75								-		Ţ					l	1		
					1.08	1.85	7.63	0.94				T	T			•	ŀ						ſ	T	T		
					1.19	I	6.18			 			-		-		 		l		-			t			
┢	-				L.	1.40			 				╀	-			<u> </u>	+-	T	-				╞			
	-		 			1.27					-		╉				-		+-	-		<u> </u>	$\left \right $	t	╋	-	
-		-	-		┢	1.08					╞	-	╉	╉	-				╉	-	-			+-	╁		
		-	┢	-	 	-					╞	-	+	$\left \right $			-		$\frac{1}{1}$					╀	╉		
		┝		-		-			-		╞	╁	+	\rightarrow			,	╞	+	-			$\left \right $	-	╞	+	
-	 	-		 	 						╞							+		}	-		╞	╞	-	-	
┞─	┢─	-								ļ.,	╞	╞	╀	+			╞	╞	┦	┦	-		╞		┦	-	
				-			-					╞	╞	-		_		╞	-	-	-		-	┢	-	-	-
<u> </u>		-			-			_			-	+-	\parallel	_		<u> </u>		╀	-	-	-			┞	╀	-	_
				 							-	-	+	+	_			╞	-	-			L.	Ļ	-	-	
		_								-	-		-	-		_			+	_		_,_		 	-	_	
	-	 			 									4			 							-		-	_
										 					_	_		-	╎				-	-	1		_
													1														



-10-

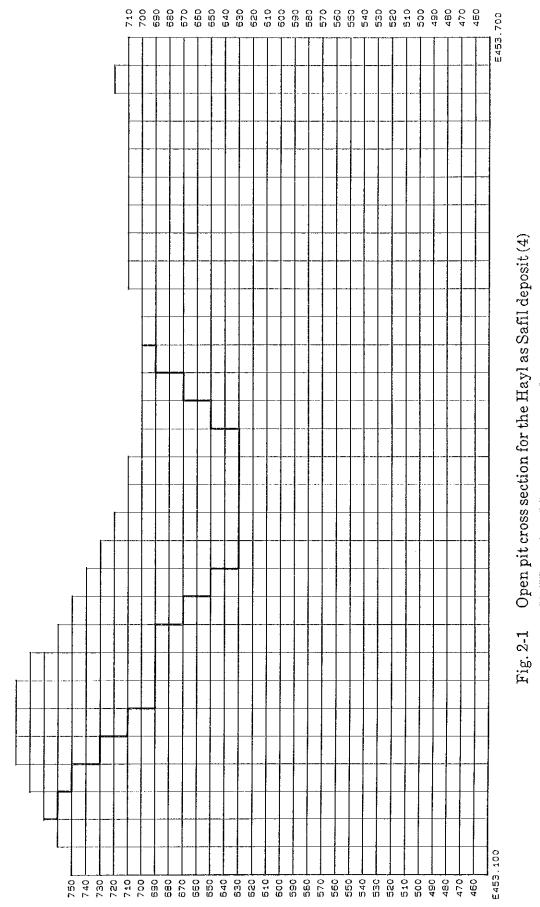
007		080	680	670	C U U														230	120	510	500	490	480	470	450)] 1
				T				ſ													T						
				1				-						T	ļ	ſ				1						-	
-		-	-	+			 													1	-			-			
			1	1			$\left[- \right]$									╞					+	╧		1		_	
-			╉	┥	_	-		-							╞──	┢	-		╞					+		-	
				-	-		-				-			╞─	╞	-	-			╀	+-				-	-	
-			╞	┥				$\left \right $	-			-	-	╞─		8	0.37	-	-	+	╀	╉	╉	+	-	-	L
		-		╉		-		-						-	1.45	Į	<u> </u>	-	╞		+	+	+	+	-	_	
		-		_	ļ				╞				-	1	I		<u> </u>	-	╞	╞	+	╀		-			
		-	-	┥					<u> </u>		_		6	12.1 0	5 1.41		0.37				+	+	4	_	4		
			ļ	_					 		7	0	5 1.79	<u> </u>	1	L	<u> _</u> .		-	-		_		_	╡	_	
Į				4	_								L	1	1.13	L_			_	ļ_	-	\downarrow	_	_			
									L	0.85	L		_	L													
								0.80	L	<u> </u>		65.0															
			ł					1.27		0.78		0,69	0.99														
			Ţ		ļ			1.63	1-21	0.75	1.03	0,55	0.69						ľ								
			T				1.78	1.72	1.15	0.72	1.19	0.57	Γ														
	•		Ì	Ť		1.46	2.14	1.27	0.88	0.67	1.27	0.59					F			1-	Ť						
	-	-	-	Ť		0.74	<u>ا</u>		0.51												t	ϯ			ľ		
		ŀ	-	┥		1.93		<u> </u>							 		┢╾			1		╏	+		╞		
				╎	_		1.62		-					╞	-	-	┢─		┢╌		t	╀		-†	┤		
			-	┥			F	-	$\left[- \right]$					┢					┢	-	+	┦	╉	┥	-	-	
			╞	╁			\vdash	$\left[- \right]$						╞					┢		$\left \right $	╀	-	┦	╀	_	-
	_	┢	┢	┥	_		 				-			-					-	-	-	╀	╞		+	-	
	_	-	$\left \right $	+	_			 		 		_			-				-	-	┨	╀	-	-			_
		-	$\left \right $	\downarrow	_				<u> </u>					┞	L				╞	╞		+	╀	-	-		
		_	$\left \right $	+				L	Ļ.	[-							L		╞			_	+		
							_								-	 				_		_	_		\downarrow		
																 						1					
ŝ)))	080	570	Cur U) () (כי היים						2	020	010	009	490	480	470	460	1

Fig. 2-1 Open pit cross section for the Hayl as Safil deposit (2)[E-W section (N 2618.750), Pit design H 55002]

-11-

										 												-		Γ
								-																F
							_			[-		[ţ_	[
	 																					1	1	T
																-		0.32	0.80					
																		32.0	0.81	[1
																	0.27	0.30	0.74			-		
																0.74	0.47	0.27	0.58					
																0.63	0.50	0.27	0.48					
										 					0.64	0	7E.0	0.23						
													0.57	h	0.69	[0.35	9E 0					
											0.78		0.54	:	L	0.27								
							0.30		0.42	1	0.70		0.46	-	0.39	0.25	0.31		=				L	
						0.38	0	L	0.42	_		I	0.25		0.29						Ĺ			
				1.33		0			0.50		0.57		0.56	0.42	-						 			
			1.45	1.49		1.78			0.63	_		09.0	0 74											
			1.19	1.51	_					0.32	0.54													Ĺ
	 			1.52			1.39																	L
					_	2.03	1.00	6. 5							 						 		 	
 			0.47	0.69	0.43				 														 	
	L	9 2.51	0.59							 						 						 		
		2.49																						
	 							ļ																
 										-										_	 		 	
 																								ļ
	 																			_				
											ĺ										Í			

Fig. 2-1 Open pit cross section for the Hayl as Safil deposit (3) [E-W section (N 2618.830), Pit design H 55002]



[E-W section (N 2618.910), Pit design H 55002]

					i 				-					-					 -	 		
╽╷┝╸		-		_		_				-			 		-			 _	 -	 		
	-																	 	 			
 		 	1.20	-						 			 					 	 			
			۰ I	0.53				-					-						 			
╏─┼─┼─┤			2.05															 				
ŀ			2.51	0.59														 				
				0.70		-																
					4.45																-	
			 	0.67	85.6 8					-												
					2.3		91 1.07			 									 	 \vdash		
	-	-				1.1	\$6.0	-	-									 				
				_							-							_	 	\vdash		
	-	F																		 -		
				_				. .			'							-	 -		-	
		l																-				
																					ļ	
									-													
										-			 			-			 			
	-																	 -				

Fig. 2-1Open pit cross section for the Hayl as Safil deposit (5)[N-S section (E 453.270), Pit design H 55002]

L			:																				-	
									_															
	_		_	 								-								 				
							-						_							 	 			$\left - \right $
-					0.58	0.51	1.47	0.37	0.47	0.56				:						 				
				0.90	0.89			L		0.70														\square
				1.03		0.67	·			0.78	·	0.55								 				\square
				1.19						E8.0		0.54												$\left \right $
L			-	1.38	2.09	1.15	2.68	2.32	1.04	0.92		0.53	·								-			
			-	1.46	2.22	1.44	2.85	2.54	1.13	1.07	0.33	0.55	0.52											
					1.36	1.69	2.37	1.91	0.96	1.15	0,40	0.56	0.50											
						1.73	1.72	\$.15	0.72	1.19	0.57													
						1.78	1.31	0.84	0.58	1.31	0.68													
				3.28	1.89	1.57	1.44	0.98	0.56	1.30														
				5.43	2.79	1.42	1.27	1.27	C.61															
	~					1.41	1.40	3.37							_									
		 					1.71																	
						-														 	 	 		
						•										,				 				
																							 	\square

Fig. 2-1 Open pit cross section for the Hayl as Safil deposit (6) [N-S section (E 453.350), Pit design H 55002]

-														_		-				 					NPR10
-	-	-															-		 				 		
-		-																_							
	-		$\left - \right $												-			-				-			
	-				0.65	0.51	0.45	0.36	0.40	0.43	0.45	0.55	0.69	0.73	0.45	0.34	0.41		 						
-	╞╴	$\left \right $			_	0,48	0.42			0.52 0		D, 49	E		0.40	۰.	L								
╞		$\left - \right $			-		0.38 0					0.45 [0.53 (L	<u> </u>	-		-		┢]		
	-	┝╌						0.47 (-		0.43		0.38 (-				-	
-		┢					-	0.67	_	0.69 (0.45		0.33		i				-		-	{ 	-	
-	.	-						1.00		0.77	Ļ	0.56				0.36					╞─				
+								1.06	<u> </u>			0.57	<u> </u>						_					-	
+								0.85		1.10	_	-				-									
-		┢─						0.45	C 46							-	 				╞─				
-	-							1.05		1.38													~		
						1.18	3.53	1.53		1.48			-												
+		-				1.50		2.01		-										-			-		
-							7.33						-			 					 				
						2.31							-			-				-					
													-												
	T						[
-																						-			
													-												
T																									
				-				-				_				 		-				-			N2618.500

Fig. 2-1 Open pit cross section for the Hayl as Safil deposit (7)[N-S section (E 453,430), Pit design H 55002]

						Γ				Γ												$\left[\right]$
								ľ					0.49	0.34	0.27	0.24						
										T			0.52	0.34	0.25	0.24	0.21					
-				 						ſ	T		0.58	0.47	0,33	0.27	0.37					
-†		 					ŀ	†	1	t			-	0.63	0.50	0.27	0.48					
			·			Į—	+	-						0.89	0.85	0.25	0.55					
		 				t	T		+	\uparrow	0.59	0.35	0.67	1.14							-	
			_	 			┢		-	<u>†</u> -	1.21		L									
							-					0.65				-	-					
		 								+		6.83										
-							╞		$\left \right $	1.14												
+		 				-	1.43	8.67		0.76	1.				-							
+							0.93			f		-								-		
		 		-				e l	-													
		 				┢				$\left \right $											-	
+		 		 				┞	1	┨	╞	┝										$\left \cdot \right $
									_	-												$\left \right $
		 		 						+		-									-	
				 		┝		$\left \right $		-										\vdash		\mid
		 		 		-	-	$\left \right $														
\vdash		 		 	 	-	╞		$\left \right $	╞												

Fig. 2-1Open pit cross section for the Hayl as Safil deposit (8)[N-S section (E 453.510), Pit design H 55002]

					 													-						
									i 		-		+				-						 	
┝	-			ĺ.	 	-		-				+-	+			-	-	-		 	-		-	
╞		~~~			_		-				-		╀	~		 	-		_~				-	
-											 	┦					-		'				-	
-	-				 							┢	┥	-		·	-	$\frac{1}{1}$			╞		┢╌	
							[╏		-			<u> </u>		احــــــــــــــــــــــــــــــــــــ	-				
			L								ŀ	Ť					-		 					1
			0.43	0	 		0.22							_										
		2 1.62	0.82			 	25.0	1	1	<u> </u>		\downarrow	-	_				-						
		4 1.92	0 1.17		8		5 0.31	L	7 0.23	L				-	-						-		╞	
	-	56 1.64	<u> </u>	02 0.64	L		41 0.45	1		.				_		 	-	4			-	-	\vdash	
	-	89 1.66		2.32 1.02	L		0.41	32 0.24	L	0	-			_				+				-	-	
	.65	1.39 0.		1.64 2.			-	9 46.		ន			╉			╞─	_	+			-	-	╞	
-	1.88 2.	~		L	-	-	┢	0			-	┼	╉	-		-				-		╞	<u> </u>	
-	1.25	0.94		L			0.49				╞╴		- -			-	╞	+			┢		} 	
-	0,92	0.70	0.66		-		0.39	 								 							F	
	0.67	0.65																						
	0.56					I							+										 	
										-			_								-		-	
										 	╞	+.	+	_		 					-		┨─	
-	-					_		-			-	╀	┥	_		-	╞	+				-	┢	
			 	<u> </u>						 		+	+			 	+				-	╞		
╞	$\left - \right $			-	-		 			 	 	╀		_			+-			╞		┝		
╞								$\left \right $			-	1	+-			 	-		<i></i>			 		
ţ.				F	¦·		1	-		[ſ	t	1			F	1-	Ť		-	Γ	ţ	1	

Open pit cross section for the Rakah deposit (1) [E-W section (N 2618.670), Pit design R 56004] Fig. 2-2

					[T	T	T	T	1	1		T	1
																				_		
												[ĺ		
	 																			; [
]		<u> </u>	L		 	_		_				_			_
											-	_										
-			L	 		-		 	9.75 E	5 0.62		1 0.64	 					_				+-
					-		0	1.0	9 0.83			4 0.81		-		_	_	_				-
							9 0.E0	1 0.45	L	I		7 0.64	m				-	-			-	
		 		 	 	0	8 0.79	4 0.41	2 0.48	0 0.62		0.47	94 1.13	1		_						_
-					1	22 1.93	17 0.98	19 0.44	1				66 0.9		╞	_					-	
-					82 0.84		1.18 1.17		.55: 0.51	0.58	 	 	0			+			_		-	+
-				_	0.72 0.1	79 0.77	0.88 1.		•					-								╞
	_			-	0.25 0.		0.22 0.	<u> </u>								-				_	-	╀
╞	 	58	52	.13 (0.29 0	<u> </u>	- -	-							+		-	-			-	+
-	1.29	1.41 1	1.55 1	0.66 1	5.00 0		-						-		+	╉	-	_				+-
0.88	1.75 1	2.00		0.48 0	2			_	-	-						┼	•	\uparrow			-	+
0.86	ļ	2.98	2.01 2		┢╼				-	-						╉						
0.64	2.48	4.32													f						-	
		1.67								-		-	-	+-	1-							$\frac{1}{1}$
ſ	-						 								ł		+		_			
												-	-								ľ	
																					Ĩ	
													ļ					l				

Fig. 2-2Open pit cross section for the Rakah deposit (2)[E-W section (N 2618.750), Pit design R 56004]

-19-

			Ţ									<u> </u>												460
		-		-		-			-				-	-						_			+-	
$\left \right $			-	_		-						-								 				
ŀ			+			-					_	-		-								}_	+	
-			+	-								-		}					-			-	+	+
															 					'			-	
				1			- {-														-		-	
												[r -			1.25								
													1,88	0.95		1.24		1 J				 		
			-			-									<u> </u>	0 1.05	·	0.56		L		╞	-	4
					•		+					-				52 0.90	0		67 0.6	23 0.22	•		+	+
		L.,	Ļ										55	0.68	24 0.35	0.54 0.62	0.33		69 0.	27 0.		╞	-	
							╉					2.30				0.25 0.			0.68 0.		-		+	+
	-		┞			 	+					1,88 2		0.55 0	_								+-	4
			┢		!	╞	+			0.62		1.16	·				 				 		+	+
	i									0.48														
										0.32														
							ł		3 0.31														1	┟
-				4			+		0.23													-	-	
												╞											╞	
	_	_					-					-				_							╞	+
	_		┞				-	.	—													-	┢	
╞	_		╞	-		┢	+					$\left \right $										╞─	╞	
			╞			t	╉					+										╞	+	
t	-1					ŀ	+			 -		ſ												
Ţ				Ţ		ľ	T	_				Γ												



-20--

										1							1			 			†-
							0.23				+		_			-	t	T					
					1.63		0.27		╞		+-	-						1					
			1.66	0.95	1.22				-	-	╈	_	-				╞		-	 			$\left \right $
	0.92	2.18	2,46		0.87			_				╡		-		-	╞	┨	-		-	-	-
	0 88.0	1.75 2	2.00 2		0.48 0											$\left \right $				 	-		1
	-	0.49 1		1.55 2		7.10				-	+	-				-		+	-				+
-				1.14 1.	0	7.	_	-		-	+-	-							~				\vdash
_		7 0.88	56 0.56	 		_						~			-			+		 			
		6 0.77	0.66					-							-					 		-	-
		0.56									+	_							_	 			\vdash
										<u> </u>									_	 		ŀ	
																						<u> </u>	
															-								
-									Γ								T						Γ
									ľ		-						T						1
						ŀ					-											1	+-
				-			-		┢	┢	\dagger				╞	+	+-	╉		 -	$\left \right $	+-	+

Open pit cross section for the Rakah deposit (4) [N-S section (E 457.270), Pit design R 56004] Fig. 2-2

	1														T					Γ		Γ	<u> </u>
T															T		Ī				T	Ì	
Î											ļ	1				ſ	l				1	1	
I							0.54	0.48			ſ					ſ	ſ			ſ	T		
T						0.40	0.60	0.58					ľ				1	-		ſ	ţ.	ſ	
Ť			-			0.3B	0.99	0.66													1	ţ-	
						0.41	1.82	0.53												ſ		ſ	
		-	!			0.25	0.62	0.22							T					T			
1	-		1.01	1.03	0.57	2.62	0.62	0.66										T				-	
-		0.82	0.71	0.86	0.63	3.39			_														
t		1.00	0.65	0.75	0.62			0.56		Ì]		1-	l		Ţ		T	T	1	
ľ		1.25	0.94	0.64				0.49						ſ	Ţ		1			-	T	ſ	
ľ		-													ſ	T				Ţ	T		
ſ		_															1			ł			
												ſ	F			1-							
ſ			_				•					-	-	T	T	T			1		Γ		
							_									1							
			-								_		-	1							ſ		
ľ											-	T		ľ			-		-	t	†		
ŀ			-								-				\uparrow	1					ţ-		

Fig. 2-2Open pit cross section for the Rakah deposit (5)[N-S section (E 457.330), Pit design R 56004]

-	670																	4 a 0			2 <u>6</u>
		-																			
-		-											0.41	0.45		0.70	0.23				
							~				0.92	0.58	0.24	0.54		0.68	0.27				
											1.01	0,42	0.27	0.45							
										1.27	0.50		0210	0.67							
•										0.30	1.20										
							1.93	0.98	0.44	0.42	0.70			0.94							
-					0.56	1.92	2.38	0.90	0.36	0.42		0.36	0.25	0.62							
-				0.35	0.81	1.18	2.24	0.74			0.82	0.62	0.23	0.34							
				0.46	1.02	1.67	1.60			0.34	1.33	0.89									
			1.66	1.88	1.02	1.26		0.41	0.24	0.33	0.85										
			3.72	4.35		0.74	0.78	0.66	0.39												
		3.07	4.53	1.73		0.84	0.45														
	- **					0.78	0.38								-						
		32														 					
		0.32														 					-
																 				 	_
	-															 			 	-	╞
	570 570														Ļ_						460

Open pit cross section for the Rakah deposit (6) [N-S section (E 457.410), Pit design R 56004] Fig. 2-2

				-									
0.32		3.07											_
		4.53	3.72	1.66									
		1.73	4.35	1.88	0.46,	0.35							
				1.02	1.02	0.81	0.56					P	
	0.78	0,84	0.74	1.26	1.67	1.18	0.91						
	0.38	0.45	0 78		1.60	2.24	2.38	1.93					
			0.66	0.41		0.74	0.90	0.98					
			0.39	0.24			0.36	0.44					
				0 .33	0.34		0.42	0.42	0.30	1.27		~~~	
				0.85	1.33	0.82		0.70	1.20	0.50	1,01	0.92	
					0.89	0.62	0.36				0,42	0.58	
						0.23	0.25			0210	0.27	0.24	0.41
						0.34	0.62	0.94	-	0.67	0.45	0.54	0.45
												0.68	0.70
												0.27	0.23
 												••• -• -•	
							ľ						

0 C 00 0000 000 0 o 0 0 0 0 0 _ 0

T		T		ſ			Γ									0.67				[
		ŀ													0.54	0.64			-	
	1	ŀ					ŀ							0.88	19.0		-~		 -	
1-	-			╞─						1.88	0.96	0.74	1.24	0.93	0.67	0.56	0.24			ŀ
										1.35	0.67	0.74	1.12	0.84	0.65	0.57	0.24			
F	1	-	-									0.75	0.94	0.73		0.57				
+	-	-							0.96	0.57		0.74								
		┢╾							0.75	0.62	-	0.64								·
\int																		-	 	╞─
	-		0.26	0.53				0.34	0.20	1.49										
1		-	0.33	0.40			0.26	0.21		0.80										
	+		0.43	0.43			0.22				_					_		-		
-		 	0.41																 	
$\left \right $												-	-							
$\left \right $						-													 I	
-	╞	┝													-	_			 	
\vdash		-																	 	-
-											-				-			-	 -	
-															-		_	-	 	
	+						—													
670					2 4 0) u					

Open pit cross section for the Rakah deposit (7) [N-S section (E 457.490), Pit design R 56004]

Fig. 2-2

0 0 n

	 																	 		 E457.600 N2619.000
	 		••••••			× /														
_	 																	 		
-	 																	 -		
																0.67		 		
															0.47	0,68				
													0,63	0.53	0.40					
												0.35	0.62	0.33		0.67	0.23			
	~~.									1.01	0.42	0.27	0.45							
									1.19	0.59								 		
-	 	-				0.51	1.14	0.50	0.58				0.44				-1			
					0.72	6,79	0.38	0.41												
		1.01	1.03	0.57	2.62	0.62	0.66											 		
	0.55	0.75	1.17	0.33	7.19													 		
_	0.90	0.60	0.83															 		
-	0.56																			
						Ļ							-					 		
																	.			
																		 	L	E457.200 N2618.600

[NE-SW section (E 457.200, N 2618.600) - (E 457.600, N 2619.000), Pit design R 56004] Open pit cross section for the Rakah deposit (8) Fig. 2-2

Table 2-1 Summary of minable ore reserves for the Hayl as Safil deposit

č
C
10 0 23444
4
¢.
ç
S
ц Ц
ŕ
٠;
40.
Dit donion UCENNY
ŏ

Strip-ping ratio

$\vdash \neg$			₽.	·																							
ц.	content	(kg)							_					17.17	285.15	486.24	436.02	772.19	388.43	347.53	317.49	445.61	112.92	33.49	11.08	4.32	
Gold	grade	(g/t)												0.17	0.59	0.74	0.60	0.84	0.49	0.44	0.50	0.84	0.37	0.15	0.17	0.08	(1 (
er	content	(t)												1,606.8	5.424.7	10.866.9	8,372.4	14.181.6	15.614.9	6, 557.0	4.971.2	7, 325.8	3.345.0	1,586.5	379.3	203.9	
Copper	grade	(%)												1.59	1.13	1.64	16		80	84	20	1.37	1.09	0.70	0.59	0.38	
	Total	(t)	67,200	134,400	302.400	313,600	358,400	515.200	560,000	772,800	1.556,800	3,617,600	2.979.200	2,990,380	2.426.003	2.410.320	1.887.904	1.920,535	1.351.740	1, 323, 096	840, 259	831,626	350.460	261.735	71.279	58.853	-
ge	Waste	(t)	67,200	134,400	302.400	313,600	358.400	515,200	560,000	772,800	1.556.800	3.617.600	2.979,200	2.889.040	1.944,813	1.749.294	1.163.870	1.000.832	564.861	540, 165	199.035	298, 704	43, 322	33, 678	7.470	4,670	
Tonnage	Ore	(t)	0	0	0	0	0	0	0	0	0	0	0	101,340	481,190	661,026	724,034	919.703	786,879	782.931	641.224	532,922	307.138	228,057	63.809	54, 183	
	Waste	(t/m3)	2.80	2.80	2.80	2.80	2.80	2.80	2.80	2.80	2.80	2.80	2.80	2.80	2.80	2.80	2.80	2.80	2.80	2.80	2.80	2.80	2.80	2.80	2.80	2.80	
S. W.	Ore	(t/m3)												3.15	3.06	3.13	3.06	3.12	3.14	3.02	3.01	3.07	3.06	3.00	2.99	2.96	
	Total	(m3)		48.000	108,000	112.000	128,000	184,000	200.000	276,000	556,000	1.292.000	1,064,000	1,064,000	852.000	836,000	652.000	652,000	452,000	452,000	284,000	280,000	116.000	88.000	24,000	20.000	
0	Waste	(m3)	24.000	48,000	108,000	112.000	128,000	184,000	200.000	276.000	556,000	1.292.000	1,064,000	1.031.800	694.576	624.748	415.668	357.440	201.736	192,916	71.084	106.680	15.472	12.028	2,668	1.668	
Volume	Ore	3)	0	0	0	0	0	0	0	0	0	0	0		~~~				250.264	259,084	212.916	173.320	100.528	75.972	21.332	18, 332	
Level	،		780	011	760	750	740	730	720	710	700	690	680	670	660	650	640	630	620	610	600	590	580	570	560	550	

3.44

osit
dep
kah
Ra
ss for the J
s for
ves
ore reserves
re
ore
ole
lab
/ of minable
£
ummary
ű
ble 2-2
Б Ц

$\begin{array}{c c c c c c c c c c c c c c c c c c c $	Rakah								Pit design R56004	R56004	Cutoff 0.35%Cu	- 35%Cu		
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	Level	Volum	je Je		S.		Tonnage	ge		Copper	per	Gold	d	Strip-
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$		1	Waste	Total	Ore	Waste	Ore	Waste	Total	grade	content	grade	content	ping
0 408,000 408,000 408,000 0 712,000 712,000 556,000 2.96 56,184 499,816 556,000 2.96 92,160 463,840 556,000 2.96 149,024 258,976 408,000 2.99 131,704 276,296 408,000 2.99 131,704 276,296 408,000 2.99 95,880 148,120 244,000 2.89 95,880 148,120 244,000 2.95 76.00 76,000 28,000 2.87 76.00 26,000 28,000 2.87 76.00 76,000 2.87 000 21,480 76,000 2.87 000 27,480 520 28,000 2.87 27,480 520 28,000 2.87 27,480 520 28,000 2.81 27,480 520 28,000 2.87 27,480 520 28,000 2.81 <		(m3)	(m3)	(m3)	(t/m3)	(t/m3)	(t)	(t)	(t)	(%)	(t)	(g/t)	(kg)	ratio
0 712,000 712,000 712,000 56,184 499,816 556,000 2.95 92,160 463,840 556,000 2.95 92,160 453,840 556,000 2.99 149,024 258,976 408,000 2.99 131,704 276,296 408,000 2.99 131,704 276,296 408,000 2.89 112,488 175,512 288,000 2.89 95,880 148,120 244,000 2.87 7,600 76,400 84,000 2.87 7,600 76,400 2.87,000 2.87 7,600 26,000 28,000 2.87 7,600 28,000 2.87 2.87 7,600 28,000 2.87 2.87 7,600 28,000 2.87 2.87 7,600 28,000 2.87 2.87 7,600 28,000 2.87 2.87 7,600 28,000 2.81 2.87	670	0	408,000	408.		2.80	0	1.142.400	1.142.400					***
56, 184 499, 816 556, 000 2. 95 92, 160 463, 840 556, 000 2. 99 149, 024 258, 976 408, 000 2. 99 131, 704 276, 296 408, 000 2. 99 131, 704 276, 296 408, 000 2. 99 131, 704 276, 296 408, 000 2. 99 95, 880 175, 512 288, 000 2. 89 95, 880 148, 120 244, 000 2. 95 95, 880 148, 120 244, 000 2. 87 7, 600 89, 100 144, 000 2. 87 7, 600 26, 000 28, 000 2. 87 27, 480 520 28, 000 2. 80 27, 480 520 28, 000 2. 81 729, 420 3, 134, 580 3, 864, 000 2. 91	660	0	712,000	712		2.80	0	1,993,600	1,993,600					***
92. 160 463. 840 556. 000 2. 99 149. 024 258. 976 408. 000 2. 90 131. 704 276. 296 408. 000 2. 90 112. 488 175. 512 288. 000 2. 89 95. 580 145. 120 244. 000 2. 95 95. 580 145. 120 244. 000 2. 95 95. 580 144. 120 2.44. 000 2. 87 7. 600 76. 400 84. 000 2. 87 7. 600 26. 000 28. 000 2. 87 27. 480 520 28. 000 2. 80 27. 480 520 28. 000 2. 81	650	56, 184		556	\$	2.80	166.078	1, 399. 485	1, 565, 563	1.49	2,472.9	0.92	152.62	8.43
149, 024 258, 976 408, 000 2. 90 131, 704 276, 296 408, 000 2. 88 112, 488 175, 512 288, 000 2. 88 95, 880 148, 120 244, 000 2. 89 95, 880 148, 120 244, 000 2. 89 76, 900 89, 100 144, 000 2. 87 7, 600 76, 400 84, 000 2. 87 2, 000 26, 000 28, 000 2. 87 2, 000 26, 000 28, 000 2. 80 27, 480 520 28, 000 2. 80 27, 480 520 28, 000 2. 81	640	92.160		556	2.	2.80	275,104	1.298.752	1.573,856	1.73	4.772.4	0.60	163.89	4.72
131, 704 276, 296 408, 000 2.88 112, 488 175, 512 288, 000 2.89 95, 880 148, 120 244, 000 2.89 54, 900 89, 100 144, 000 2.87 7, 600 76, 400 84, 000 2.87 7, 600 76, 400 84, 000 2.87 2, 000 26, 000 28, 000 2.87 2, 000 26, 000 28, 000 2.87 27, 480 520 28, 000 2.87 729, 420 3, 134, 580 3, 864, 000 2.87	630	149,024		408	2	2.80	432.251	725,133	1,157,384	1.22	5,268.7	0.68	291.89	1.68
112.488 175.512 288.000 2.89 95.880 148,120 244,000 2.95 54,900 89,100 144.000 2.95 7.600 76,400 84,000 2.87 7.600 76,400 84,000 2.87 2.000 26,000 28,000 2.82 27.480 520 28,000 2.80 27.480 520 28,000 2.87 729.420 3.134.580 3.864.000 2.91	620	131,704		408		2.80	378.819	773, 629	1,152,448	0.88	3.347.9	0.47	176.35	2.04
95, 880 148, 120 244, 000 2.95 54, 900 89, 100 144, 000 2.87 7, 600 76, 400 84, 000 2.87 2, 000 26, 000 28, 000 2.80 27, 480 520 28, 000 2.80 729, 420 3, 134, 580 3, 864, 000 2.81	610	112.488		288		2.80	325.490	491,434	816.924	1.21	3.941.8	0.92	299.09	1.51
54,900 89,100 144,000 2.87 7.600 76,400 84,000 2.82 2.000 26,000 28,000 2.80 27,480 520 28,000 2.87 7729,420 3.134,580 3.864,000 2.91	600	95,880		244		2.80	282,587	414,736	697,323	1.42	4.013.9	0.37	104.22	1.47
7.600 76.400 84.000 2.82 2.000 26.000 28.000 2.80 27.480 520 28.000 2.87 779.420 3.134.580 3.864.000 2.91	590	54,900		144		2.80	157,509	249,480	406.989	0.83	1,300.4	0.26	41.70	1.58
2.000 26.000 28.000 2.80 27.480 520 28.000 2.87 729.420 3.134.580 3.864.000 2.91	580	7.600		8		2.80	21,394	213,920	235.314	0.41	87.7	1.36	28.99	10.00
27,480 520 28,000 2.87 729,420 3,134,580 3,864,000 2,91	570	2,000		28.	2.80	2.80	5,605	72.800	78.405	0.39	21.9	0.53	2.97	12.99
729-420 3-134-580 3.864.000 2.91	560	27,480		28.	2.87	2.80	78,996	1.456	80,452	0.88	696.6	0.66	51.96	0.02
	Total		3.134.580	3, 864, 000	2.91	2.80	2.80 2.123.833		8.776.824 10.900.657	1.22	25,924.1	0.62	0.62 1,313.68	4.13

Total minable ore reserve

Level	Level Volume	e		ŝ		Tonna	96		Copper	er	Gold		Strip-
		Waste	Total	Ore	Waste	Ore	Waste	Total	grade content	content	grade c	content	ping
L	(m3)	(m3)	(m3)	(t/m3)	÷	(t)	(t)	$\left \begin{array}{c} \mathbf{t} \end{array} \right $	(%) (%)	(t)	(g/t)	(kg)	ratio
	2.043.516	H.S. 2.043.515 7.720,484 9.764.000	9.764.000	3.08	ŀ	2.80 6.284.435 21.617.355	21.617.355	27.901.791	1.28 <	1.28 80,436.1	0.58	0.58 3.657.64	3.44
ah	729.420	Rakah 729, 420 3, 134, 580 3, 864, 000	3.864.000	2.91	2.80	2.123.833	8, 776, 824	2.80 2.123.833 8.776.824 10.900.657 3	1.22	1.22 25.924.1	0.62 1	1.313.68	4.13
-	2.772.936	Total 2,772.936 10.855.064 13.628.00	13.628.000	3.03		8.408.269	30.394.179	38, 802, 448	1.26 II	1.26 106.360.2	0.59 4	.971.32	

2-3 Mine development

2-3-1 Pre-stripping

Required amount of pre-stripping for Hayl as Safil is 12.0 million tons and that of Rakah is 3.1 million tons. The pre-stripping of Hayl as Safil is scheduled to be completed within the two years of construction period. While Rakah will be pre-stripped in the first year of operation. The heavy equipments for the pre-stripping are basically the same as those for production and will be described in the next section. Fig. 2-3 and Fig. 2-4 show the pit plan just after the completion of pre-stripping.

The gossan waste in Rakah which contains relatively high gold will be stockpiled separately.

2-3-2 Pre-stripping method

The overburden is to be ripped and dozed by bulldozers and loaded by either front end loaders or hydraulic excavators to 30t dump trucks. When blasting is required, 6 1/2" blast holes are to be drilled by DHD. AN-FO is expected as major explosive. Crawler drill is required on the steep terrain in Hayl as Safil. When the ore body is close to the drilling place, all the cutting cones should be sampled and assayed to check the copper grade. The ore mind during construction period is to be stockpiled in the appropriate place. Operation is to be carried out on three shifts 24 hours basis. Typical bench cross section and blasting pattern are shown in Fig. 2-5 and Fig. 2-6 respectively.

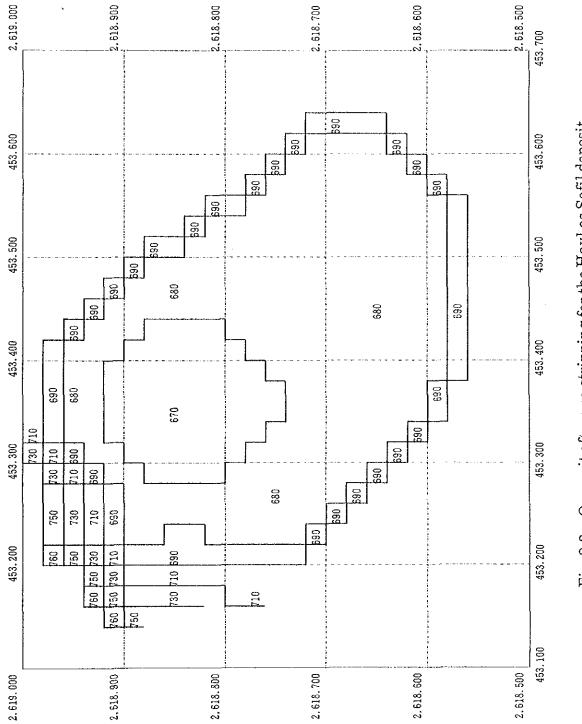
2-3-3 Selection of the mining equipments

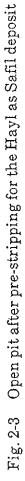
The heavy equipments anticipated to be used in this project are shown in Table 2-3. The policy for selection of size, type and specification is that the priority has been given to the smaller in size and the higher in mobility considering the size of the pits and operation. The manufacturers shown in the table are recommended because their products can be expected high availability and durability in severe mining operation. Also the manufacturers have established high technical service system and efficient spare parts supply system in Sultanate of Oman. The dealer can be utilized in the omanization program. Our suggestion is that OMCO could put obligation of technical training to the dealer when purchasing heavy equipment.

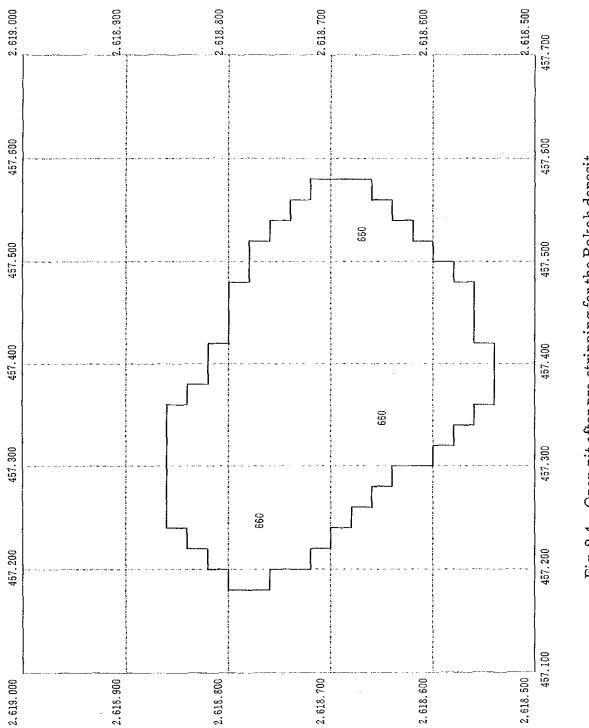
2-3-4 Wadi diversion

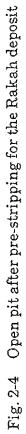
As is shown in Fig. 1, there is a relatively large wadi just above the expected Hayl as Safil pit. Obviously it should be diverted and connected to a west adjacent one for security at a heavy rain.

Moreover a large size embankment is to be constructed on the open area between the diverted wadi and the expected Hayl as Safil pit. The construction cost of the embankment would be very









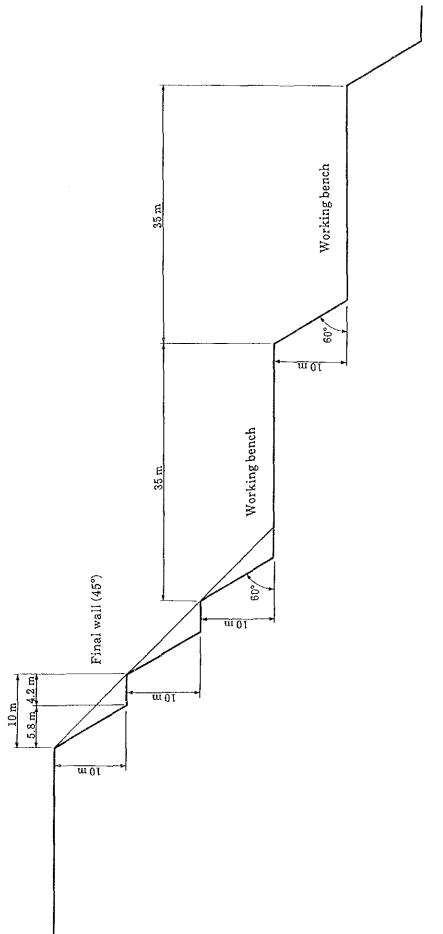


Fig. 2-5 Typical cross section of the benches

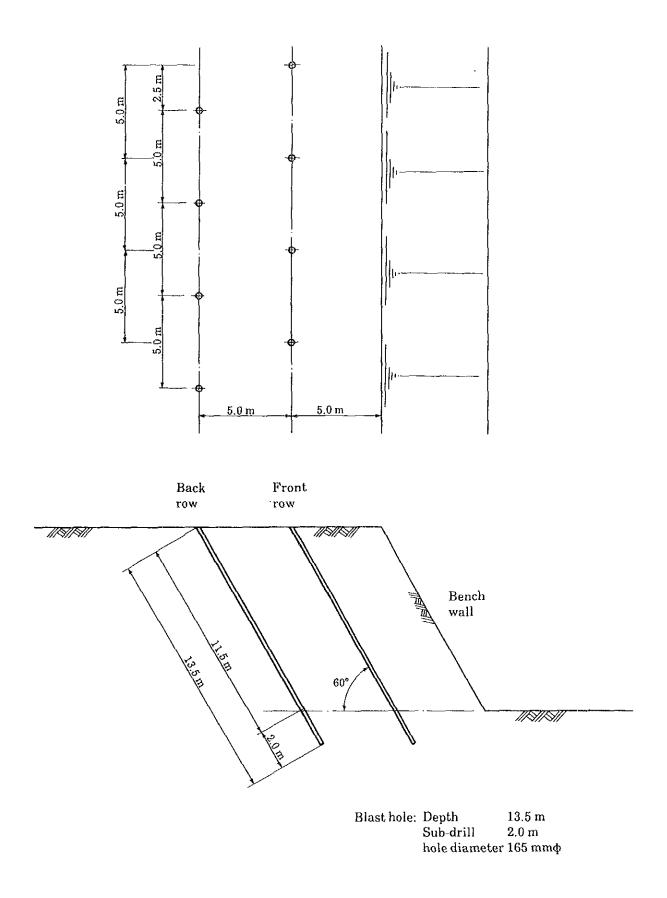


Fig. 2-6 Typical blasting pattern

Table 2-3 Proposed mining heavy equipments and main specification

			Operating	Engine	U	
Equipment	Manufacturer	Model	weight (Kg)	Model	(flywheel) (HP)	Main specification
Drill	Ingersoll-Rand	T-4	21,800	GM12V-71N	400	ssor HP
Front End Loader	CAT	966D	19,868	CAT3306	200	α·
Hydraulic Excavator	CAT	235C	42.510	CAT3305	195	(Kock v-edge with teeth) Bucket 1.8 cu m (notto brill
Dump Truck	CAT	D30C	48,535	CAT3306	260	Payload 30.0 ton
Bulldozer	CAT	D7H	22,796	CAT3306	215	Blade Width 3.65 m (************************************
Bulldozer	CAT	DGD	15,695	CAT3306	140	(Straight) Blade Width 3.20 m
Motor Grader	CAT	1406	13.540	CAT3306	150	(suraight) Blade Width 3.66 m
Backhoe (Wheel type)	CAT	214	15.500	Perkins	102	Bucket 0.725 cu m (ISO Heaped)

low because the embankment can be assumed as a waste dump for the pre-stripping of Hayl as Safil pit.

2-3-5 Mining construction cost

Followings are the construction cost for the mining department.

Heavy equipment purchase	US\$ 7,890,000
Pre-stripping	10,737,500
Wadi diversion	545,200
Total	US\$ 19,172,700

Table 2-4 shows the mining heavy equipment purchasing schedule and Table 2-5 shows the yearly dump truck requirements.

2-4 Operating plan

2-4-1 Mining production plan

The annual mining handling volume schedule is shown in Table 2-6. In the first year, the annual ore production is 80% of the following years considering the start-up of the mine. The production is to be maintained at a level of 1,080,000 t/year on the second year and onward. The waste removal volume is scheduled to be reduced year by year.

The annual ore production plan is shown in Table 2-7. The copper grade is relatively higher in the early stage of the operation than that of the later stage.

The mining sequence of the Rakah and Hayl as Safil pits are shown in Fig. 2-7, Fig. 2-8, Fig. 2-9 and Fig. 2-10 respectively.

The massive ore which has been proven by the flotation tests to be very difficult in recovering copper is to be stock-piled independently.

2-4-2 Mining method

The mining method is basically as same as that of pre-stripping. Cuttings of all the blast holes are to be sampled and assayed. After blasting, materials are to be decided either ore or waste at hole by hole basis.

The operation is three shift a day and 24 hours basis.

Table 2-4 Purchasing schedule for mining heavy equipments

(1|n;t, : 1|S\$1,000)

ItemsItemsMathificant Investment.Additional Investment.Fronti UnitsFriceAmount UnitsFriceAmount UnitsFriceAmount UnitsFronti UnitsFriceAmount UnitsFriceAmount UnitsFriceAmount UnitsFronti UnitsFriceAmount UnitsFriceAmount UnitsFriceAmount UnitsFronti UnitsFriceAmount UnitsFriceAmount UnitsFriceAmount UnitsFronti EnderlichGases12012011120120120Buldozer (CMT DB0 class)1201201120120120Buchorer (CMT DB0 class)1201001120120120Buchorer (CMT DB0 class)11601601100120Buchorer (CMT DB0 class)116016011200230Buchorer (CMT DB0 class)116016011200230Buchorer (CMT DB0 class)116016011200230Buchorer (CMT DB0 class)116016011200230Buchorer (CMT DB0 class)1160116011200230Buchorer (CMT DB0 class)1160111200230Buchorer (CMT DB0 class)1116011200230Buchorer (CMT DB0 class)11111200 <th>(Unit : US\$1.000)</th> <th></th>	(Unit : US\$1.000)															
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$		Ini	tial	Investm	ent				Additi		estment					
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$	Items	Year -2				1		Year 1			Year	2				
ass) $\begin{bmatrix} 2 & 500 & 1.200 \\ 320 & 200 & 120 \\ 1 & 120 & 120 \\ 2 & 230 & 460 \\ 1 & 160 & 160 \\ 1 & 160 & 160 \\ 1 & 160 & 160 \\ 1 & 180 & 80 \\ 800 \\ 1 & 1 & 180 \\ 800 \\ 1 & 1 & 180 \\ 800 \\ 1 & 1 & 180 \\ 800 \\ 1 & 1 & 180 \\ 800 \\ 1 & 1 & 180 \\ 1 & 180 \\ 800 \\ 1 & 1 & 180 \\ 1 & 18$		Units Pr	ice	Amount	Units	Price		i	1 -					Units	Price	Amount
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	Drill(Ingersoll-Rand T-4 class)	2	600	1.200												
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	Front End Loader (CAT 966 class)	2	160	320					160	160						
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$	Hydraulic Excavator (CAT 235C class)	1	120	120				 -	120	120				⊷1	120	120
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$	Dump Truck (CAT D30D class)	12	350	4,200		350	350	•								
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$	Bulldozer (CAT D7D class)	5	230	460										*1	230	230
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$	(CAT D6D class)		160	160				،۔۔۔	160	160						
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$	Motor Grader (CAT 140G class)	-	160	160												
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$	Backhoe		80	80												
Additional Investment 7.540 350 440 0 Notat 4Notat 4Year 5Year 6Year 7 & Year 8TotalYear 4UnitsPriceAmount UnitsPriceAmount UnitsPriceAmount Unitsuss)1230230131201i1230230131201i1160160160313150i18080000009	Auxiliary Equipment			840												
Additional Investment Year 6 Year 7 & Year 8 Total Year 4 Year 5 Year 7 & Year 8 Total Inits Price Amount Units Price Amount Units Price Amount uss Units Price Amount Units Price Amount Units Price Amount uss 1 230 230 1 2 600 1 i 160 160 160 13 350 4 i 160 160 160 23 3 120 i 160 160 160 2 80 3 160 i 160 160 1 0 0 0 0 9	Total			7.540			350			440			0			350
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$		Vdd	lition		stment											
Units Price Amount Is Is<	Items										Year	ļ		• •	Total	
uss) iss)		Units Pr		Amount	Units	Price			Price					Units	Price	Amount
uss) (class) (class) 1 230 230 1 1 230 230 1 1 230 230 1 1 230 230 1 230 230 1 230 230 2 80 4. 2 80 4. 2 80 4. 2 80 6. 2 80 9. 0 0 0 0 6 9.	Drill (Ingersoll-Rand T-4 class)													2	600	1,200
class) 3 120 1 230 230 4, 230 1 160 160 160 1 160 160 22 1 160 160 160 1 160 160 160 1 80 80 0 0 0 0 0	Front End Loader (CAT 966 class)													(m	160	480
1 230 230 4 230 4 230 4 230 1 1 13 350 4 4 230 1 1 1 10 1 10 1 10 1 1 10 1<	Hydraulic Excavator (CAT 235C class)													en en	120	360
1 230 1 230 230 230 1 160 <td>Dump Truck (CAT D30D class)</td> <td></td> <td>· —</td> <td></td> <td>13</td> <td>350</td> <td>4.550</td>	Dump Truck (CAT D30D class)											· —		13	350	4.550
1 160 160 1 160 160 1 160 160 1 160 160 0 0 2 0 0 0 0 0 0 0 0 0	Bulldozer (CAT D7D class)		230	230										4	230	920
1 160 160 1 80 80 80 80 80 630 0 0 0 0 0 0 0 0	(CAT D6D class)	+-u	160	160			-							ന	160	480
1 80 80 630 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Motor Grader (CAT 140G class)	1	160	160										2	160	320
630	Backhoe	1	80	80			<u> </u>					• •		\$	80	160
	Auxiliary Equipment															840
	Total			630			0			0			0			9,310

|--|

-36-

Waste Waste Ore Waste Ore Waste Ore Waste Ore Waste Ore Ore Maste Ore	Dre Waste (1. 000t) (1. 00t) (1. 0	Ore Waste (1.000t) (1.000t) 1.000t) 1.000t	Dre Weste (1.000t) (1.000t) (1.000t) (1.000t) (1.000t) (1.00t)	00re (1. 000t) (1. 000t) (1. 200t) (1. 200t) (2. 4 502. 4 274. 2	(1.000t) (1.	(1.000t) 300.0 13.9 13.9	≝ []	05e (1.000£) 101.3 101.3 561.0 788.9 1789.9 1789.9	
(1.000t) (1.000t) (1.000t) (1.000t) (1.0 2.198.4 2.979.2 2.198.4 2.979.2 2.979.2 2.57 403.2 2.65.7 403.2 2.65.7 403.2 3.81.3 113.0 46.4 46. 46. 46. 46. 46. 46. 46	(1.0001) (1.0001) (1.0001) (1.0001) (1.0001) (1.0001) (1.0001) (1.0001)	1,000(1) (1,00(1) 1,000(1	(1. 000t) (1. 000t) (1. 00t) (1. 00t)		00t) (1. 000t) 00t) 00t) 00 00 00 00 00 00 00 00 00 0	(1.000t) <u>100</u> <u>133.9</u> (1.000) <u>133.9</u> (1.000) (1.0	0000t) (1. 000t) 1. 100. 0	(1,000t) (1,000t) (101.3 (101.3 (101.3 (101.3 (101.3 (101.3 (101.3 (101.3) (101.3) (101.3) (101.3) (1000t) (10	1 1 1 0.001 2 67 2 67 2 3 1 103.4 4 103.4 3 1 103.4 4 103.4 3 1 133.6 6 133.6 3 1 156.0 0 560.0 3 157.6 8 772.8 8 3 157.6 9 2 423.0 3 1517.6 8 2 423.0 3 1 410.3 3 560.0 3 1 2 3 517.6 8 3 1 2 3 517.6 8 3 1 2 3 3 3 3 3 1 3
2.198.4 2.979.2 2.979.2 822.4 101.3 1.066.6 822.4 101.3 1.066.6 822.4 101.3 1.066.6 822.4 101.3 1.066.6 822.4 101.3 1.066.6 113.0 346.1 45.00.0 846.2 1.714.6 776.6 1.759.1 77			╷╶╎╴╎╴╎╌┇╴╎╴┇╍┥╍╎┯╄╍╎┯┝╸╎╴╎╴╞╌╎╼╷┝╼┇╍╎╼╋╍┥╍╇╍	502.4 274.2	┝╍┥╼╎╼┥╖┥┅╽╾┊┈╎╌╎╍╎╍╎╌╎╼╷╎╌╎╴╴╎╼╷┥╼┝╼┝╼			67 134 134 134 134 135 131 135 131 135 131 1155 151 1155 151 1155 151 1155 151 1155 151 1155 151 1155 151 1155 151 1155 151 1155 151 1155 151 1155 151 155 151 155 151 155 151 155	2 67.2 4 134.4 134.4 134.4 135.5.4 312.6 5 55.5 6 355.4 134.4 134.4 5 555.5 2 515.5 3 555.4 5 555.4 5 555.4 5 555.4 5 555.4 5 555.4 5 555.4 5 555.4 5 555.4 5 555.4 5 555.5 5 555.5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
2. 136. 4 2. 136. 4 2. 279. 2 3. 279. 2 3. 279. 2 3. 279. 2 3. 279. 2 4. 101. 3 1. 1066. 6 3. 31. 0 3. 346. 1 4. 4 4. 10. 3 3. 346. 1 4. 4 4. 10. 3 3. 113. 0 4. 4 4. 10. 0 3. 113. 0 4. 4 5. 000. 0 8. 45. 2 4. 10. 3 1. 13. 1 4. 4 5. 000. 0 8. 113. 0 4. 4 5. 000. 0 8. 113. 0 4. 4 5. 113. 0 4. 4 5. 113. 0 4. 4 5. 113. 0 4. 4 5. 113. 0 5. 113. 0 5			╎╴╎╌╏┄╢╴╎╌╞╌┥╌╎─┝╌╎─┝╌╎─┝╴╞╴╎╴╞╌╎╌╟╼┇╌╎╌╇╌╇	502.4 274.2	┟╍╎╾╎╌╎╌╎╶╎╴╎╌╎╴╎╴╎╴╎╴	13.9 13.9		134 134 136 1302 1361 1361 1361 1361 1566 101.2 1261 1101.3 1261 1101.3 1261 1101.3 1261 1101.3 1261 1101.3 1261 1101.3 1261 1101.3 1261 1101.3 1261 1101.3 1261 1101.3 1261 101.2 1261 1001.2 1001.2 1001.2 1001.2 10000000000	4 134.4 134.4 302.4 302.4 302.4 302.4 353.5 302.4 353.4 302.4 353.4 302.4 353.4 302.4 353.4 302.4 302.4 302.4 307.4 302.4 307.4 302.4 307.4 302.4 307.5 31.5 515.2 32.4 1.556.8 32.4 1.03.3 32.4 1.03.3 32.2 4.10.3 32.2 4.10.3 32.2 1.193.3 32.1 1.193.3 32.1 1.193.3 32.1 1.193.3 32.1 1.193.3
2.193.4 2.973.2 8.22.4 8.22.4 101.3 2.973.2 8.22.4 101.3 2.65.7 403.2 2.65.7 403.2 3.05.6 3.346.1 3.347.1 3.34			╎╌┇┈╢╴╎╌╏╌╀╼╎━╫╌┦━╫╍╏╴╎╴╿╴╿╌╢╌╢╌╢╌╫╌╇╌╇	502.4 274.2		13.9 13.9		302 313. 313. 313. 313. 313. 313. 313. 313	4 302.4 313.6 6 313.6 5 313.6 5 313.6 5 313.6 5 313.6 5 313.6 5 313.6 5 313.6 5 313.6 5 313.6 5 31.5 5 31.5 5 31.5 5 31.5 5 31.5 5 32.4 4 33.2 4 33.2 4 33.2 4 33.3 5 33.3 5 33.3 5 33.3 5 33.3 5 4 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
2.198.4 2.979.2 822.4 101.3 1.066.6 822.4 101.3 1.066.6 822.7 403.2 395.3 346.1 265.7 403.2 395.3 346.1 381.3 113.0 46 46 46 46 46 46 46 46 46 46 46 46 46				502.4 274.2	<u> </u>	13.9 13.9		313. 313. 356. 356. 561. 560. 772. 3.517. 772. 3.517. 712. 3.517. 11.556. 3.517. 12.517. 1.444. 2.973. 1.1.55. 3.517. 1.444. 3.517. 1.444. 724.0 1.1.65. 313.1 1.1.05. 313.2 1.1.05. 313.4 1.1.05. 313.4 1.1.05. 313.4 1.1.05. 313.4 1.1.05. 313.4 1.1.05. 313.4 1.1.05.	6 313.6 4 358.4 2 515.2 6 358.4 560.0 6 3.517.6 8 772.8 8 772.8 8 772.8 9 1.887.9 9 1.887.9 9 1.323.5 0 3.30.2 1.323.5 0 3.40.2 0 2.323.5 0 2.325.5 0 2.325.5 0 2.325.5 0 2
2. 198. 4 2. 198. 4 2. 979. 2 822. 4 101. 3 2. 979. 2 822. 4 101. 3 1. 066. 6 822. 4 101. 3 1. 066. 6 820. 0 820. 0 113. 0 113. 0 45. 113. 0 45. 5. 000. 0 845. 2 1. 714. 6 776. 6 1. 759. 1 77			╏╴╎╌╏╌┦╌╿╌╿╌┞╌┇╴╎╴╏╴╎╌╎╌╎╼┇╌┤╌┿	502. 4 274. 2	│	13.9 13.9 13.9 13.9 13.9		2388 560 560 560 560 560 3.515 3.517 3.517 3.517 3.517 3.517 3.517 3.517 1.567 561.2 7.2 919.7 1.0163 3.517 1.0163 3.517 1.0163 3.517 1.0163 5.017 2.979 5.017 2.979 5.017 2.979 5.017 2.979 5.017 2.979 5.017 2.979 5.017 2.979 5.017 2.979 5.017 2.979 5.017 5.007 5.0	4 358.4 2 515.2 358.4 556.6 0 560.0 560.0 560.0 6 1.556.8 8 1.556.8 8 1.556.8 8 1.576.8 8 1.576.8 8 1.576.8 8 1.576.8 8 1.576.8 8 1.576.8 8 1.2.391.2 8 1.2.391.2 9 1.870.3 1.1320.5 1.323.1 1.1320.5 1.323.1
2.198.4 2.198.4 2.979.2 101.3 2.979.2 101.3 2.979.2 101.3 2.979.2 101.3 2.979.2 101.3 2.979.2 101.3 2.979.2 101.3 2.979.2 101.3 2.979.2 101.3 2.979.2 101.2 2.979.2 361.1 45.2 1.714.6 7.000.0 845.2 1.759.1 776.6			╽╌╏╌┥╌╿─╏╌╎─┝╴╏╴╎╴┠╌╿╶╷┝╸┟╌┼	502. 4 274. 2	╽ <u>╸</u> ┊┈┧╍╎╺┟┑┟┑┝╴╎╸╎╴╎╴╎╺┝┱╋╍┟╍┝╍┝╸	13.9 13.9		513. 560 560 560 772 772 772 1.1556 560 561.0 1.1556 561.0 712 101.3 2.951.0 101.3 101.3 561.0 561.0 724.1 712.2 101.3 724.1 101.3 724.1 561.0 724.1 724.2 561.2 724.1 724.2 561.2 724.2 561.2	2 552 6 550 6 550 7 550 6 550 6 550 7 550 6 550 7 550 6 550 7
2. 136. 4 2. 136. 4 2. 979.2 2. 979.2 2. 979.2 2. 979.2 2. 979.2 1.01.3 3. 273.4 101.3 3. 255.7 403.2 3. 346.1			┋╌┦╌╿╌┋╌╎╴┟╴╎╴╏╴┟╌╎╌╿╼┇╌╎╶┾	502.4 274.2		13.9 13.9		560 560 772 772 772 3.615 772 3.615 1.556 3.617 1.155 3.611 1.153 2.839 1.113 2.839 1.113 2.839 1.113 2.839 1.113 2.839 1.113 2.839 1.113 2.839 1.113 2.839 1.113 2.839 1.113 2.839 1.1163 1.163 1.1163 2.631 1.1163 2.641 1.1163 5.641 1.1163 5.641	0 500 0 500
2.198.4 2.979.2 822.4 101.3 1.066.6 822.4 101.3 1.066.6 822.7 403.2 395.3 346.1 265.7 403.2 381.3 113.0 34 381.3 113.0 34 46 46 46 46 46 46 46 46 46 46 46 46 46			┥╌╽─┋╌╎─┟╌┋╴╎╴╏╴╏╴╎╴╎╌╎	502.4 274.2	┼╍┼┉┠╍┠╍╎╍╎╾╎╴┼╺┠╍╉╍┠╍┝╍	13.9 13.9		1.155 772 1.556 1.556 1.556 1.556 1.556 1.556 1.556 1.556 1.556 1.556 1.556 1.556 1.556 1.556 1.556 1.556 1.557 1.238 1.557 1.244 1.557 1.244 1.557 1.546 1.556 1.546 1.557 1.546 1.557 1.546 1.557 1.546 1.557 1.546 1.557 1.546 1.557 1.546 1.556 1.540 1.557 1.540 1.556 1.540 1.557 1.540 1.557 1.540 1.557 1.540 1.557 1.540 1.557 1.540 1.557 1.540	8 1.556 8 1.55
2. 198. 4 2. 198. 4 800. 0 2. 279. 2 822. 4 101. 3 1.066. 6 800. 0 822. 4 101. 3 1.066. 6 800. 0 36. 1 2. 565. 7 403. 2 381. 3 113. 0 36 2. 665. 7 403. 2 381. 3 113. 0 36 45 381. 3 113. 0 36 45 6.000. 0 845. 2 1.714. 6 776. 6 1.759. 1 77	· · · · · · · · · · · · · · · · · · ·	· · · · · · · · · · · · · · · · · · ·	╎╼╏╾╎╾┟╴╎╴╎╴╏╴╎╴╎╺╷┥╸	502.4 274.2		100.0 1300.0		1. 556. 1. 556. 1. 556. 2. 979. 101. 3. 2. 889. 101. 3. 2. 689. 101. 3. 2. 689. 101. 3. 2. 689. 102. 3. 1. 100. 103. 7. 1. 000. 104. 2. 1. 100. 104. 104. 104. 104. 104. 104. 104. 104.	8 1.556.8 8 1.556.8 9 1.556.8 9 1.2 990.3 9 1.887.9 9 1.887.9 1.323.1 0 2.33.3 1.323.3 0 3.32.410.3 1.323.1 0 3.30.2 1.323.1 0 3.323.1 0 3.325.1 0 3.325.
2.198.4 2.979.2 822.4 101.3 1.066.6 800.0 822.4 101.3 2.565.7 403.2 381.3 113.0 381.3 113.0 45 381.3 13.0 36.1 45 381.3 13.0 36.1 45 381.3 13.0 36.1 45 381.3 13.0 36.1 45 381.3 13.0 36.1 45 381.3 13.0 36.1 45 381.3 13.0 36.1 45 381.3 13.0 36.1 45 381.3 5.000.0 845.2 1.714.6 776.6				274.2 274.2		1000 13000 13000		1. 335. 1. 351. 1. 351. 1. 351. 2. 573. 1. 101. 1. 2. 573. 1. 101. 1. 101.	6 4 1, 327 6 6 3, 677 6 7 2, 2930 3 7 2, 2930 3 8 2, 225 0 9 1, 887 9 9 1, 887 9 9 1, 351 0 1, 353 1 0 330, 2 0 330, 2 0 1, 353 0 0 340, 2 0 1, 353 0 0 1, 354 0 0 1,
2. 196. 4 2. 979. 2 822. 4 101. 3 1. 066. 6 822. 4 101. 3 1. 066. 6 265. 7 403. 2 381. 3 113. 0 361. 0 361. 0 361. 1 365. 1 46 45 45 46 45 46 1 46 45 46 46 46 46 46 46 46 46 46 46			╶┈╎╼╌┟╌╴╏╴╶╎╴╴╏╶╌╎╼╌╽╼╌┟╌╌┼╼╄╍╌╄╸	502.4 274.2	┉┼╼┝╌╎╾╎╌┦╌┟╍┟╍┝╼┝╼	100.0 13.9		3.517 3.517 101.2 2.979 101.2 2.979 101.2 2.989 561.0 11.749 101.749 561.0 11.749 786.9 564 786.9 564 788.9 540	6 3,617,6 2 2,979,2 2 2,979,2 2 2,990,3 3 2,410,3 3 2,410,3 3 2,410,3 4 1,920,5 1,351,8 8 1,920,5 1,351,8 8 1,920,5 1,351,8 8 1,353,1 1,351,8 8 1,353,1 1,351,8 8 1,353,1 1,351,8 1,353,1 1,351,8 1,353,1 1,351,8 1,353,1 1,351,1 1,35
2.979.2 301.0 800.0 822.4 101.3 1.066.6 800.0 822.4 101.2 244.8 800.0 265.7 403.2 395.3 346.1 265.7 403.2 381.3 113.0 34 946 341.3 113.0 34 1000.0 845.2 1.714.6 776.6 1.759.1		· []] . []]. []		502.4 274.2	╼┝╌╎╾╎╌╎╶┝╼╂╍╁╼┝╼┝╼	100.0 13.9		2.975 101.3 2.889 641.2 1.944 641.2 1.944 724.0 1.165 919.7 1.000 786.9 540 782.9 540	
822.4 101.3 1.066.6 800.0 451.2 244.8 500.0 265.7 403.2 395.3 346.1 45 381.3 113.0 34 45 45 6.000.0 845.2 1.714.6 776.6 1.759.1 77			╷╴┇╴╷╎╴╶╷╴╷┥╌╷┥╼┑┥╌┥╌╇╸╸╇╸	502.4 274.2	┍┈╎╾╷└╌┊╴╸╎╾╸┫╼╸┫╼╸┥	100.0 13.9		101.3 2.889. 481.2 1.944. 661.2 1.195. 724.0 1.165. 919.7 1.005. 786.9 540. 786.9 540. 782.9 540. 641.2 139.	
481.2 244.8 500.0 265.7 403.2 395.3 346.1 381.3 113.0 3 45 381.3 113.0 3 60.00 346.1 346.1 45 60.00 345.2 1.714.6 776.6 1.759.1 77				502.4 274.2	╏╍╷┠╌╿╶╌┠╼╌┠╼┝╼	13.9 1300.0 13.9		481.2 : 1. 944 661.0 : 1. 749 724.0 : 1. 163 919.7 : 1. 000 786.9 : 564 782.9 : 540 641.2 : 139	
265.7 403.2 395.3 346.1 331.3 113.0 34 45 381.5 113.0 46 36 345.2 5.000.0 845.2 1.714.6			-	502.4 274.2	<u> </u>	1300.0 1300.0 13.9		661 0 1 749 724 0 1.163 1.163 819 7 1.1000 1.163 786 9 564 1.101 782 9 564 1.101 782 9 564 1.101 782 9 564 1.193	
381.3 113.0 34 45 6.000.0 845.2 1.714.6 776.6 1.759.1 77				502.4 274.2	!	100.0 300.0 13.9		724.0 1.163 919.7 1.000. 786.9 564. 782.9 564. 641.2 199.	
45 6.000.0 845.2 1.714.6 776.6 1.759.1			-	502.4 274.2	╎_┟╻┟╻┝╺	100.0 300.0 13.9		819.7 1.000. 786.9 564. 782.9 540. 641.2 199.	8 1.920.5 9 1.351.8 2 1.323.1 0 840.2
6.000.0 845.2 1.714.6 776.6 1.759.1		1	╎─┤╌╎╌┼╌┾	502.4 274.2	┟╻┟╻┝╻	100.0 300.0			111
6.000.0 845.2 1.714.6 776.6 1.759.1		<u>],],] .</u>]	╏╎-┼-┾	502.4 274.2	 	300.0			
6.000.0 845.2 1.714.6 776.6 1.759.1				274.2		13.9			
6.000.0 846.2 1.714.6 776.6 1.759.1 77					ļ				ļ.
6.000.0 846.2 1.714.6 776.6 1.759.1 77						229.6		532.9 1 298.7	7 831.6
6.000.0 846.2 1.714.6 776.6 1.759.1 77								307.1 43.3	
6.000.0 846.2 1.714.6 776.6 1.757 1.								228.1 33.7	7 261.8
6.000.0 848.2 1.714.6 776.6 1.759.1 77							63.8 7.5		_
6.000.0 848.2 11.714.6 776.6 1.759.1 77				-					7 58.9
	6 6 2.123.1	776.6 1.637.4	775.6 1 849.5	776.61	631.8 1 776.6	643.5	76.5 258.3	6.284.3 21.517.4	4 27, 901.7
942.4 200.0								: 1.142.4	4 1 142.4
				•				1,993	6 11.993.5
166.1 539.5		1 300.6							1.399.5 11.565.6
3 148.2	137.8 350.6	1 500.01	1 200.0						8 1.573.9
 		7 2	200.(100.01				
		36.7 75.0	303.4 519.6	38.7:	9.01	-		378.8 773.5	5 1.152.4
				264.7	399.6 60.8	91.8			
					242.6			282.6 414.	7 697.3
									5 407.0
	 							~	
	_		-					5.6 72.	8
				~			79.0 1.5	79.0 1	5 80.5
0.0 0.0 0.0 0.0 2.136.0 303.4 1.747.7 30	03 4 1,028.4	303.4 1.222.3	303.4 1.019.6	303.4	578.6 303.4	447.8	303.5 596.4	2.123.9 8.775	8 10.900.7
0 050 0 1 050 0 0 500 0	1 3 1 3 1 6 1	1 0 0 0 1	0 000 1 0 000 1	1 000 0 1 010 1	- -	1 101 2 10	30 0 SE4 7		000 00 0
5,000.0 5,000.0 1 040.4 13,000.0 11,000.0 13,000.8 11,000.0	0.101.0	1. UOU. U 6. 033. ()	7 100 1 1 002 7		000 T 7.000.0	1. USL - 2 - 1. UOU. U	-	0.400.2 20.334.2 30.002.4	2 36, 502.4

Table 2-6 Mining schedule

Tonnage Grade Content Tonnage Grade Ou Au Cu Au Cu Au Cu Au Cu	(content i) onnage irrade (content Tonnage Grade i Content
Cu Au Cu Au Cu Au Cu Au C	
	Au Au Cu Au Cu Au Co
$(1,000t) \in (3, [(e/t)] = (t) = (ke) = ((1,000t) \in (3, [(e/t)] = (t))$	(kg) $[(1,000t)] (2) [(g/t)] (t) [(kg)](1,000t)] (g/t)] (t) (t) [kg]$
5.2	
195.45 1 395.3 1.54 0.74 16.498.8 230.8	
381.3 1.16 0.60 4.409.4 229.63 342.7 1.16 0.60 3.963.0	206.4
1 433.9 1.54 0.84 6.690.	7 354.31 485.8 1.54 0.84 7.490.9 407.9 1 1
	1 290.8 1.98 0.49 5.770.5 143.54 496.1 1.98 0.49 9.844.4 244.9
	1 1 1 1 280.5 0.84 0.44 2.349.3 124.51
497,77 776.61.40 0.67 10.908.2 520.42 776.61.37 0.73 10.653.	7 570.69 776.5 1.71 0.71 13.261.5 551.43 776.5 1.57 0.48 12.193.7 369.40
1.49 0.92 12.	
1 137.3 1.73 0.60 2.331.9 81.80 137.8 1.73 0.60 2.390	5 82.1
1 165.6 1.22 0.68 2.018.3	3 111.81 266.7 1.22 0.68 3.250.4 180.1
	36.7 0.88 0.47 324.4 17.09 303.4 0.88 0.47 2.681.5 141.25
0.00 303.4 1.60 0.77 4.854.8 234.42 303.4 1.45 0.64 4.408.8	3 193.91 303.4 1.18 0.65 3.574.8 197.15 303.4 0.88 0.47 2.681.5 141.25

Table 2-7 Mining annual production (1)

.

Grade Content Tonnase Content Tonnase $(0.1 - Au)$ Cu Au $Tonnase$ $Tonnase$ $(2.1 - Bu)$ $(1, 0000t)$ $(2.1 - Bu)$ $(1, 0000t)$ $(2.1 - Bu)$ $(1, 000t)$ $(2.1 - Bu)$ $(1, 000t)$ $(2.1 - Bu)$ $(2.2 - Bu)$ $(2.1 - Bu)$ $(2.1 - Bu)$ $(2.1 - Bu)$ $(2.2 - Bu)$ $(2.1 - Bu)$ $(2.1 - Bu)$ $(2.1 - Bu)$ $(2.2 - Bu)$ $(2.1 - Bu)$ $(2.1$	Grade Content Tourage	and Farda . Partar
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$		2005
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	Au : Cu Au	Cu Au :
502.4 0.84 0.4 4.207.7 223.0 502.4 0.84 0.44 4.207.7 223.0 274.2 0.78 0.50 2.105.9 105.77 274.2 0.78 0.50 2.105.9 105.77 274.2 0.78 0.64 5.630.8 342.51 123.3 28.1 1 1 1 1 233.1 274.2 1.37 361.0 1 1 1 274.2 1.36 135.77 1 361.7 233.1 274.1 1.31 0.64 5.630.8 342.51 123.3 28.1 1 1 1 1 234.2 28.1 1 1 1 1 242.51 123.3 38.7 1 1 1 1 234.2 54.2 38.7 1 1 1 1 24.2 54.2 38.7 1 1 1 1 24.1 54.2 38.7 1 1 1 1 24.2 3 38.7 1 1 1 1 1 1 38.7 1 1 1 1 24.5 <t< td=""><td> (g/t) (t) = (t)</td><td>i (%) (g/t) (t) (t) (</td></t<>	(g/t) (t) = (t)	i (%) (g/t) (t) (t) (
502.4 0.84 0.44 4.207.7 223.0 502.4 0.84 0.84 5.50 2.125.9 214.2 0.78 0.50 2.125.9 135.77 214.2 0.78 0.64 5.630.8 342.51 123.3 109.6 1.37 307.1 204.7 233.6 353.79 776.6 1.09 238.7 0.68 8.476.1 524.23 256.1 1.37 225.1 256.2 2.120.5 242.61 54.2 264.7 332.79 776.6 54.2 264.7 342.01 18.0 55.9 264.7 1.21 0.92 3.205.5 244.72 264.7 2.23 776.5 55.9 264.7 1.21 0.32 55.9 264.7 1.21 0.32 55.9 264.7 1.21 0.32 55.6 264.7 1.21 0.37 54.47 274.6 1.42 3.745.8 89.47 21.45 1.42 3.745.8 56.6 21.45 1.42 1.31 57.45 21.45 1.42 1.31 54.47		0.17 1.506.8 1
502.4 0.84 0.44 4.207.7 223.0 274.2 0.78 0.50 2.125.9 1357.0 0.78 0.50 2.125.3 274.2 0.78 0.50 2.125.9 1357.7 357.0 0.78 5.630.8 342.51 123.3 274.2 0.78 0.46 5.333.6 135.77 357.0 0.78 5.630.8 342.51 123.3 275.6 0.48 5.630.8 342.51 123.3 327.51 228.1 275.6 0.48 5.333.6 353.79 776.6 1.09 6.8 476.1 524.23 776.5 33.7 0.88 0.68 8.476.1 524.23 776.5 54.2 33.7 0.88 0.68 8.476.1 524.23 776.5 284.7 1.21 0.92 3.206.5 242.6 1.21 29.2 284.7 1.21 0.92 2.242.6 1.475.8 89.47 40.0 16 1 1 1 1 1 51.4 17.5 1 1 1 1 1<57.5		0.59 5,424.7 2
502.4 0.84 0.84 4.207.7 223.0 274.2 0.78 0.50 2.126.9 135.77 357.0 0.78 181.7 274.2 0.78 0.50 2.126.9 135.77 357.0 0.78 123.3 274.2 0.78 0.50 2.126.9 135.77 357.0 123.3 274.2 0.78 0.50 2.126.9 135.77 357.1 274.4 0.50 2.126.9 135.77 367.1 275.1 125.1 135.77 367.6 123.3 28.1 100.6 1.37 123.3 53.3 216.5 0.82 0.46 5.333.6 355.79 776.5 38.7 0.88 0.47 3.42.0 18.0 120.0 54.23 284.7 1.21 0.92 3.206.5 242.6 1.21 0.92 284.7 1.21 0.92 242.6 1.21 0.92 776.5 214.5 1.21 0.92 242.6 1.46.5 16.1 1 1 1.21 0.92 242.6 1.46.5 1 1 1.21 0.92 245.8 21.4 1 1 1 1	199	_
202.4 0.84 0.44 4.207.7 223.0 214.2 0.78 0.50 2.125.9 135.77 387.0 0.78 342.51 123.3 214.2 0.78 0.50 2.125.9 135.77 387.0 0.78 342.51 123.3 274.2 0.78 0.84 5.630.8 342.51 123.3 307.1 307.1 307.1 233.6 353.79 776.5 716.6 0.82 0.46 6.333.6 353.79 776.5 33.7 0.84 7.66.1 0.92 342.51 123.3 33.7 776.6 0.86 1.21 0.92 354.23 776.5 33.7 1.80 0.81 0.65 8.476.1 524.23 776.5 33.7 1.80 0.81 0.83 1.21 0.92 354.9 33.7 1.21 0.92 3.205.5 243.6 1.21 0.92 776.5 36.4 1.21 0.32 1.21 0.37 36.47 40.0 38.7 1.21 0.92 246.6 1.45 36.47 40.0 36.4 1.21 0.37 3.445.8 89.47 40.0 36.6 <td< td=""><td>724.</td><td></td></td<>	724.	
502.4 0.84 0.44 4.207.7 233.0 155.77 357.0 0.78 0.50 2.125.9 135.77 357.0 0.78 0.50 2.125.9 135.77 274.2 0.50 2.125.9 135.77 357.0 0.78 0.50 2.125.3 123.3 776.6 0.82 0.46 6.333.6 356.79 776.6 1.09 6.8 476.1 524.2 776.6 0.82 0.47 342.0 18.0 1.87 54.2 776.6 0.82 0.46 6.333.6 356.79 776.5 54.2 1.80 0.68 8.476.1 524.23 776.5 54.7 1.12 0.92 3.205.5 242.61 1.42 0.0 38.7 0.84 1.42 0.37 3.445.8 89.47 40.0 157.5 242.6 1.42 0.37 3.445.8 89.47 40.0 157.5 1.32 0.92 2.43.23 7.45.8 56.6		0.84 14, 181.6]
502,4 0.84 0.4 4.207,7 223.0 274,2 0.73 0.64 5.630,8 381.7 274,2 0.73 0.64 5.630,8 342.61 273,3 499.6 1.37 0.64 5.630,8 342.61 274,2 0.78 0.64 5.630,8 342.61 233.123.123.123.123.123.123.123.123.123.	786.9	1.98 0.49 15.614.9
274.2 0.73 0.50 2.125.9 135.77 367.0 0.78 0.50 12.845.3 181.7 123.3 201.1 123.3 10.64 5.630.8 342.61 123.3 201.1 223.1 125.5 1	782.9	0.84 0.44 6.557.0
409.6 1.37 0.84 5.630.8 342.51 123.3 307.1 307.1 307.1 307.1 53.8 776.6 0.48 5.630.8 342.51 123.3 54.2 54.2 54.2 54.2 776.6 0.48 6.333.6 353.79 776.6 1.09 0.68 8.476.1 524.23 776.5 33.7 0.48 0.47 342.0 18.0 18.0 18.0 18.0 120.32 55.9 264.7 1.21 0.92 3.205.5 243.26 1.21 0.92 35.9 40.0 264.7 1.21 0.92 3.205.5 242.6 1.27 0.37 36.47 20.1 1.21 0.92 2.3.205.5 242.6 1.27 0.37 36.47 20.1 1.21 0.92 3.205.5 242.6 1.27 21.45 21.4 1.21 0.92 3.445.8 89.47 40.0 20.1 1.21 0.92 3.445.8 89.47 21.45 21.4 1.21 0.92 3.445.8 89.47 40.0	641.2	0.78 0.50 4.971.2
367.1 307.1 776.6 0.82 0.46 6.333.6 353.79 776.6 1 224.23 776.5 38.7 776.6 0.82 0.46 6.333.6 353.79 776.5 54.2 38.7 0.82 0.46 6.333.6 353.79 776.6 1 54.2 38.7 0.88 0.47 324.0 18.0 1 0 92 776.5 38.7 0.88 0.47 342.0 18.0 1 0 92 3 20.4 1.21 0.92 3.205.5 243.6 1.21 0.92 35.9 1 1 1 1 1 1 1 40.0 1 1 1 1 1 21.45 8 47 40.0 1 1 1 1 1 1 1 21.45 1 21.45 1 1 1 1 1 1 1 21.45 1 21.45 1 1 1 1 1 1 1 21.45 1 21.45 1 1 1 1 1 1 1 1 21.45	37 0.84 1.695.0 103.1 532.9	1.37 0.84 7.325.8
228.1 228.1 776.6 0.82 0.46 5.333.6 353.79 776.6 1.09 0.68 18.476.1 524.23 756.5 38.7 0.88 0.47 342.0 18.0 18.0 1 228.1 284.7 1.21 0.92 3.205.5 243.26 142 0.37 3.455.8 89.47 40.0 284.7 1.21 0.92 3.205.5 242.6 1.42 0.37 3.455.8 89.47 40.0 284.7 1.21 0.37 3.455.8 89.47 40.0 284.7 1.32 0.32 3.445.8 89.47 40.0	09 0.37 3.345.0 1 112.9 307	1.09 0.37 3.345.0
776.6 0.82 0.46 6.333.6 353.79 776.6 54.2 776.6 0.82 0.46 6.333.6 353.79 776.6 54.2 83.7 0.47 342.0 18.0 68.476.1 524.23 776.5 38.7 0.47 342.0 18.0 18.0 264.7 342.5 243.6 51.42 264.7 1.21 0.92 736.5 243.6 1.42 0.37 3.455.8 89.47 10.0 16 1 1 0.37 3.455.8 89.47 10.0 16 1 1 0.37 3.445.8 89.47 10.0 16 1 1 0.37 3.445.8 89.47 16.0 16 1 1 0.37 3.445.8 89.47 157.5 16 1 1 0.37 3.445.8 89.47 157.5 16 1 1 0.37 3.445.8 89.47 157.5 16 1 1 1 1 1<12	ي. ما	0.70 0.15 1.586.5
776. 6 0. 82 0. 45 (5. 333. 6 353. 79 776. 6 1. 09 0. 68 (8, 476. 1 524. 23 776. 5 38. 7 0. 88 0. 47 342. 0 18. 0 38. 0 38. 7 36. 3 3. 445. 8 89. 47 40. 0 284. 7 1. 21 0. 92 3. 205. 5 243. 22 60. 8 1. 42 0. 37 3. 445. 8 89. 47 40. 0 284. 7 1. 21 0. 92 3. 205. 5 243. 2 50. 8 1. 42 0. 37 3. 445. 8 89. 47 40. 0 284. 7 1. 21 0. 92 3. 205. 5 243. 2 50. 8 1. 42 0. 37 3. 445. 8 89. 47 40. 0 284. 7 1. 21 0. 92 3. 205. 5 243. 2 50. 8 1. 42 0. 37 3. 445. 8 89. 47 40. 0 284. 7 1. 21 0. 92 3. 205. 5 243. 2 50. 8 1. 42 0. 37 3. 445. 8 89. 47 40. 0 284. 7 1. 20 0. 92 5 5 243. 2 50. 8 1. 42 0. 37 3. 445. 8 89. 47 40. 0 284. 7 1. 20 0. 92 5 5 243. 2 50. 8 1. 42 0. 37 3. 445. 8 89. 47 40. 0 284. 7 1. 20 0. 92 5 5 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	3 11.1	3 0.59 0.17 379.3 1
776. 6 0. 82 0. 46 5, 333. 6 355, 79 776. 6 1. 09 0. 68 8, 476. 1 524, 23 776. 5 33. 7 0. 88 0. 47 342. 0 18. 0 33. 7 0. 88 0. 47 342. 0 18. 0 264. 7 1. 21 0. 92 3. 205. 5 243. 20 242. 6 1. 42 0. 37 3. 445. 8 89. 47 10. 0 264. 7 1. 21 0. 92 3. 205. 5 243. 20 242. 6 1. 42 0. 37 3. 445. 8 89. 47 21. 40. 0 264. 7 1. 20 0. 92 3. 205. 5 243. 20 242. 6 1. 42 0. 37 3. 445. 8 89. 47 21. 40. 0 264. 7 1. 20 0. 92 3. 205. 5 243. 20 242. 6 1. 42 0. 37 3. 445. 8 89. 47 21. 40. 0 264. 7 1. 20 0. 92 3. 205. 5 243. 20 242. 6 1. 42 0. 37 3. 445. 8 89. 47 20. 400. 0 264. 7 1. 20 0. 92 3. 205. 5 243. 20 243. 6 1. 47 0. 37 3. 445. 8 89. 47 20. 0 264. 7 1. 20 0. 92 3. 205. 5 243. 20 243. 6 1. 42 0. 37 3. 445. 8 89. 47 20. 0 264. 7 1. 20 0. 92 3. 205. 5 243. 20 243. 6 1. 42 0. 37 3. 445. 8 89. 47 20. 0 264. 7 1. 20 0. 92 3. 205. 5 243. 20 243. 6 1. 42 0. 37 3. 445. 8 89. 47 20. 0 264. 7 1. 20 0. 92 3. 205. 5 243. 20 243. 20 243. 20 245. 6 1. 42 0. 37 3. 445. 8 89. 47 20. 0 264. 7 1. 20 0. 92 3. 205. 5 243. 20 243. 20 243. 20 245. 6 1. 42 0. 44 0. 4	0.08 203.9 4.3	54.2 0.38 0.08 203.9 4.32
38.7 0.88 0.47 342.0 18.0 18.0 18.0 284.7 1.21 0.92 3.205.5 243.22 50.8 1.21 0.92 3.55.9 204.7 1.21 0.92 3.205.5 243.22 50.8 1.21 0.92 3.55.9 204.7 1.21 0.92 3.205.5 243.22 50.8 1.21 0.37 3.445.8 89.47 40.0 1 1 21.42 0.37 3.445.8 89.47 40.0 1 1 21.42 0.37 3.445.8 89.47 40.0 1 1 21.42 0.37 3.445.8 89.47 157.5 1 1 21.42 0.37 3.445.8 89.47 157.5	0.34:7.209.7 264.91 6.2	60
38.7 0.88 0.47 342.0 18.0 18.0 264.7 1.21 0.92 3.205.5 243.22 50.8 1.21 0.92 35.9 264.7 1.21 0.92 3.205.5 243.65 1.42 0.37 3.445.8 89.47 40.0 157.5 242.6 1.42 0.37 3.445.8 89.47 40.0 21.4 242.6 1.42 0.37 3.445.8 89.47 157.5 20.0 242.6 1.42 0.37 3.445.8 89.47 157.5		
38.7 0.88 0.47 342.0 18.0 60.8 1.21 0.92 55.9 40.0 264.7 1.25 242.6 1.42 0.32 3.455.8 89.47 40.0 264.7 1.21 0.92 7.3205.5 243.25 51.42 0.37 3.445.8 89.47 40.0 264.7 1.21 0.37 3.445.8 89.47 40.0 157.5 21.4 1.42 0.37 3.445.8 89.47 40.0 21.4 20.0 2.42.6 1.42 0.37 3.445.8 89.47 40.0 21.4 20.0 2.42.6 1.42 0.37 3.445.8 89.47 40.0 21.4 21.4 20.0 2.42.6 0.37 0.345.8 89.47 40.0 21.4 21.4 21.4 21.4 21.4 21.4 21.4 21.4 21.4 21.4 21.4 21.4 21.4 21.4 21.4 21.4 21.4 21.4 21.4	156.	11.49 0
38.7 0.88 0.47 342.0 18.0 264.7 1.21 0.92 3.205.5 243.25 50.8 1.42 0.37 3.445.8 89.47 40.0 264.7 1.21 0.92 3.205.5 243.25 51.42 0.37 3.445.8 89.47 40.0 264.7 1.21 0.37 3.445.8 89.47 40.0 214.6 1.42 0.37 3.445.8 89.47 40.0 21.4 0.37 0.37 3.445.8 89.47 40.0 21.4 0.37 0.37 3.445.8 89.47 40.0	1 275.	1 1.73 D.
33.7 0.85 0.47 342.0 18.0 18.0 264.7 1.21 0.92 3.205.5 243.22 60.8 1.21 0.92 264.7 1.21 0.92 3.205.5 243.61 1.21 0.92 3.445.8 89.47 40.0 1 1 1 1 1.21 1.21 1.21 1.21 1.21 1.21 1 1 1 1.21 1.21 1.21 1.21 1.21 1.21 1 1 1 1.21 1.21 1.21 1.21 1.21 1.21 1 1 1 1.21 1.21 1.21 1.21 1.21 1.21 1 1 1 1 1.21 1.21 1.21 1.21 1 1 1 1.21 1.21 1.21 1.21 1.21 1 1 1 1.21 1.21 1.21 1.21 1.21 1 1 1 1.21 1.21 1.21 1.21 1.21 1 1 1 1.21 1.21 1.21 1.21 1.21 1 1 1 1.21 1.21 1.21 1.	432.3	1.22 1.68 : 5.268.7
264.7 1.21 0.92 3.205.5 243.22 60.8 1.21 0.92 736.3 55.9 1 1 2 242.6 1.42 0.37 3.445.8 89.47 40.0 1 1 1 2 2.42.6 1.42 0.37 3.445.8 89.47 40.0 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 <	372.8	0.88 0.47 (3.347.9)
	325.5	1.21 0.92 3.941.8
	0.37 568.1 14.8	1.42 0.37 4.013.9
	0.26 1.300.4	ιD
	1.35 87.7 29.01	1.35 87.7
	0.53 21.9 3.0	0.39 0.53 21.9
	D.66 696.5 i 5.	0.88 0.66 696.6
1 303.4 1.1/ 0.65 3.54/ D 1 201.24 303.4 1.30 0.46 4.162.0 1 143.34 303.5 U	88 D.46 2.674.7 140.37 2 123.	.9 1.22 0.62 25,924.2 1.313.68
Total 1,080.0 0.91 0.57 9.881.1 620.03 1.080.0 1.17 0.62 12.658.2 669.56 1.080.0 0.9	<u>52</u> 0.38 9.884.4 405.28 8.408	8,408.2 1.26 0.59 106.360.2 4.971.32

Table 2-7 Mining annual production (2)

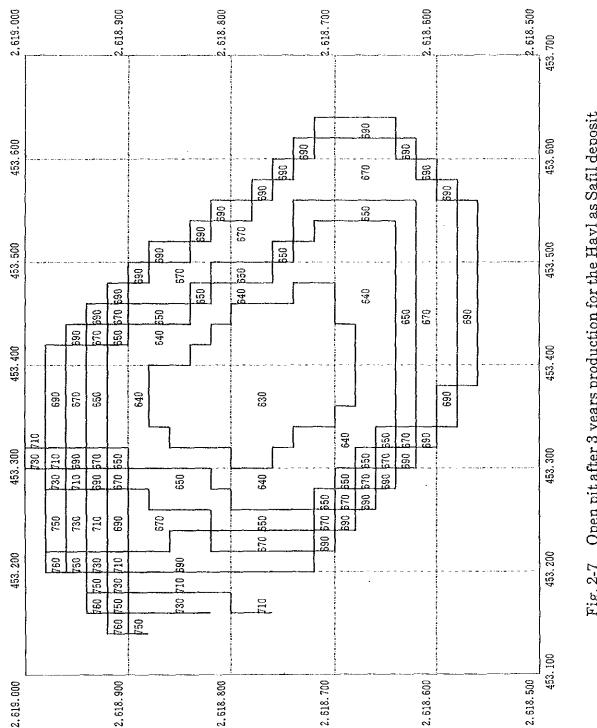
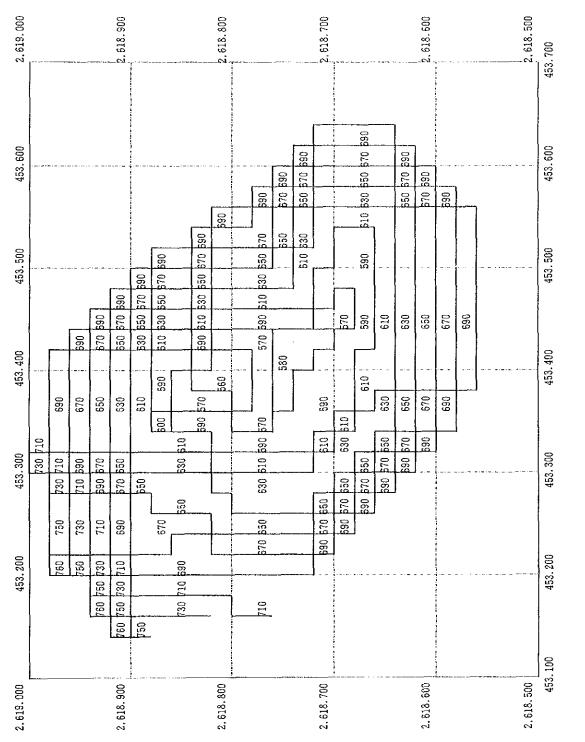


Fig. 2-7 Open pit after 3 years production for the Hayl as Safil deposit





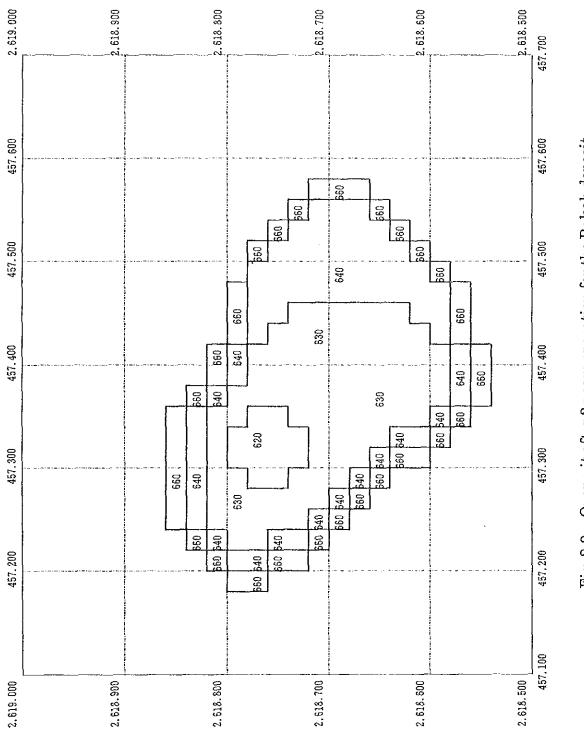


Fig. 2-9 Open pit after 3 years operation for the Rakah deposit

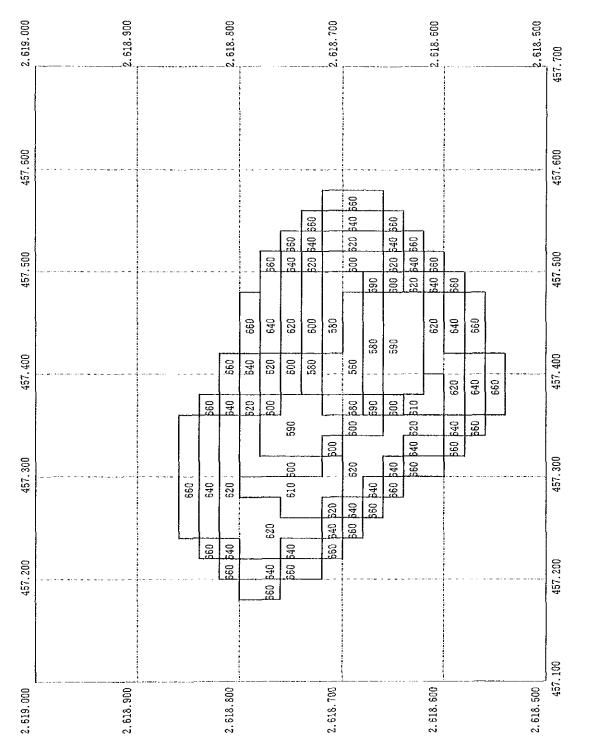


Fig. 2-10 Final pit of the Rakah deposit

2-4-3 Operating cost

Due to the difference of the hauling distance, the unit operating cost of Rakah ore and other materials (ore of Hayl as Safil and waste of both pits) are obtained independently. The unit operating cost for the Rakah ore is 153.9 US cents per ton, and that of the other materials is 112.1 US cents per ton. The details are shown in Table 2-8.

		Unit Cos	t (US¢/t)	
	Labour	Supply	Equipment	Total
Rakah Ore				
Drill & Blast Ore	5.4	14.4	8.0	27.8
Excavation, Load & Haul	40.2	0.0	85.9	126.1
Total	45.6	14.4	-93.9	153.9
Other Material				
Drill & Blast Ore	5.4	14.4	8.0	27.8
Excavation, Load & Haul	29.0	0.0	55.3	84.3
Total	34.4	14.4	63.3	112.1

Table 2-8 Mining operation cost

2-4-4 Mining manning plan

The mining department consists from five groups which are shown below.

- (1) Geological group
- (2) Mine planning and survey group
- (3) Operation group
- (4) Heavy equipment repair shop
- (5) Clerical group

The number of mining operators required for the first year's operation is shown in Table 2-9. The whole organization including all the necessary personnel is shown in Fig. 6-1 (2) of section 6 in this volume. The total manpower of mining department will be reduced year by year as the mining handling volume reduces.

Equipment	Units	Operato	or	Assis-	Total
		Ι	II	tant	
Drill	2	6		6	12
Front End Loader	2	4	3		7
Hydraulic Excavator	2	4	3		7
Dump Truck	12	20	25		45
Bulldozer	3	5	5		10
Motor Grader	1	2	2		4
Backhoe	1	1	1		2
Blasting Crew		1	1	3	5
Total		43	40	9	92

Table 2-9 Mining operators manning plan

Chapter 3 Mineral processing

3-1 Metallurgical tests

The metallurgical tests were conducted on the samples of the Hayl as Safil and Rakah deposits to study the optimum condition and flotation method recovering valuable minerals in the ore. All the test works were carried out by Central Research Institute of Mitsubishi Metal Corporation.

3-1-1 Outline of test works

(1) Sample identification

All the head samples were taken from diamond drill cores performed in this project in 1988. Test works were conducted on three samples, namely stockwork ore of the Hayl as Safil deposit containing some quantity of massive ore, stockwork ore of the Rakah deposit and massive ore of the Rakah deposit. These samples are called, hereafter, Hayl as Safil ore, Rakah stockwork ore and Rakah massive ore. The details of the samples are shown in Table 3-1.

(2) Testing items

(i) Characteristics of the ore

The following test works were performed to study the characteristics of the ores.

- ① Chemical assays
- ⁽²⁾ Mineral identification by X-ray diffraction analyses
- ⁽³⁾ Microscopical examination
- @ Assays of soluble ions in the ore
- [©] Measurement of Work Index
- 6 Measurement of specific gravity

(ii) Fundamental flotation tests

The tests were performed on following two flotation methods.

(a) Copper selective flotation

This method is to recover the copper mineral selectively by depressing pyrite in rougher flotation. The following items were tested.

Nole No.	Depth (m) from to	Type of ore	D.L. m	∆u g∕t	Ag g/t	Cu %	2n %
MJO-A1	77.60 - 80.60	massive ore with siliceous frag	3.00	2.0	4.1	0.76	0.06
	91.70 - 95.50	stockwork ore	3.80	tr	0.3	0.85	0.17
	108.40 - 112.00	stockwork ore	3.60	0.5	2.5	0.42	0.44
	114.80 - 115.70	stockwork ore	0.90	0.6	3.1	1.38	0.69
MJO-A2	38.80 - 40.30	sulfide dominant	1.50	1.7	10.8	0.91	0.25
1100 114		stockwork ore					
	46.10 - 48.85	stockwork ore	2.75	0.7	2.7	0.45	0.21
	49.90 - 50.80	stockwork ore	0.90	0.5	1.8	1.03	0.06
	53.80 - 63.45	stockwork ore	9.65	0.3	1.3	1.18	0.15
	86.70 - 88.70	stockwork ore	2.00	0.4	3.0	2.42	0.44
MJO-A4	81.10 - 82.50	massive ore	1.40	2.1	5.5	3.32	0.37
HS -17	59.50 - 60.20	massive ore	0.70	1.3	10.4	9.00	1.88
total			30.2	0.7	2.8	1.29	0.27

Table 3-1 List of samples for bench scale flotation testwork

Hayl as Safil ore (Weight 76.6 kg)

Rakah stockwork ore (Weight 69.0 kg)

Hole No.	Depth (m) from to	Type of ore	D.L. m	Au g/t	Ag g/t	Cu %	Zn %
MJO-B2 MJO-B4 MJO-B5 MJO-B6	$\begin{array}{rrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrr$	stockwork ore stockwork ore stockwork ore stockwork ore stockwork ore stockwork ore stockwork ore stockwork ore	$\begin{array}{c} 3.80 \\ 1.90 \\ 5.70 \\ 4.10 \\ 2.80 \\ 2.80 \\ 2.60 \\ 4.00 \end{array}$	0.6 0.1 0.2 0.7 0.3 0.5 0.3 0.2	$ \begin{array}{c} 1.7\\ 0.2\\ 1.6\\ 1.0\\ 1.5\\ 1.2\\ 0.6\\ 0.5 \end{array} $	$\begin{array}{c} 0.86\\ 0.56\\ 0.70\\ 0.62\\ 1.07\\ 3.17\\ 0.56\\ 1.44 \end{array}$	$\begin{array}{c} 0.48 \\ 0.04 \\ 0.19 \\ 0.52 \\ 0.06 \\ 0.13 \\ 0.03 \\ 0.03 \\ 0.03 \end{array}$
total			27.7	0.4	1.1	1.08	0.21

Rakah massive ore (Weight 47.8 kg)

Hole No.	Depth (m) from to	Type of ore	D.L. m	Au g/t	Ag g∕t	Cu %	Zn %
MJO-B1	35.00 - 37.00 37.00 - 39.00	massive ore massive ore	2.00	6.9	18.0	1.70	0.08
	39.00 - 41.70 41.70 - 43.40	massive ore massive ore		12.7	26.6	2.02	0.09
	43.50 - 45.00 45.00 - 46.90	massive ore massive ore	$1.50 \\ 1.90$	9.2	6.9	1.60	0.09
	46.90 - 50.60	massive ore	3.70	9.2	7.0	1.30	0.15
total			15.5	9.7	14.6	1.62	0.11

① Selection of optimum grind size

⁽²⁾ Collector screening

③ Flotation rate tests

(b) Bulk and differential flotation

This method is to recover copper mineral with pyrite in rougher circuit. After regrinding of bulk concentrate, the copper mineral was recovered by depressing pyrite.

The following items were tested.

⁽¹⁾ Selection of optimum grind size

- @ Selection of optimum pH value in rougher flotation
- ⁽³⁾ Selection of optimum pH value in cleaner flotation to separate copper mineral and pyrite.

(iii) Overall flotation test

The overall flotation tests which are based on the fundamental test results, were performed on the composite sample of 65/35% weight mixture of Hayl as Safil ore/Rakah stockwork ore to determine the optimum flotation method.

(3) Preparation of samples for testing

Three samples were prepared according to flowchart shown in Fig. 3-1. The samples were separately crushed to minus 12.7 mm by jaw crusher and roll jaw crusher. The product of roll jaw crusher was screened by hand at 9.52 mm and 1 kg sample was taken from screen oversize for Hardgrove grindability testing. Screen undersize and residual of oversize were crushed to minus 1.68 mm by roll crusher. The roll products were screened by hand at 1.68 mm and screen oversize returned to the roll for further size reduction.

All the samples were divided into 1 kg lot each by coning and quartering method. Each lot was packed in polyethylene bag with nitrogen gas. One lot of packed sample was used for testing of ore characteristics and other lots were provided for flotation tests.

(4) Chemical assays

Chemical assay methods of head samples or flotation products samples are shown in Table 3-2.

(5) Reagents and test machines

Reagents and test machines used in this test work are shown in Table 3-3 and Table 3-4.

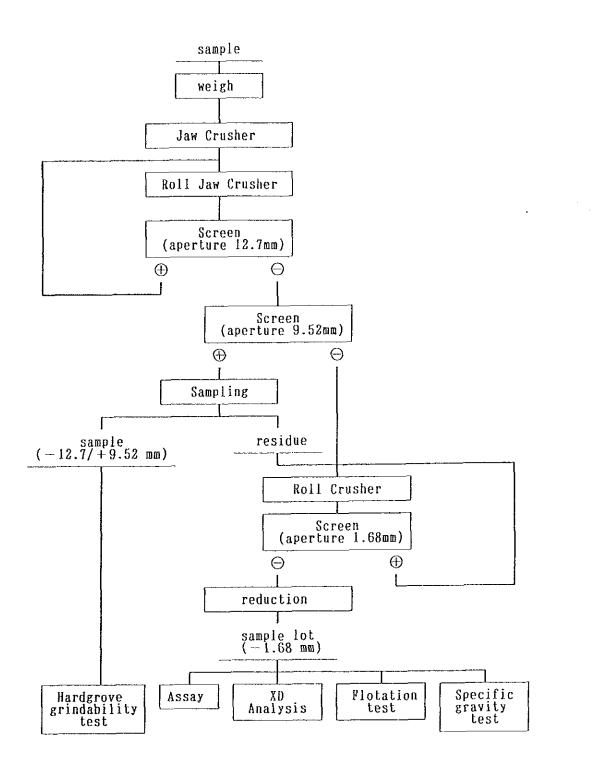


Fig. 3-1 Flowchart of sample preparation

Element	Assay method	Reference	
Au,Ag SiOz As Fe S Ug Mo,Cd,Zn,Pb Cu,Al,Ca,Mg	Fire assay Precipitation gravimetry Absorptiometric method with AgDDC Permanganate titration Precipitation gravimetry Atomic absorption analysis ICP (Inductively coupled algon plasma emission spectrophotometer) analysis	head sample	
Au,Ag Cu Zn Fe S	Atomic absorption analysis Absorptiometric method Chelatometric titration Permanganate titration Precipitation gravimetry	flotation product	

Table 3-2 Assay method

Table 3-4List of chemicals used throughout bench scale flotation testwork

Chemical Abbrev ations		Component	Manufacturer
AERO 350 Xanthate	КАХ	potassium salt of amyl dithiocarbonic acid	ACC1,
AERO 3501 Promoter	AP3501	sodium diisoamyl dithiophoshate	ЛСС
AEROPHINE 3418A Promotor	AP3418	dialkyl dithiophosphínate	ACC
AERO 404 Promoter	AP404	sodium salt of mercaptobenzothiazole	ACC
AEROFROTH 65 Slaked lime	AF65 lime	polypropylene glycol calcium hydroxide	ACC
Sodium hydrogen	NallSO ₃	sodium hydrogen	Wako ²⁾
Zinc sulfate	ZnSO4	zinc sulfate (ZnSO ₄ · 7H ₂ O)	Wako

1) ACC : American cyanamid Company

2) Wako : Wako pure chemical industies, Ltd.

Test machine	Model	Specification	Manufacturer	reference
Laboratory jaw crusher		<pre>Peed opening: 170×110mm, Open discharge cotting: 97 to 50mm 0 97W</pre>	Otsuka Tekkou Co., Ltd.	Sample
Laboratory roll jaw crusher	R-52	open utsonarge securis. Zr co zommu, Z.ZAM Peed opening: 125×50mm, Open discharge actticat (0 to 7mm 1 ZVM	Otsuka Tekkou Co.,Ltd.	prepa- ration
Laboratory roll crusher		open urscharge setting: IV VO ANNA, 1.30M Roll size: Ø180×130mm, Discharge setting: 3 to 0.5mm, 1.5KW	Satou Seisekusho Co.	
Hardgrove grindability test machine X-rey diffractometer Electron probe micro analyzer	RAD-3C JXA-8600M	In conformity to JIS M8801 , 0.1KW Scintillation counter	Yoshida Seisakusho Co. Rigaku Co.,Ltd. JEOL Co.,Ltd.	Physical & mineralogi cal test
Laboratory ball mill Laboratory flotation machine Laboratory flotation machine Laboratory flotation machine Oven Oven Balance Precision balance Precision balance	D-1 TG100-2 DS-42 PT3-1200D HM-1k	Cell size: ¢150×185mm, 0.2KW Denver type, Tank size: 250,500g & 1kg,1/4HP Denver type, Tank size: 200g, 0.2KW Denver type, Tank size: 100g, 0.1KW Forced convection cycle type Natural convection type Weighing range: 10g - 10kg Weighing range: 10mg - 1200g	Homemade Denver Equipment Co. Sugimoto Tekkou Co. Sugimoto Tekkou Co. EM Kousetsu Co.,Ltd. YAMATO Scientific Co. Murayama Seisakusho Co Chuou Keiryoki Seisakusho Co. TOA Electronics Ltd.	Flotation test

Table 3-3 List of test machines used in bench scale flotation testwork

(6) Water

Water for testing was supplied from the well in laboratory and distilled water was used in dissolution reagents or other precise purposes.

(7) Method of testing

(i) Work Index

Exact measurement of Work Index needs a lot of sample. Because quantity of samples was not enough to test in exact method, Work Index was estimated from the Index of Hardgrove grindability test in JIS method (Japan Industrial Standard). Work Index (Wi) is given from Hardgrove Index (Hb) using following equations of (1) and (2).

 $Wi = 400/(Hb)^{0.86}$ (1) $Wi = 435/(Hb)^{0.91}$ (2)

(1): given by Ishihara(2): given by Bond

(ii) Specific gravity

Specific gravity was measured in JIS A1202 method using 50ml pycnometer.

(iii) Assays of soluble ions in ore

500 g of sample was ground for 16 minutes with distilled water 335cc. Filtrate from filtering of ground pulp was assayed for Cu, Zn and Fe.

(iv) Flotation test procedure

<u>Grinding</u>: 500 g of sample was ground in laboratory mill with r.p.m. 138 and a ball charge 4kg for timed period at 60% solid. In the case of Rakah massive ore, sample charge was 400 g and pulp density was 50% solid. Screen analysis of ground samples were shown in Table 3-5.

<u>Flotation</u>: All the rougher flotation tests were conducted in a 500 g Denver flotation test machine with an initial pulp density of 35%. The cleaning tests were conducted in 500 g or 200 g or 100 g Denver machine depending on the feed pulp quantity.

The conditioning with reagents (except those added to grind) was conducted in the flotation machine with the air valve closed.

Table 3-5 Screen analysis of ground samples		Table 3-5	Screen analysis of ground samples	
---	--	-----------	-----------------------------------	--

.

	GRINDING TIME								
SIZE PRACTION	8 min.		11	11 min.		13 min.		min.	
	W %	ΣW%	W %	ΣW%	W %	ΣW%	W%	ΣW%	
$\begin{array}{r} +1000\\ -1000 \ /+ \ 710\\ -710 \ /+ \ 500\\ -500 \ /+ \ 250\\ -250 \ /+ \ 177\\ -177 \ /+ \ 179\\ -149 \ /+ \ 105\\ -105 \ /+ \ 74\\ -74 \ /+ \ 53\\ -53 \ /+ \ 37\\ -37\end{array}$	$\begin{array}{c} 0.25\\ 0.16\\ 0.26\\ 3.65\\ 7.72\\ 5.45\\ 19.89\\ 11.64\\ 13.59\\ 8.33\\ 29.07 \end{array}$	$95.69 \\ 87.96 \\ 82.52$	$\begin{array}{c} 0.05\\ 0.06\\ 0.07\\ 0.50\\ 2.32\\ 4.20\\ 15.00\\ 14.95\\ 16.94\\ 10.31\\ 35.61\end{array}$	$\begin{array}{c} 100.00\\ 99.95\\ 99.90\\ 99.82\\ 99.32\\ 97.00\\ 92.80\\ 77.80\\ 62.86\\ 45.92\\ 35.61 \end{array}$	$\begin{array}{c} 0.00\\ 0.00\\ 0.08\\ 0.16\\ 0.89\\ 1.29\\ 11.46\\ 14.32\\ 19.35\\ 12.22\\ 40.23\end{array}$	$\begin{array}{c} 100.00\\ 100.00\\ 99.92\\ 99.76\\ 98.87\\ 97.58\\ 86.12\\ 71.80\\ 52.45 \end{array}$		$\begin{array}{c} 100.00\\ 99.90\\ 99.70\\ 99.10\\ 93.89\\ 82.02 \end{array}$	
TOTAL	100.00		100.00		100.00		100.00		

Hayl as Safil ore

Rakah	stockwork	

			usui 500						
	GRINDING TIME								
SIZE FRACTION (µm)	9 min.		11 min.		13 min.		16 min.		
	W%	ΣW%	W %	ΣW%	W%	ΣW%	W%	ΣW%	
$\begin{array}{r} +1000\\ -1000 \ /+ \ 710\\ -\ 710 \ /+ \ 500\\ -\ 500 \ /+ \ 250\\ -\ 250 \ /+ \ 177\\ -\ 177 \ /+ \ 179\\ -\ 149 \ /+ \ 105\\ -\ 105 \ /+ \ 74\\ -\ 74 \ /+ \ 53\\ -\ 53 \ /+ \ 37\\ -\ 37\end{array}$	$\begin{array}{c} 0.59\\ 0.61\\ 0.86\\ 6.86\\ 9.04\\ 5.23\\ 17.93\\ 9.10\\ 10.12\\ 7.45\\ 32.21 \end{array}$	99.41 98.79 97.93 91.07 82.04	$\begin{array}{c} 0.00\\ 0.00\\ 0.60\\ 1.90\\ 4.57\\ 3.87\\ 17.07\\ 10.37\\ 14.68\\ 9.74\\ 37.20\\ \end{array}$	$\begin{array}{c} 100.00\\ 100.00\\ 100.00\\ 99.40\\ 97.50\\ 92.93\\ 89.06\\ 72.00\\ 61.62\\ 46.95\\ 37.20\\ \end{array}$	0.00	$\begin{array}{r} 99.26 \\ 97.44 \\ 94.78 \\ 82.23 \\ 72.18 \end{array}$	$\begin{array}{c} 0.00\\ 0.00\\ 0.06\\ 0.11\\ 0.36\\ 0.63\\ 6.80\\ 8.72\\ 20.24\\ 12.65\\ 50.43 \end{array}$	99.94 99.83 99.47 98.84 92.04 83.31 63.08	
TOTAL	100.00		100.00		100.00		100.00		

Rakah massive ore

	GRINDING TIME							
SIZE FRACTION	4.5 min.		6.5 min.		8.5 min.		10.5 min.	
(µm)	W%	ΣW%	W%	ΣW%	W %	ΣW%	W%	ΣW%
$\begin{array}{r} +1000\\ -1000 \ /+ \ 710\\ -710 \ /+ \ 500\\ -500 \ /+ \ 250\\ -250 \ /+ \ 177\\ -177 \ /+ \ 149\\ -149 \ /+ \ 105\\ -105 \ /+ \ 74\\ -74 \ /+ \ 53\\ -53 \ /+ \ 37\\ -37\end{array}$	$\begin{array}{c} 1.82\\ 1.47\\ 1.50\\ 6.18\\ 7.38\\ 4.04\\ 16.12\\ 11.05\\ 9.51\\ 7.53\\ 33.40 \end{array}$	$\begin{array}{c} 100.00\\ 98.18\\ 96.71\\ 95.20\\ 89.03\\ 81.65\\ 77.61\\ 61.48\\ 50.43\\ 40.92\\ 33.40 \end{array}$	$\begin{array}{c} 0.85\\ 0.60\\ 0.55\\ 2.36\\ 3.63\\ 3.08\\ 15.70\\ 13.18\\ 11.26\\ 9.55\\ 39.23 \end{array}$	$\begin{array}{c} 100.00\\ 99.15\\ 98.54\\ 97.99\\ 95.63\\ 92.00\\ 88.92\\ 73.23\\ 60.04\\ 48.78\\ 39.23 \end{array}$	$\begin{array}{c} 0.28\\ 0.20\\ 0.20\\ 0.94\\ 1.49\\ 1.22\\ 9.38\\ 14.14\\ 12.85\\ 14.75\\ 44.55\\ \end{array}$	$\begin{array}{c} 100.00\\ 99.72\\ 99.52\\ 99.32\\ 98.38\\ 96.89\\ 95.67\\ 86.29\\ 72.15\\ 59.30\\ 44.55 \end{array}$	$\begin{array}{c} 0.15\\ 0.11\\ 0.08\\ 0.37\\ 0.62\\ 0.56\\ 6.16\\ 11.28\\ 15.64\\ 13.52\\ 51.51 \end{array}$	$100.00 \\99.85 \\99.74 \\99.66 \\99.29 \\98.67 \\98.10 \\91.95 \\80.67 \\65.03 \\51.51 \\$
TOTAL	100.00		100.00		100.00		100.00	