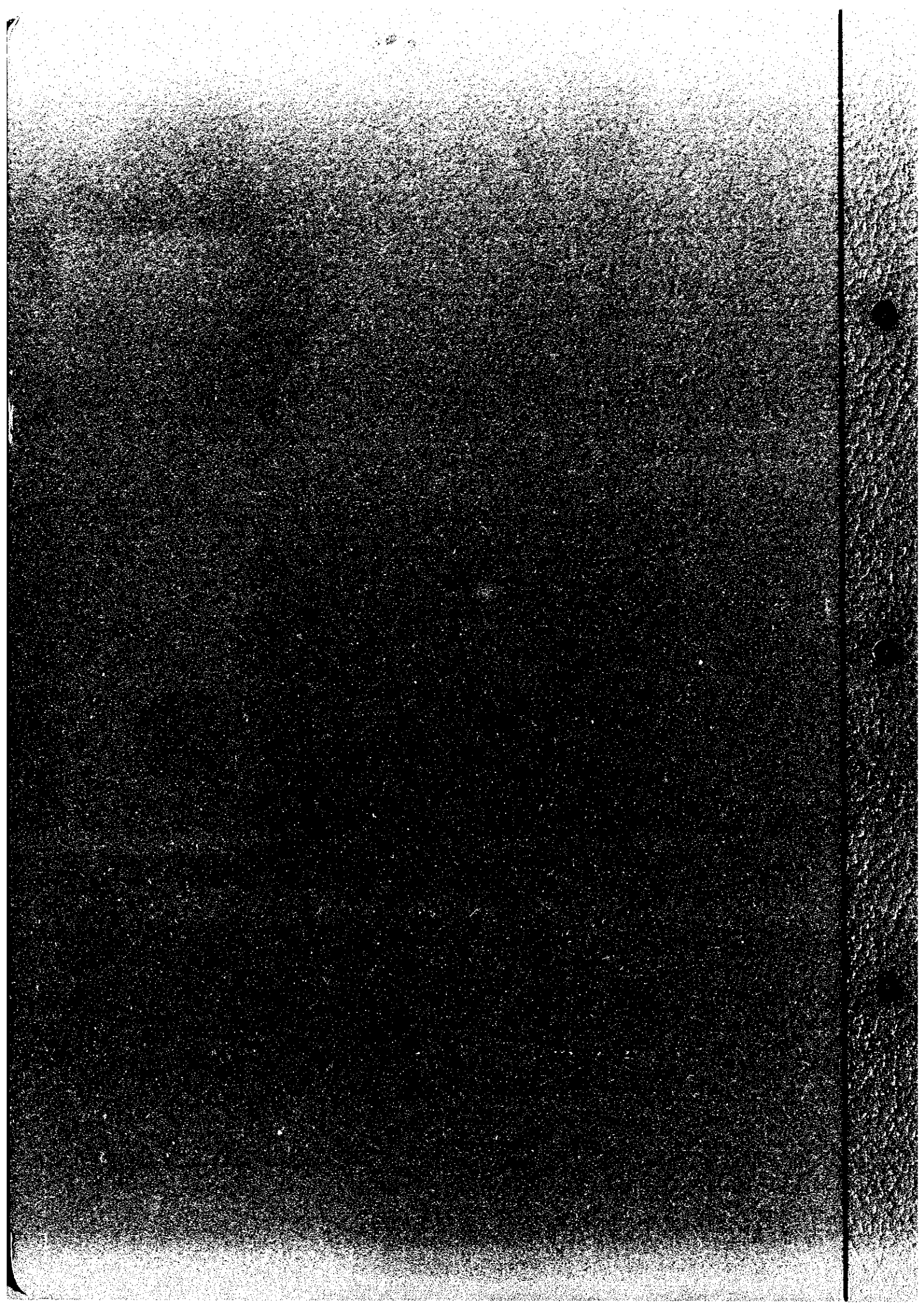
REPORT
ON
THE MINERAL EXPLORATION
IN
THE ALAY AREA
THE KYRGHYZ REPUBLIC

(PHASE II)

JAPAN INTERNATIONAL COOPERATION AGENCY

METAL MINING AGENCY OF JAPAN



REPORT
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(PHASE Ⅱ)

MARCH 1999

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PREFACE

In response to the request of the Government of the Kyrghyz Republic, the Government of Japan decided to conduct a Mineral Exploration Project in the Alay area and entrusted the survey to the Japan International Cooperation Agency (JICA) and the Metal Mining Agency of Japan (MMAJ).

The JICA and MMAJ sent to the Kyrghyz Republic a survey team headed by Mr. Haruaki Tsuchiya from June 14 to December 11, 1998.

The team exchanged views with the officials concerned of the Government of the Kyrghyz Republic and conducted a field survey in the Alay area. After the team returned to Japan, further studies were made and the present report has been prepared.

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

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

March, 1999

Kimio Fujita
President
Japan International Cooperation Agency

Hiroaki Hiyama
President
Metal Mining Agency of Japan

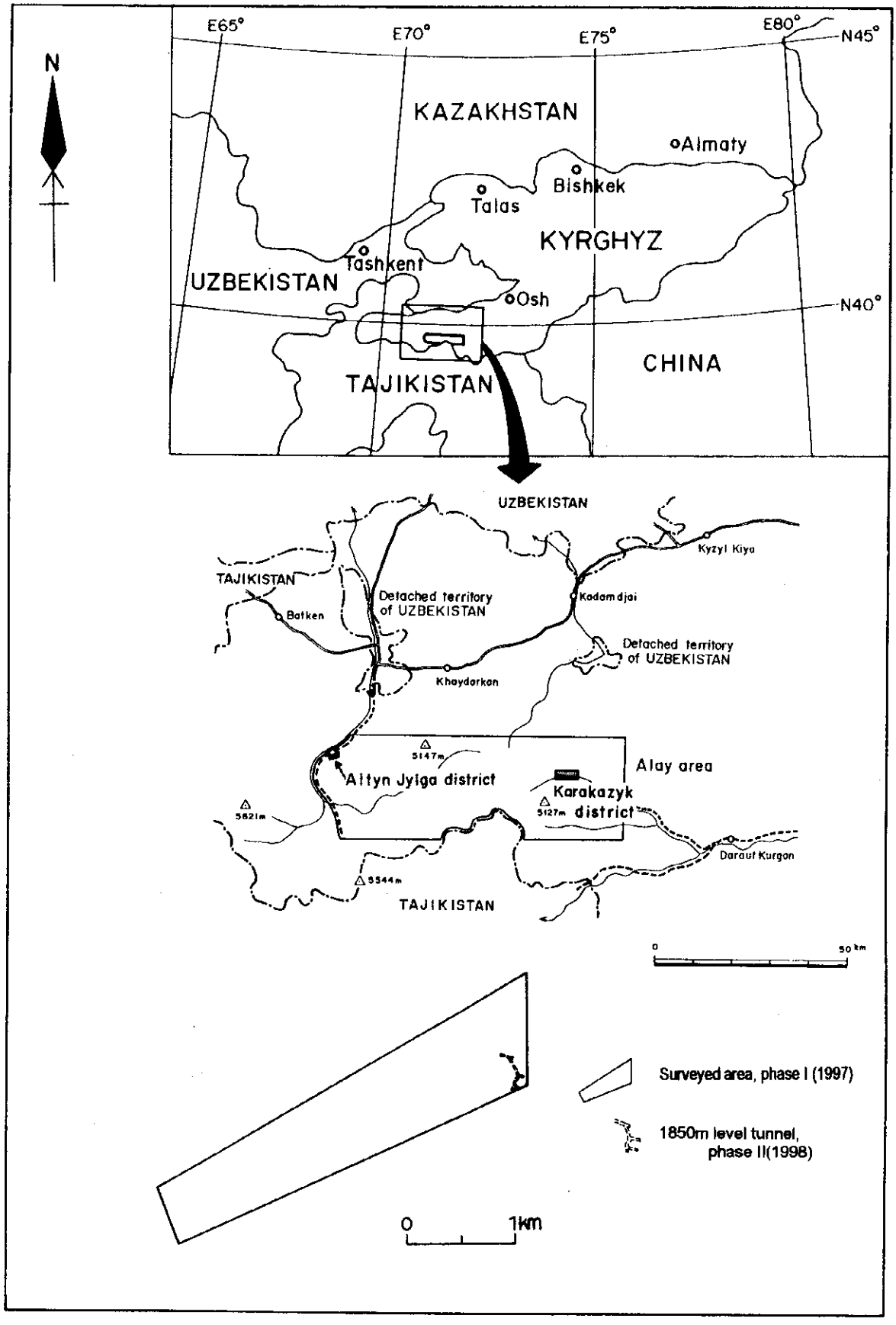

Fig.I-1-1 Location Map of the survey Area

РЕЗЮМЕ

Настоящий документ является кратким изложением Фазы II исследований по проекту технического сотрудничества по осуществлению геологоразведочных работ в Алайском районе Кыргызской Республики. Целью настоящего изучения является проведение разведки и оценка потенциальных возможностей изучаемой площади, а также разведка новых рудных месторождений. Полевые работы проводились с июня по декабрь 1998 года.

В течение Фазы II изучения, проводилась проходка штольни на горизонте 1 850 м по рудному телу №3 на месторождении Алтын – Джилга с целью:
(i) подтвердить протяженность зоны золоторудной минерализации, обнаруженной при проведении предыдущих буровых работ; (ii) исследовать минерализацию и составить рекомендации по дальнейшим геологоразведочным работам; и (iii) разработать программу изучения на предстоящий период. Выводы Фазы II изучения и рекомендации для проведения работ в Фазе III сведены в следующих параграфах:

[Выводы]

(1) Протяженность рудного тела №3, обнаруженного проходкой штольни и последующим бурением на горизонте 1930м, была установлена в Фазе II при проходке штольни на горизонт 1 850м. Длина рудного тела составляет 150м, ширина – от 2 до 20м, а объем площади месторождения - 2 000м^2 , среднее содержание золота – 7,0 г/т.

(2) Рудное тело №3 с поверхности до горизонта 1850м простирается приблизительно в направлении с севера на юг, падение от 65^0 до 70^0 в восточном направлении. По результатам изучения геологии и минерализации с поверхности и на горизонтах 1930м и 1850м, а также последующего бурения, сделан вывод, что, рудное тело простирается с севера на юг и падает вертикально вниз.

(3) Минерализация контролируется скарновой зоной, протягивающейся с севера на юг, и разрывными нарушениями СВ-ЮЗ и СЗ-ЮВ направлений, которые пересекают скарновую зону. Считается, что в этих пересечениях были сформированы рудные столбы.

(4) Сделан вывод, что скарнизация и минерализация в рудном теле №3 имели место в следующей последовательности:

1 стадия :Формирование скарновой зоны вдоль границы между интрузивным телом Алтын-Джилги и известняками Кумбельской формации.

2 стадия :Интрузия лампрофировых даек.

3 стадия :Рескарнизация и золотомедная минерализация вдоль разрывных нарушений в скарне и в лампрофировых дайках.

4 стадия :Золотомышьяковая минерализация вдоль системы разрывных нарушений СВ-ЮЗ направлений в зонах, прилегающих к скарнам.

(5) Рудное тело №5 и месторождение Южное были изучены во время предыдущих геологических исследований. Минерализация этих рудных тел имеет такое же залегание, как и рудные столбы рудного тела №3.

(6) Потенциальные запасы золота рудных тел №3, №5 и Южного оцениваются в 29,3 тонны. Кроме этих рудных тел, месторождение Алтын-Джилга имеет потенциальные участки, такие как жильные рудные тела на северном фланге месторождения Северное, и в восточной смежной части рудного тела №3, а также на Западном месторождении и его западном продолжении.

(7) Предполагается, что извлечение золота из рудного тела №3 будет относительно легким, как это видно из проведенных анализов.

[Рекомендации]

Во время Фазы II изучения посредством проходки штолен была установлена протяженность рудного тела №3 между горизонтами 1930м и 1850м. Так как предполагается, что рудное тело далее распространяется на горизонт 1850м и на более глубокие горизонты, требуется провести разведку более глубокой части, ниже горизонта 1850м, в целях выяснения перспектив рудного тела.

Для того, чтобы довести месторождение Алтын-Джилга до стадии разработки, на основе результатов Фазы II, необходимо дальнейшее выяснение, общего характера минерализации, а также разработка рекомендаций по проведению геологоразведочных работ на рудной зоне, состоящей из рудного тела №5 и месторождения Южное, а также и других перспективных рудных тел, где предполагается наличие руды, посредством чего значительно увеличить запасы руды.

(1) Рекомендации по проведению геологоразведочных работ

(i) Изучить протяженность скарновой зоны в горизонтальном и вертикальном направлениях

(ii) Проследить пересечения скарновой зоны с дайками

(2) Местоположение и методы изучения

А. Бурение на глубину и горизонтальное бурение на рудном теле №3

Б. Проходка штольни к рудной зоне, состоящей из рудного тела №5 и южных рудных тел, а также детальное геологическое изучение поверхности рудной зоны.

В. Детальная геологоразведка поверхности рудных тел на северном фланге и к востоку рудного тела №3, а также Западного месторождения и его западного продолжения.

Г. Анализ руды на обогатимость.

SUMMARY

This is a summary of the results of the Phase II survey of a technical cooperation project for mineral exploration conducted in the Alay area, the Kyrghyz Republic. The survey focused on clarification of the geology and the mineral potential of the area and exploration for new ore deposits. The field survey was conducted from June to December 1998.

In the Phase II survey, adit survey was conducted at the 1,850m level on the No.3 ore body in the Altyn-Jylga District, which was intended to (i) confirm continuity of the gold mineralization zone discovered by the past drilling surveys; (ii) examine the actual state of mineralization for drawing exploration guidelines; and, (iii) design survey programs for the succeeding years. Results of the Phase II survey and recommendations for the Phase III are summarized in the following paragraphs:

【Survey Results】

(1) The continuity of the No.3 ore body discovered by the adit survey at 1,930m level and past drilling surveys was ascertained by the Phase II adit survey at 1,850m level. The ore body is 150m in extension, 2m to 20m in width, and 2,000m^2 in ore deposit area, averaging Au 7.0 g/t.

(2) The No. 3 ore body, from the surface to the 1,850m level, trends nearly north to south and dips 65° to 70° eastward. The ore body is inferred to continue horizontally north to south and vertically downward, in the light of the geology and mineralization examined on the surface, at the 1,930m and the 1,850m levels, and by the past drilling surveys.

(3) The mineralization is controlled by the skarn zone extending north to south and by fissures trending NE-SW and NW-SE, which intersect the skarn zone. Bonanzas are inferred to have been formed at the intersections.

(4) The skarnization and the mineralization in the No.3 ore body is inferred to have taken place in the following sequence:

First stage : Formation of skarn zone along the boundary between the Altyn-Jylga intrusive body and limestone of the Kumbel Formation

Second stage : Intrusion of lamprophyre dikes

Third stage : Re-skarnization and mineralization of Au-Cu along the fissures in the skarn and in the lamprophyre dikes

Fourth stage : Mineralization of Au-As along the fissure system trending NE-SW in the surrounding zones of the skarn

(5) The No.5 ore body and the Southern deposit had been ascertained at the surface by the past surveys. The mineralization of these ore bodies was probably formed in the similar mode of occurrence as the bonanzas of the No.3 ore body.

(6) The potential gold reserves of the No.3, the No.5 and the Southern ore bodies is estimated altogether at 29.3 tons. Besides these ore bodies, the Altyn-Jylga ore field has potential areas, such as vein-like ore bodies at the extreme north of the Northern deposit and in the eastern adjacent part of the No. 3 ore body, as well as the Western and Far western deposits.

(7) Separation of gold minerals from the ore of the No.3 ore body is presumed to be relatively easy on the basis of the separation test results.

【Recommendations】

The Phase II survey ascertained the continuity between the 1,930m and the 1,850m levels of the No.3 ore body by means of the adit survey. As the ore body is inferred to spread further at the 1,850m level and extend to deeper levels, it is required to explore the deeper part below the 1,850m level thereby clarifying the potentials of the ore body.

In order to bring the Altyn-Jylga District to the development stage, it would be necessary to clarify further, on the basis of Phase II results, the mechanism of the mineralization, and also to establish guidelines for exploring the ore zone consisting of the No. 5 ore body and the Southern deposit, as well as the other promising ore bodies and deposits, thereby increasing ore reserves substantially.

(1) Exploration targets

(i) Extensions of the skarn zone in the horizontal and vertical directions

(ii) Intersections of the skarn zones with dikes

(2) Localities and methods of survey

A. Downward and horizontal drilling survey of the No.3 ore body

B. Driving a survey adit toward the ore zone consisting of the No.5 and the Southern ore bodies and detailed surface geological survey of the ore zone

C. Detailed surface geological survey of the vein-like ore bodies at the extreme north and to the east of the No. 3 ore body, as well as the Western and Far Western deposits.

D. Ore dressing test (quantification of ore characteristics and studies on ore dressing process)

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PART I

GENERAL REMARKS

CHAPTER 1 INTRODUCTION

1-1 Background and purpose

Potential for the existence of metalic ore deposits is high in the Kyrghyz Republic. Many mineral resources, such as gold, silver, copper, lead, zinc, mercury, antimony, tin, tungsten, uranium and rare earths have been found.

In the USSR era, exploitation was limited to mercury, antimony, uranium and rare earths. After destruction of USSR, the Kyrghyz Republic have focused its policy on mining to earn foreign currency, especially, gold mining which is very competitive in the market economic world. In 1997, the Kumtor gold mine was developed by the Kyrghyz governmental organization in cooperation with a Western mining company.

In response to the request of the government of the Kyrghyz Republic, Japan had successfully conducted the mineral exploration project in Talas area from 1994 to 1997.

The government of the Kyrghyz Republic (the State Agency on Geology and Mineral Resources) evaluated the project with Japan and requested a new technical cooperation project for mineral exploration in Alay area in December 1996. It includes the Altyn-Jylga and Karakazyk which are promising districts for mine development. The Japanese government (the Ministry of International Trade and Industry (MITI), Japan International Cooperation Agency (JICA) and Metal Mining Agency of Japan (MMAJ)) sent a delegation to the Kyrghyz Republic for the preliminary survey in June 1997. An agreement on the scope of work for the Alay area project was signed between the governments of the Kyrghyz Republic and Japan on 27 June 1997.

The purpose of the project was to clarify the geology and the occurrence of ore deposits in the survey area and discover the new deposit. Another purpose was to transfer Japanese technologies of survey and analysis to the Kyrghyz counterpart through the collaborative survey.

1-2 Results of the Phase I survey

The Phase I survey involved analysis of satellite images for the whole survey area, detailed geological survey in the Altyn-Jylga and Karakazyk districts and drilling survey of the Northern deposit in the Altyn-Jylga ore field.

1-2-1 Altyn-Jylga district

(1) Altyn-Jylga ore field is of gold-copper bearing skarn, which was formed along

the boundary between late Carboniferous to early Permian intrusive body and Devonian limestone.

(2) In the No.4 ore body of the Northern deposit, drilling survey proved that the skarn zone spreading on the surface shrinks to the deep. Although gold mineralization occurs in wide zone, the Au grades are low as 0.1 to 0.5 g/t.

(3) In the existing 1930m level adit of the No.3 ore body in the Central deposit, predominant gold mineralization zone is confirmed. It is inferred that the mineralization zone extends and forms bonanzas in deeper levels on the basis of past downward drilling survey (SKV-13), homogenization temperatures of fluid inclusions and geological structure.

1-2-2 Karakazyk district

(1) Karakazyk ore field is of gold-copper bearing skarn, which was formed along the boundary between granodiorite and marble.

(2) The size of ore zone on the surface is 20m x 40m in maximum. High gold grade parts are dispersed as spots, and of a small-scale.

It was proposed that the exploration should be concentrated on the No.3 ore body of the Altyn-Jylga District, where the mineralization zone extends and forms bonanzas in deeper levels.

As for the Karakazyk district, the problems about mineralization process, an overall scale of ore zone and a continuity to the deep remain as future object.

1-3 Outline of the Phase II survey

1-3-1 Survey site and purpose

At 1850m level in the No.3 ore body of the Altyn-Jylga District, adit survey was designed based on the results of Phase I survey. Its purpose is to (i) confirm continuity of the gold mineralization zone discovered by the past drilling survey; (ii) examine the mineralization, thereby drawing exploration guidelines; and, (iii) design survey programs for the succeeding years. The adit design is shown in Fig.I-1-2.

1-3-2 Methods and contents of the survey

Adit survey was conducted at 1850m level. Methods and contents are shown in Table I-1-1.

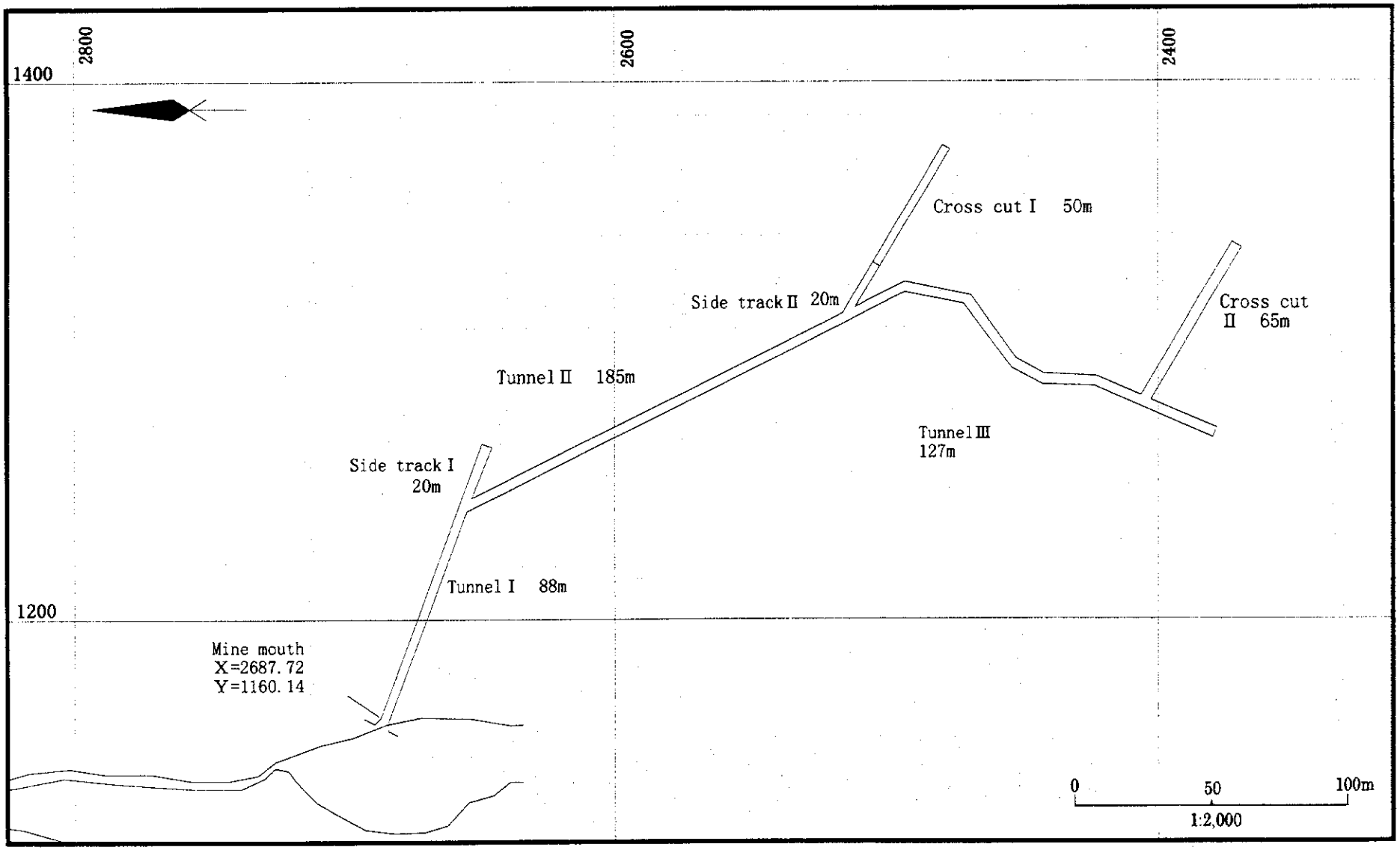


Fig.I-1-2 Location Map of the 1850m Level Tunnel

TableI-1-1 Methods and Contents of the Survey

(Survey)

Methods	Contents				
Adit Survey	Type	Section Height(m) x Width(m)	Length (m)	Gradient	Direction
	[Tunnel I]				
	*Mine Mouth-				
	Tunnel II Junction	2.5×2.45	88.0	1/200	109°
	*Tunnel II Junction-				
	Side Track I	2.5×2.45	20.0	1/200	109°
	[Tunnel II]				
	*Tunnel II Junction-				
	Tunnel III Junction	2.5×2.45	185.0	1/200	150°
	*Tunnel II -				
	Side Track II	2.5×2.45	20.0	1/200	150°
	[Tunnel III]				
	*Tunnel III Junction-				
	Terminal Point	2.5×2.45	127.0	1/200	192°
	(Drifting along skarn zone)				
	[Cross Cut I]				
	*Side Track II-				
	Cross Cut I	2.5×2.45	50.0	1/200	120°
	[Cross Cut II]				
	*Tunnel III(99.0m point)				
	-Cross Cut II	2.5×2.45	65.0	1/200	120°
Total			555.0		

Remark: The direction of tunnel III has a range of ±0° based on the starting point shown in Fig.I-1-2.

(Laboratory Studies)

Methods	Items	Quantity
Adit Survey	Observation of Thin Sections	26pcs
	Observation of Polished Sections	19pcs
	Chemical Analysis(Au, Ag, Cu, Pb, Zn, Mo, As, Sb)	529pcs
	X-ray Diffraction Analysis	8pcs
	Fluid Inclusion Homogenization Temperature Measurement of Fluid Inclusions	11pcs
	EPMA Analysis	5pcs
	Mineral Separation Test	
	Crushing and Separation for Grain Size Analysis	4pcs
	Chemical Analysis	28pcs
	Separation of Minerals	8pcs
	X-ray Diffraction Analysis	36pcs
	Observation of Polished Section	16pcs
	Mode Analysis	12pcs
	EPMA Analysis	4pcs

1-3-3 Organization of the survey team

Japanese survey team engaged in field works from June 14 to December 11, 1998. The member of Japanese survey team and Kyrghyz counterparts are shown below. The survey was carried out with cooperation with South Kyrghyz Geological Expedition (SKGE) and its subsidiary, Shuran Geological Party.

Japanese survey team:

Mr. Haruaki TSUCHIYA	OMRD*; Leader of survey team, Geology
Mr. Hirotaro FUJII	OMRD; Mining
Mr. Haruo HARADA	OMRD; Geology
Mr. Toshiaki ARIIE	OMRD; Mining

*Overseas Mineral Resources Development co., LTD

Kyrghyz counterparts:

Mr. Sheyshenaly MURZAGAZIEV	SAGMR*; Leader of survey team
Mr. Duishenbek KAMCHYBEKOB	SAGMR; Mining
Mr. Vladimir P. ZUBKOV	SAGMR; Geology
Mr. Victor P. ROGALSKY	SAGMR; Mining
Mr. Ivan I. SOLOSHENCO	SKGE; Geology
Mr. Ysmanaly MANSUROV	SKGE; Mining
Mr. Nikolay Andr. PYKHOTA	SKGE; Geology

*SAGMR: State Agency on Geology and Mineral Resources

CHAPTER 2 ECONOMIC INFRASTRUCTURE AND NATURAL CONDITIONS IN THE SURVEY AREA

The survey area is located in the southwestern part of the Osh province (Fig. I-1-1). The area belongs administratively to the Kadamjai, Batken and Chon-Alay regions of Osh province and is situated on the Turkestan-Alay Mountains of the Southern Tien-Shan range.

2-1 Roads

The Altyn-Jylga District, where the Phase II survey was conducted, lies in the westernmost part of the Alay area. The survey district is accessible from the Osh City, the Province capital, by following a principal road southwestward, passing through Kizyr-Kiya, Kadamdjai and Khaydarkan, and going upstream along the Sokh River, which flows into the Fergana Basin, to the Sokh Village,

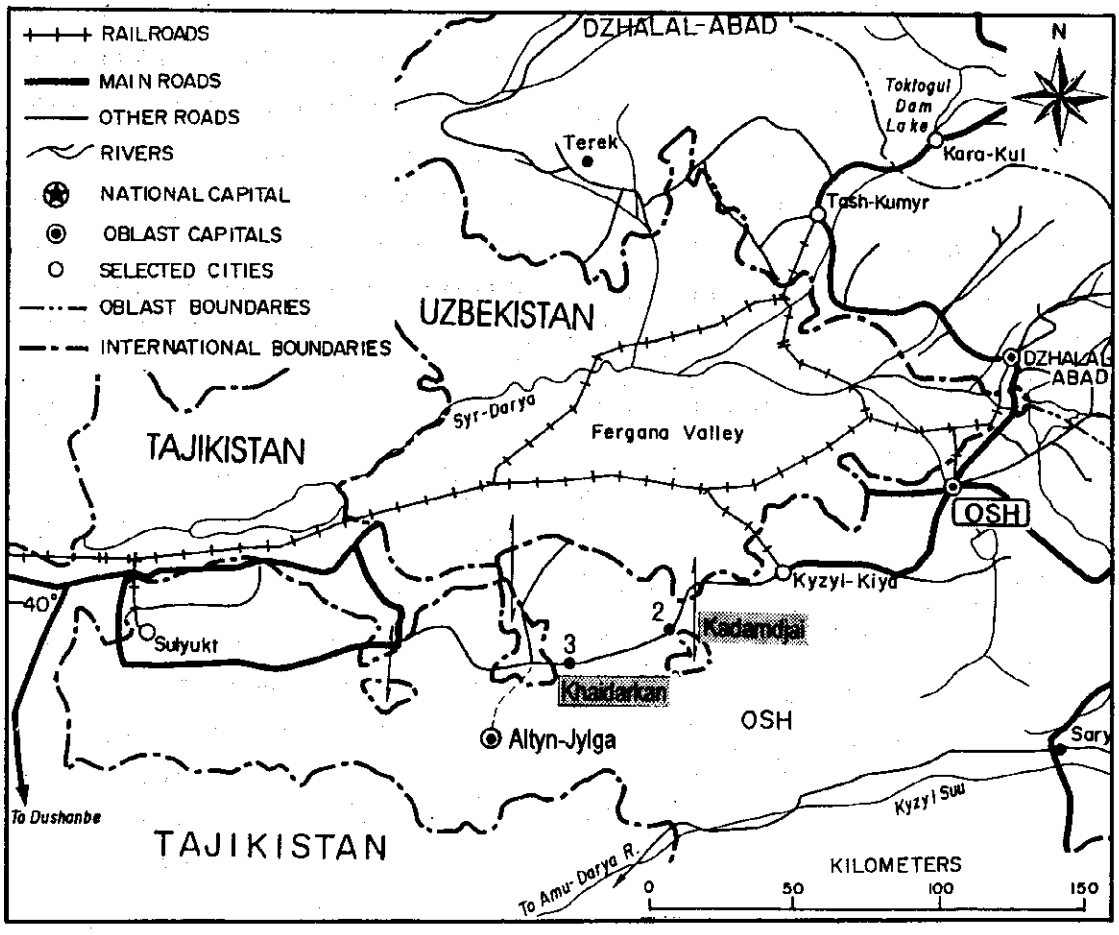


Fig.I-1-3 Transportation System

the nearby population center of the survey area. The principal road passes through two Uzbek territories. One is in the south of Kadamdjai and another is Sokh Village. Osh and Khaydarkan are connected by the approx.174km paved road (a three-hour car ride). From Khaydarkan to Altyn-Jylga, the road distance is some 50km, of which the 20km section before the Sokh Village is paved while the rest consists of gravel roads; it takes some one hour and half by car. Small villages are spotted along the Sokh River from the Sokh Village to Altyn-Jylga. In Sary-Tara, one of such small villages nearest to the survey district, there remains piles of copper slags reminiscent of old copper mining and smelting operation.

The Shulan Geological Party of the South Kyrghyz Geological Expedition, which is the Kyrghyz counterpart for operation of the subject survey, is headquartered in Kadamjai and has a workshop in Khaydarkan.

2-2 Electric Power and Communication

The Kirghyz electric power network is an integral part of the Central Asian power network, and has been developed characteristically in order to connect the cities and the existing Kombinats. Consequently, most of the mountainous regions which have high potentialities of mineral resources are left unconnected with the network. The Altyn-Jylga District is some way off the main power lines but a 10 kVA transmission line from Kara-Tokoi via the Uzbek enclave passes

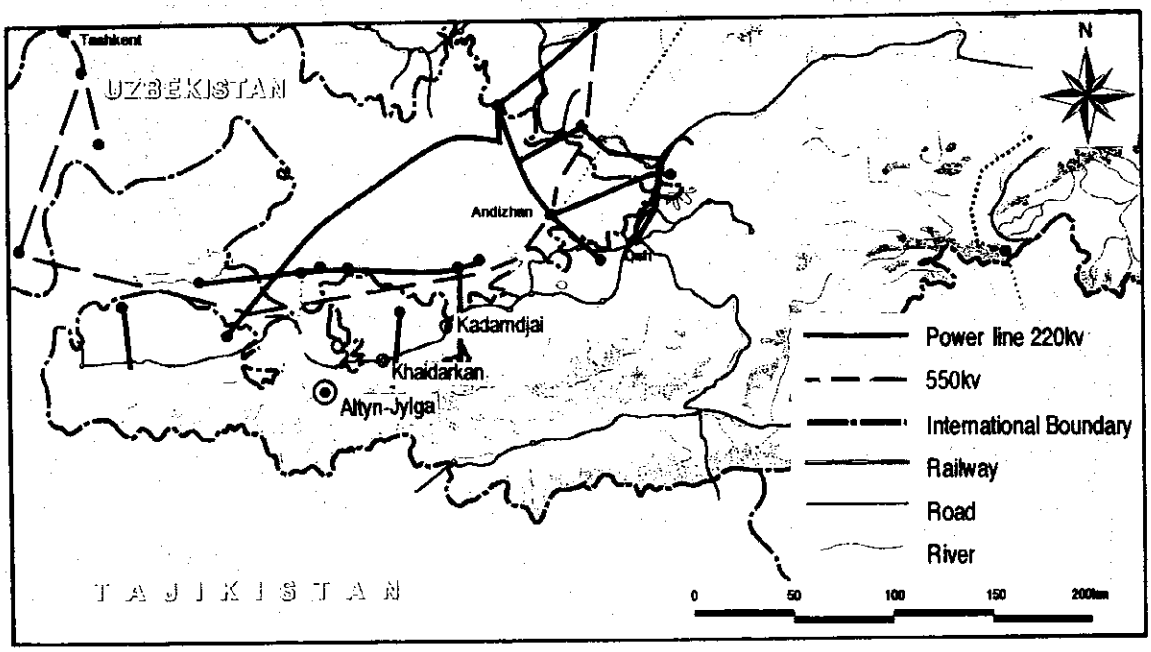


Fig.I-1-4 Electric Power Line System

through Altyn-Jylga and the power is supplied from Tajikistan. However, the transmission line has become so superanuated that it has to be replaced by new lines to ensure stable power supply.

The existing telecommunication lines / facilities in Khaydarkan are also superanuated. To communicate from there to Bishkek, one has to rely on operators' service, which will bring difficulties in case of emergency.

2-3 Natural condition

The Altyn-Jylga district is located in the right bank of the Sokh River. In the district, ore bodies crop out on the slope ranging from 1,800m to 2,200m in altitude. The topography is characterized by steep rocky ridges with 3,200m to 4,500m in altitude and deep valley.

The Sokh River originates from the border on Tadjikistan. The river terraces occur widely on the both banks. The annual average discharge is 50-60m^3/s. The river water is not available for drinking and mining works because it contains very fine sands supplied from glaciers during spring to autumn. Water from branches of the Sokh River is used for drinking and and mining works.

The climate of the survey area is typical continental type. In the Altyn-Jylga district, the monthly average temperature ranges from -25℃ ～ -20℃ in February, to 30℃ ～ 35℃ in July. The annual precipitation is low as 250mm ～ 300mm. It is covered with snow from the end of October to April. It is about the 220 fine days per year.

The Altyn-Jylga district is mostly covered with grassy barren soil. Bushes and poplar trees grow along the valley.

CHAPTER 3 ORE DEPOSITS IN THE SURVEY AREA

3-1 Alay area

In the Turkestan-Alay area, gold-silver-polymetallic mineralization is associated with the calc-alkalic rock series as the Karakazyk complex. Tin-tungsten mineralization is associated with the alkali-calcic rock series as the Surmetash complex. Rare metals are accompanied with pegmatite and metasomatic rocks around alkali intrusives.

Ore deposits and mineral manifestations in this area are as follows: Altyn-Jylga ore field (Au, Cu), Kokusu ore field (Au, Ag, Cu, Bi, W, Sb, Pb, Zn), Augul-Gavian ore field (Au, Cu) and Allaudin ore field (Sn, W).

3-2 Around Altyn-Jylga district

Ak-Sai, Chakush and Kara-Shoro gold manifestations has been known around the Altyn-Jylga district (Fig.I-3-1). These are regarded as vein type deposit consisting of gold - sulfide silicified veins and veinlets.

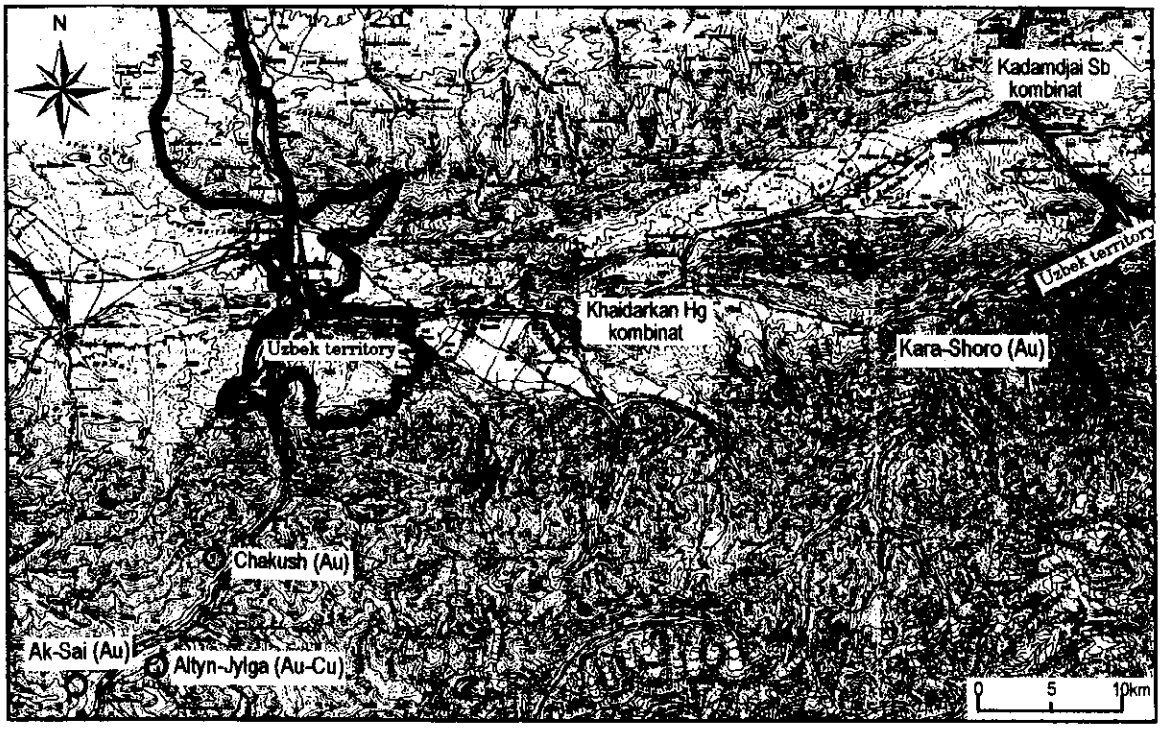


Fig.I-3-1 Gold Manifestations around Altyn-Jylga District

3-3 Altyn-Jylga ore field

Altyn-Jylga ore field is made of gold-bearing skarn deposit formed in contact zone between granodiorite of Lower Carboniferous to Upper Permian age and limestone of the Devonian Kumbel Formation. The skarns are composed of predominant pyroxene skarn, pyroxene-garnet skarn, wollastonite skarn and garnet skarn. These skarns are accompanied with disseminated sulfide minerals.

There are the Northern, the Central (the No.3 ore body) and the Southern deposits distributed at altitude of 1,900m to 2,050m and the Western and the Far Western deposits distributed at altitude of 2,000m to 2.100m. These skarn deposits include gold, silver and copper.

The average grade of the No.3 ore body at the surface shows 9.4 g/t Au and the highest grade shows 121 g/t Au. The ore body dips 65° ~ 70° ESE. At the 1,930m level of the No.3 ore body, the adit survey was carried out by Kyrghyz side. As a result of the survey, it was clarified that ore zone including more than 1 g/t Au are situated mainly in garnet skarn. Dimension of the ore zone is around 300m in length, 10m to 20m in width and 3,100m^2 of area at 1930m level. The average grade is higher than 5.5 g/t Au.

In the 1,870m level, the high-grade ore which has average grade 25.7 g/t Au with 13.0m horizontal width was founded by the drilling (SKB-13). Ore reserves of the No.3 ore body (cut-off grade: 1.0g/t Au) were reported by Kyrghyz side to be 1,138 thousands tons of possible reserves, 8.6 tons of gold amount and 7.6 g/t Au average grade. Main ore minerals are electrum, chalcopyrite, pyrite, magnetite, arsenopyrite, bornite, chalcocite, bismuthinite and sphalerite.

As a result of the phase I survey, it was clarified that the gold mineralization is strong in the No.3 ore body and it comes weaker toward the northern part. The center of geochemical anomaly of gold is located in the south-southeast of the No.3 ore body. It is presumed as the center of the mineralization.

CHAPTER 4 COMPREHENSIVE ANALYSIS

4-1 Geological structure, and characteristics and controlling factors of mineralization

Generalized result of the survey is shown on Fig.I-4-1.

4-1-1 Geological structure

(1) Geological structure

(i) The skarn zone is located along the boundary between the Altyn-Jylga intrusive body and the limestone at the 1,850m level (Fig.II-2-1), which is almost concordant with the structure of N-S trend confirmed on the surface and in the 1930m level tunnel.

(ii) The position of the skarn zone at the 1850m level is on the same plane as that confirmed in the 1930m level tunnel and in drillholes. The skarn zone is 8m to 25m in width, dips 65° ~ 70° east and has a plate-like shape(Fig.II-2-2, Fig.II-2-3).

(iii) The skarn zone is cut by NW-SE fault system and displaced apparently as right- and left-lateral by 7m at the maximum in separation (Fig.II-2-1).

(iv) There are two fracture systems. One is NE-SW trending system and the other is NW-SE trending system. Arsenopyrite veins containing gold are recognized along the former system and skarnized lamprophyre dikes with Au-Cu mineralization are recognized along the latter system.

(2) Continuity of ore zone

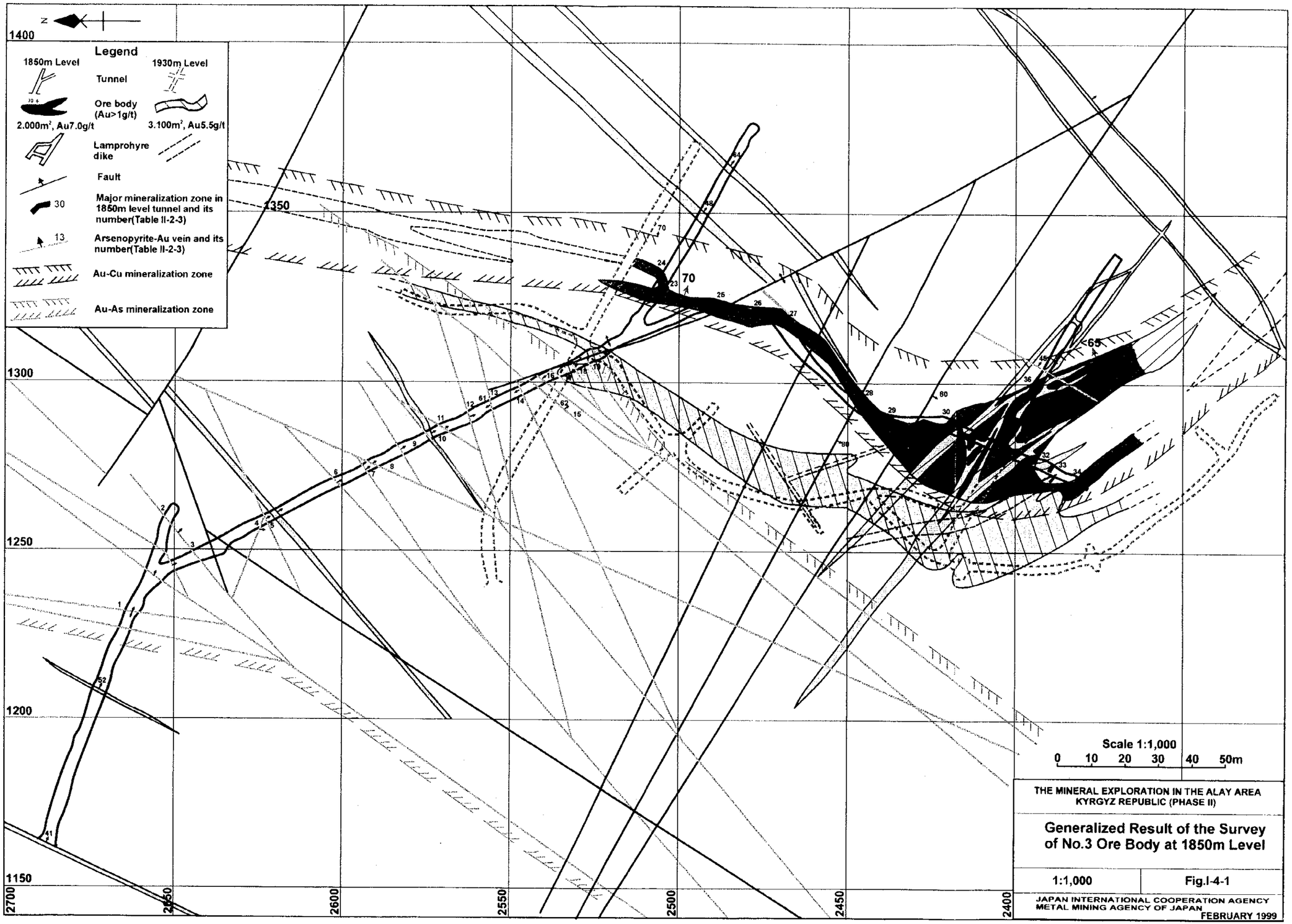
(i) The No.3 ore body was formed in the skarn zone between the intrusive body and the limestone as well as in the skarnized dikes which intersected the skarn zone (Fig.I-4-1, Fig.II-2-1).

(ii) Shape and size of the No.3 ore body at 1,850m level is similar to that of at 1,930m level. It shows that the ore body continues well vertically.

(iii) Average grades of the No.3 ore body are 7.0g/t Au at 1,850m level and 5.5g/t Au at 1,930m level, respectively. There is no sign of a decline in mineralizaton by depth.

(iv) The mineralization of the ore body at the 1,850m level tunnel shows no signs of a decline towards the north and the south. The ore body is therefore inferred to continue further north and south.

(v) From the above evidences, it is concluded that the No.3 ore body further continues horizontally and vertically, in harmony with the structure of skarn zone.


N
1400
Legend
1850m Level
1930m Level
Tunnel
Ore body (Au>1g/t)
2.000m², Au7.0g/t
3.100m², Au5.5g/t
Lamprohyre dike
Fault
30
Major mineralization zone in 1850m level tunnel and its number(Table II-2-3)
13
Arsenopyrite-Au vein and its number(Table II-2-3)
Au-Cu mineralization zone
Au-As mineralization zone
1350
1300
1250
1200
1150
2700
2650
2600
2550
2500
2450
2400
70
65
Scale 1:1,000
0 10 20 30 40 50m
THE MINERAL EXPLORATION IN THE ALAY AREA
KYRGYZ REPUBLIC (PHASE II)
Generalized Result of the Survey of No.3 Ore Body at 1850m Level
1:1,000
Fig.I-4-1
JAPAN INTERNATIONAL COOPERATION AGENCY
METAL MINING AGENCY OF JAPAN
FEBRUARY 1999

4-1-2 Mineralization

(1) The No.3 ore body

Occurrence of the skarns and ores observed at the 1,850m level tunnel is shown in Fig.I-4-2. Process of mineralization is summarized in Table I-4-1.

(i) Skarnization and mineralization

The skarn zone mainly of clinopyroxene was formed along the boundary between the Altyn-Jylga intrusive body and the limestone. Gold mineralization with grade under 1g/t is recognized widely in the skarn zone, therefore low-grade gold mineralization is inferred to have been accompanied with the skarnization.

(ii) Reskarnization

Intrusion of lamprophyre dikes along fractures striking NE-SW and NW-SE and reskarnization formed garnet skarn in the lamprophyre as well as in the first skarn zone at the lower temperature than that of the first skarnization.

(iii) Remineralization and concentration of gold

Most of Au-Cu ore bodies were formed at the late stage of the reskarnization by the mineralization along the same fractures.

(iv) Mineralization of arsenopyrite and gold

Au-As mineralization took place along the NE-SW fractures in the intrusive body and in the limestone along the skarn. Au-As ore mainly of arsenopyrite was formed in these fractures in the intrusive body. Au-Fe ore composed of pyrite, arsenopyrite and chalcopyrite was formed in the limestone.

(2) Deposits around the No.3 ore body

(i) In the south of the No.3 ore body, the No.5 ore body (vein-like ore body with average Au-grade of 16.6g/t, mineralized dike with average Au-grade of 4.7g/t; Fig.I-4-3) and the Southern deposit (mineralized skarn with average Au-grade of 3.2-13.8g/t, mineralized dike with average Au-grade of 3.0-50.0g/t) had been ascertained at the surface by the past surveys. The mineralization of these ore bodies was probably formed in the similar condition as the bonanzas of the No.3 ore body. The No.5 ore body and the Southern deposit are assumed to constitute a continuous mineralization zone extending in ENE-WSW direction (Fig.I-4-4).

(ii) In the east of the No.3 ore body, a vein-like ore body (average Au-grade of 13.9g/t) has been ascertained at the surface by the past survey. The ore body extends parallel to the bonanza of the No.3 ore body, therefore those two ore bodies constitute a continuous mineralization zone extending in NW-SE direction.

(iii) At the northernmost part of the Altyn-Jylga ore field, a vein-like ore body extending in N-S direction (average Au-grade of 19.6g/t) has been ascertained at

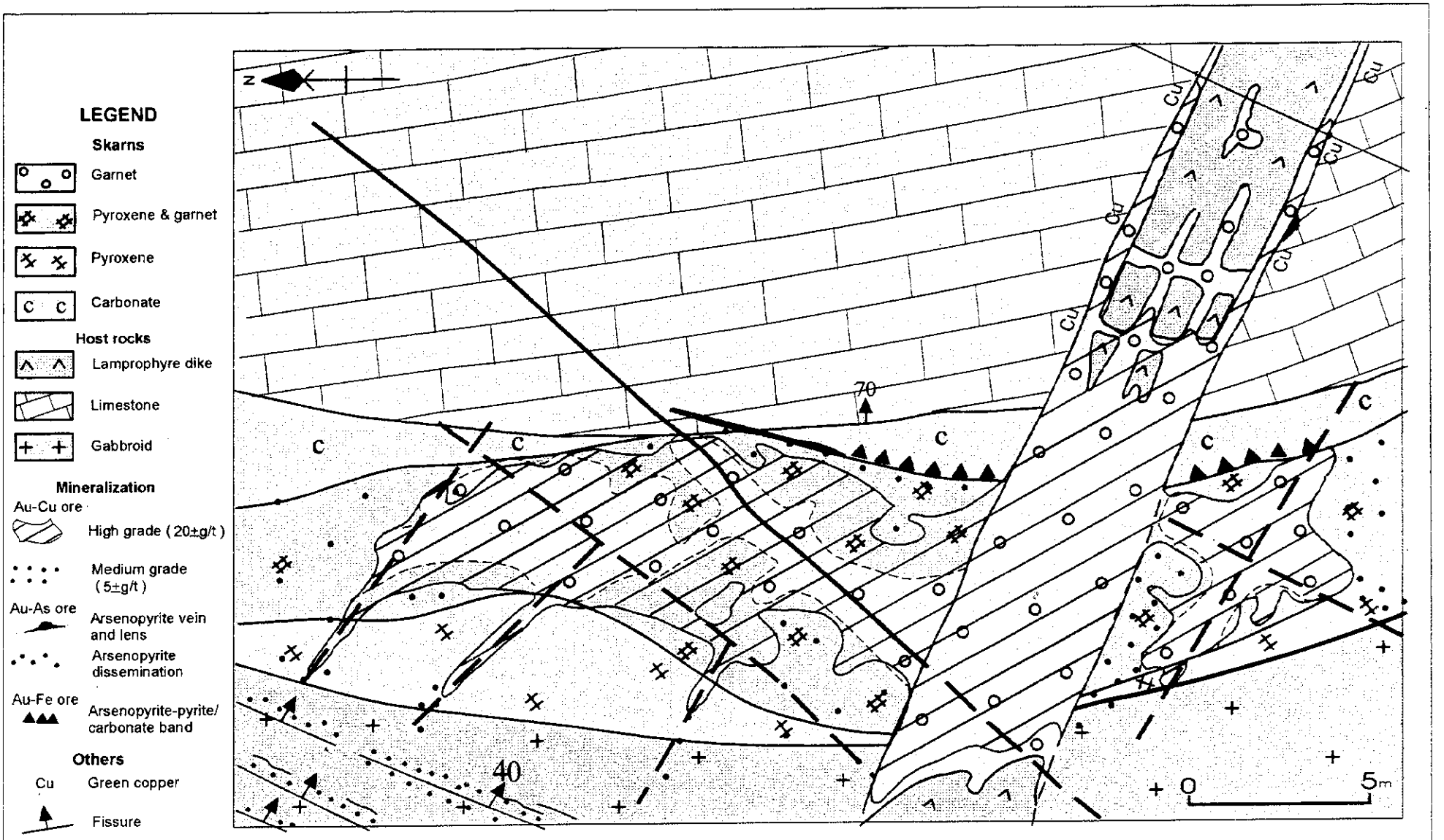


Fig. I-4-2 Schematic Plan of No.3 Ore Body at 1850m Level

Table I -4- 1 Process of Skarnization and Mineralization

Stage	Process	Location		Main skarn minerals		Main ore minerals	Ore type		Au grade & width of ore body		Average homogenization temp (℃)	
1st	Skarnization & Au mineralization?	Contact between gabbroid of the Altyn-Jylga intrusive body and limestone of Kumbel Formation		Clinopyroxene		Magnetite Molybdenite (Au?)			6.3g/t - 2.0m?		<267	
2nd	Intrusion of lamprophyre dike	Fracture NW-SE, 90 ° -85 ° N and NE-SW, 41 ° -64 ° S										
3rd	Re-skarnization	Lamprophyre dikes and fracture system of 2nd stage in and around the skarn zone of 1st stage		Garnet (andradite)							<258	
	Au-Cu mineralization					Chalcopyrite Bornite Electrum	Au-Cu		23.9g/t - 7.0m		97-258	
4th	Au-As mineralization	A : Parallel fissure system in the intrusive body NE-SW,30 ° - 75 ° S	B : In hanging wall of limestone along the skarn zone of 1st and 3rd stages	A : None	B : Siderite	Arsenopytite Pyrite Chalcopyrite Native Au	A : Au -As	B : Au -Fe	A: 2.1g/t - 1.0m	B: 4.4g/t - 2.2m	A: 112-135	B: 108-117

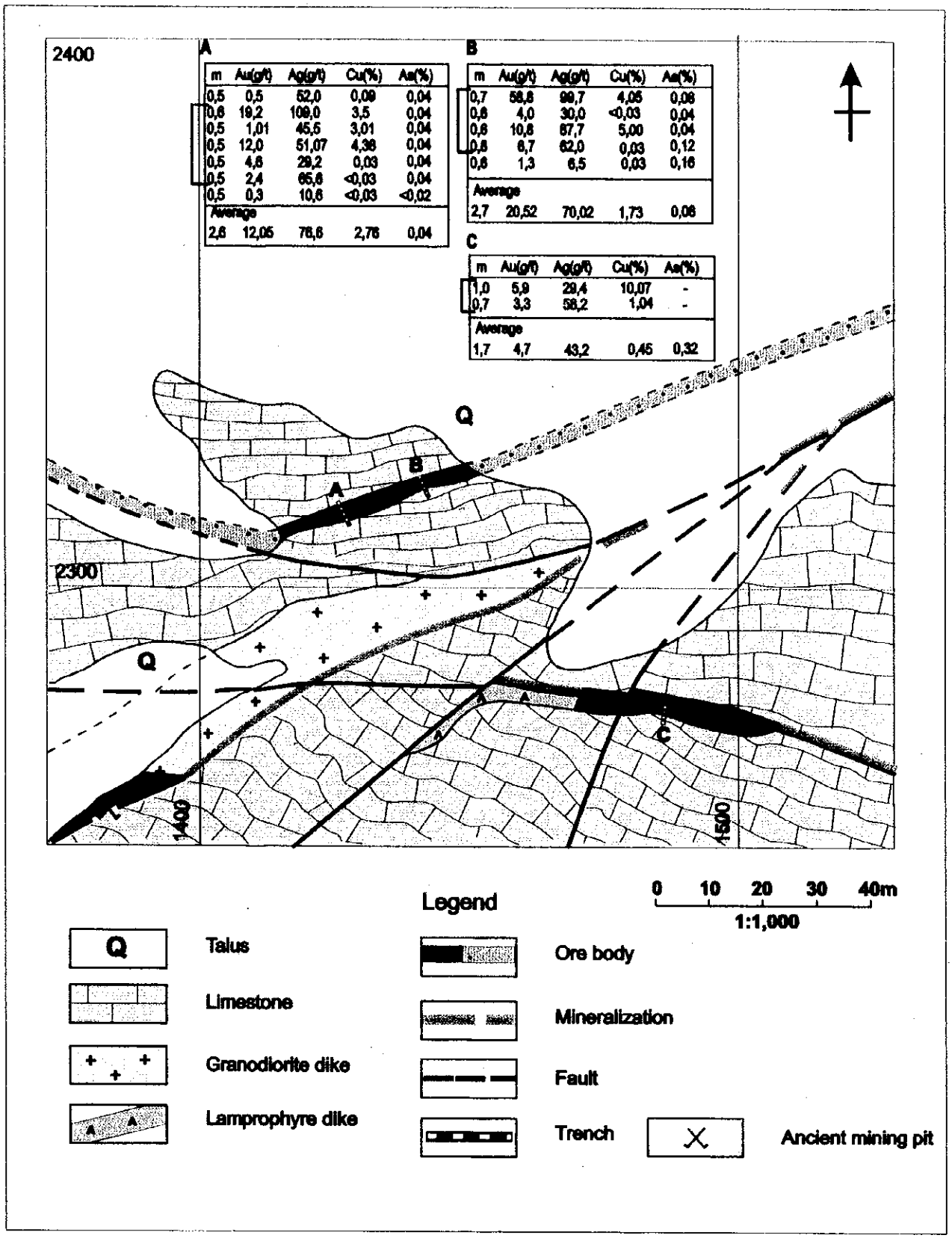
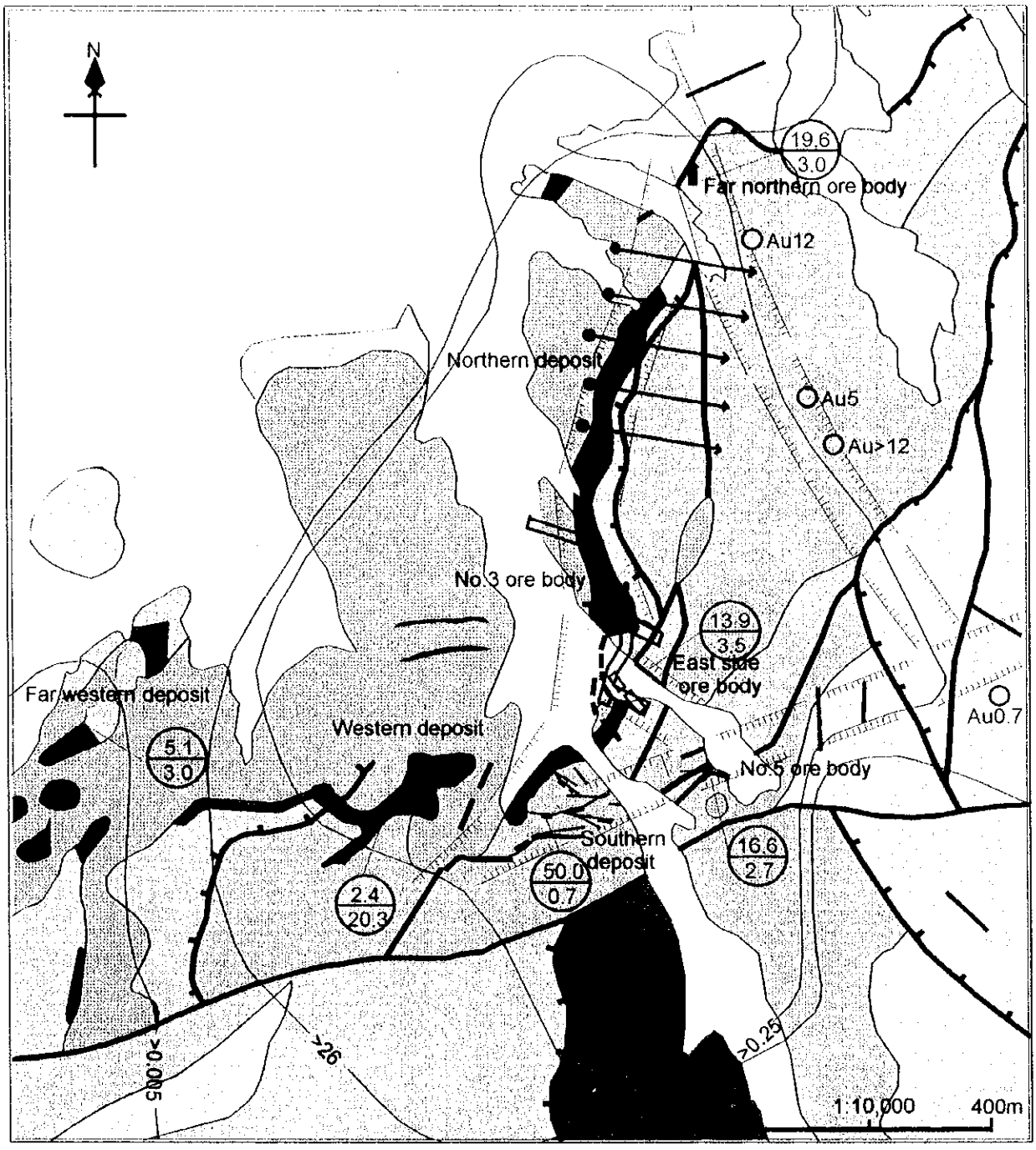


Fig. I-4-3 Geological Map of No.5 Ore Body



LEGEND

- Ore body
- High grade ore vein (1850m level tunnel)
- Average Au grade(g/t) / width(m) (e.g. 20.5 / 2.7)
- Ore zone
- Barren skarn
- Au geochemical anomaly (g/t)
- Sb geochemical anomaly (ppm)
- Au12 Au grade of rock sample(g/t)
- Lamprophyre dike
- Granodiorite dike
- Granodiorite
- Limestone
- Cherty limestone
- Slate
- Chert
- 1850m level tunnel
- 1930m level tunnel
- drilling survey line (phase I)

Fig. I-4-4 Distribution of Mineralization Zones in Altyn-Jylga District

the surface by the past survey. Au-containing (5-12g/t) sample points are aligned on a SSE-trending line from the ore body. It shows the possibility of existence of a minelarization zone extending in NNW-SSE direction (Fig.I-4-4).

(iv) In the southwestern part of Altyn-Jylga ore field, the Western deposit (average Au-grade of 2.4g/t) and the Far western deposit (average Au-grade of 5.1g/t) has been ascertained at the surface by the past survey. Elucidation of mineralization and geological structure of these deposits remains as a future object.

4-1-3 Controlling factors

The mineralization was controlled by the skarn zone extending in N-S direction and by fissures trending NE-SW and NW-SE, which intersect the skarn zone. Bonanzas are inferred to have been formed at these intersections (the southern part of the 1,850m level and 1,930m level tunnels).

4-2 Potential of gold reserves

It is concluded that the No.3 ore body has an area of 2,000m^2 and Au-grade of 7.0g/t on average according to the results of Phase II. Potential of ore reserves including the No.3 and the No.5 ore bodies and the Southern deposit is shown below. Perspective section of ore reserves is shown in Fig.I-4-5. Besides these ore bodies, the Altyn-Jylga ore field has potential areas, such as vein-like ore bodies at the northernmost of the Northern deposit and in the eastern adjacent part of the No. 3 ore body as well as the Western and Far western deposits. Increase of ore reserves are anticipated by underground exploration of these ore bodies and deposits.

(1) Rules of the estimation of ore reserves

Cut-off grade : 1g/t Au

Area : area over 1g/t Au or determined by geological structure. Width of horse rock is less than 1m

Depth : for the No.3 ore body, lower limit is 1,710m(exploration level for the succeeding year)

: for the No.5 ore body and the Southern deposit, lower limit is 1,850m

Calculation : the section method, specific gravity = 3.0(on the basis of the measured value by the Kyrghyz side)

Area and grade at each level :

Ore body	Level (m)	Area (m^2)	Au grade (g/t)	Height (m)
NO. 3 ore body	Surface (1, 980m)	3, 100	5. 5	50
	1, 930m	3, 100	5. 5	80
	1, 850m	2, 000	7. 0	140
	1, 710m	2, 000	7. 0	
No. 5 ore body	Surface (2, 170m)	536	13. 6	320
Southern deposit	Surface (2, 100m)	1, 370	7. 4	250

(2) Potential of gold reserves

The No.3 ore body	Au average grade	Au reserves	Category
Above 1,930m level	5.5g/t	2.6t	C_2
1,930 – 1,850m levels	6.1g/t	3.7t	C_2
1,850 – 1,710m levels	7.0g/t	8.4t	P_1
subtotal		**14.7t**	
The No.5 ore body			
2,170 – 1,850m levels	13.6g/t	7.0t	P_2
The Southern deposit			
2,170 – 1,850m levels	7.4g/t	7.6t	P_2
subtotal		**14.6t**	

The No.3 ore body + the No.5 ore body + the Southern deposit = 29.3t

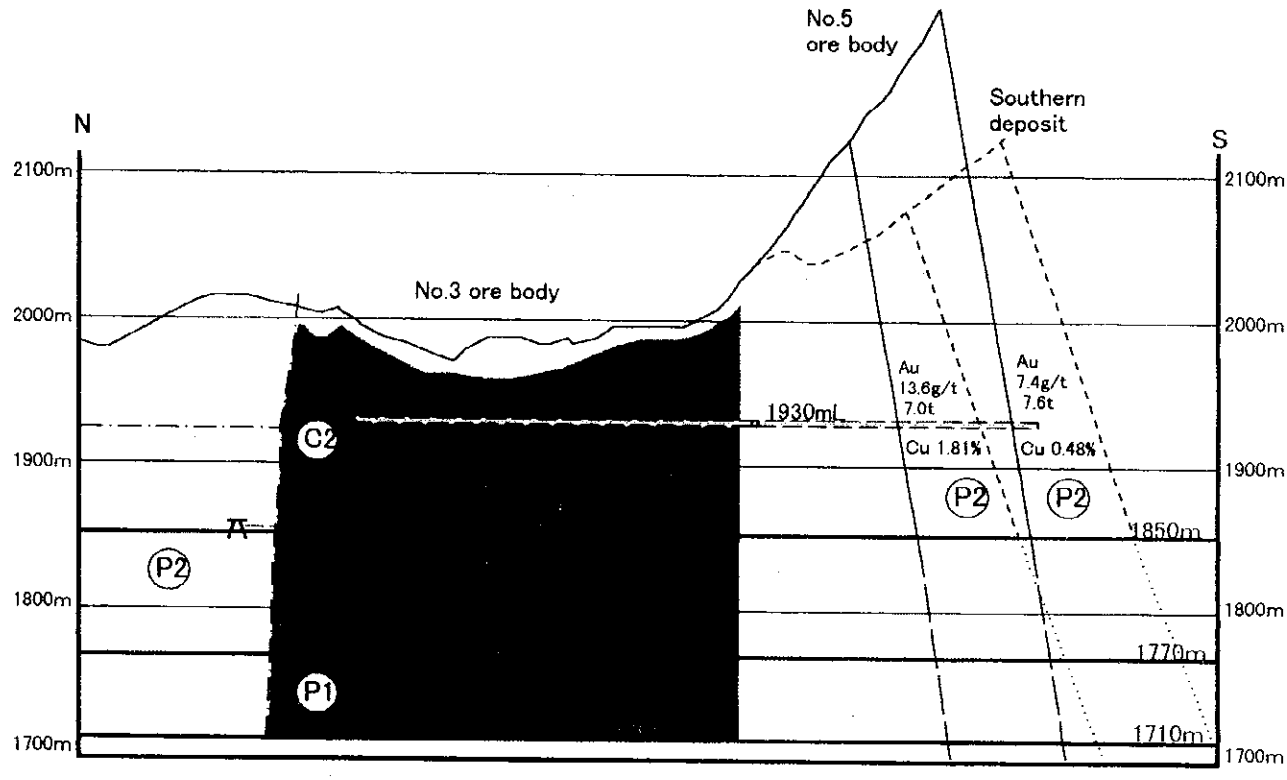


Fig.I-4-5 Perspective Section Showing a Potential of Ore Reserves

CHAPTER 5 CONCLUSIONS AND RECOMMENDATIONS

5-1 Conclusions

(1) The continuity of the No.3 ore body between 1,930m level and 1,850m level and of the high-grade zone found by the past drilling surveys has been ascertained. Area and average grade of the ore body at the 1,850m level was estimated to be 2,000m^2 and 7.0g/t Au (cut-off grade 1g/t), respectively. The ore body is inferred to continue horizontally and vertically downward.

(2) The gold mineralization of the No.3 ore body can be divided into the following three stages:

Stage A. Mineralization accompanied with the pyroxene-dominant skarnization along the boundary of the Altyn-Jylga intrusive body and the limestone in the late stage of the skarnization

Stage B. Mineralization accompanied with the garnet-dominant reskarnization of the lamprophyre and the skarn of the first stage in the late stage of the reskarnization

Stage C. Mineralization which occurred along the fractures near the skarn after formation of the skarn

High-grade ore and bonanzas were formed in the second stage around intersections of the skarn zone and the dikes.

(3) It is inferred that the No.5 ore body and the Southern deposit consist a continuous mineralization zone. The mineralization of these ore bodies was probably formed in the similar mode of occurrence as the bonanzas of the No.3 ore body. The potential gold reserves of the No.3, the No.5 and the Southern ore bodies are estimated altogether at 29.3 tons.

5-2 Recommendations for the Phase III survey

It is required to explore the deeper part below the 1,850m level thereby clarifying a potential of the ore body.

In order to bring the Altyn-Jylga District to the development stage, it would be necessary to clarify further the mechanism of the mineralization on the basis of Phase II results, and also to establish guidelines for exploring the ore zone consisting of the No. 5 ore body, the Southern deposit, as well as the other promising ore bodies and deposits, thereby increasing ore reserves substantially.

(1) Exploration targets

(i) **Extensions of the skarn zone in the horizontal and vertical directions**

(ii) **Intersections of the skarn zones with dikes**

(2) Localities and methods of survey

A. Downward and horizontal drilling survey of the No.3 ore body

B. Driving a survey adit toward the ore zone consisting of the No.5 and the Southern ore bodies and detailed surface geological survey of the ore zone

C. Detailed surface geological survey of the vein-like ore bodies at the extreme north and to the east of the No. 3 ore body, as well as the Western and Far Western deposits.

D. Ore dressing test (quantification of ore characteristics and studies on ore dressing process)

PART II

PARTICULARS

CHAPTER 1 ADIT SURVEY

1-1 Purpose

At 1,850m level in the No.3 ore body of the Altyn-Jylga District, adit survey was designed based on the results of Phase I survey. Its purpose is to (i) confirm continuity of the gold mineralization zone discovered by the past drilling survey; (ii) examine the mineralization, thereby drawing exploration guidelines; and, (iii) design survey programs for the succeeding years.

1-2 Location

The coordinates of the mine mouth is X =2687.72, Y=1160.14. The location map of the tunnel is shown in Fig. I -1-2. The total length of the tunnel excavated is 555m. The length and direction of each tunnel segments are shown in Table I-1-1.

1-3 Period

The period of the site survey was from 14 June 1998 to 11 December 1998. The arrival on the site was 18 June 1998 and the actual period of excavation was from 21 June to 4 December. The clean up was finished on 6 December 1998. Progress of the survey is shown on Table. II -1-1.

During the survey, the camp was isolated by road collapse due to heavy rains in the period of 25 to 29 June, 6 to 8 July and 5 to 8 August. Repair works took longer because of shortage of heavy machine, although tunneling works was continued using stock materials.

1-4 Methods

For the tunneling survey, the surface around the mine mouth was leveled and the equipment such as compressor, generator, fuel tank, cabin, etc. was installed (Fig. II -1-1). A warehouse was built in the campsite. The water for drilling was drew from the stream at the opposite bank of Sokh River and stored in a tank at the riverside and pumped up to upper tank on the river terrace, then transported to the mine mouth.

1-4-1 Specification of adit

The standard section area of tunnel is 5.64m^2. Three types of supporting was adopted depending on the rock conditions. Every junction had been fixed by supporting by the legal obligation.

(i) Type Ⅰ :Close supporting with timber(Fig. Ⅱ-1-2).

Adopted for fault-shear zone or strong weathering zone.

(ii) Type Ⅱ :Space supporting with timber and saw timber(Fig. Ⅱ-1-3)

Distance between timbers is 1.2m. Adopted for fissure and crack zone.

(iii) TypeⅢ:Non-supported(Fig. Ⅱ-1-4).

Adopted for hard and fresh rock zone.

1-4-2 Method of excavation and used equipment

(i) Drilling: jack leg PR63B2. Average hole length is 1.6m.

(ii) Blasting: ammonia explosives with detonator and fuse. Ventilation takes 30 minutes after explosion.

(iii) Mucking: loader PPN-1C. Sampling of assay after every mucking of the drift.

(iv) Transportation: electric locomotive AK2U using track VO-0.8.

(v) Disposing: ore and waste are disposed to separated place with bulldozer.

For an efficient survey, compressor(PDS700S), generator(SDG25S), welder(BP-400) and engine welder(BLW280SS) were brought from Japan(Table Ⅱ-1-2).

1-4-3 Operation and safety system

(1) Operation system

(i) Kyrghyz side: 12 hours/shift×2 shifts/day - 15 days work at the site and 15 days off

(ii) Japan side : 8 hours/shift × 3 shifts/day. To maintain safety and the operation, Japanese team took 3 shifts a day and employed 3 interpreters.

Number of staff is shown in Table. Ⅱ-1-3.

(2) Safety system

(i) 24 hours double check system

(ii) Safety meeting with Kyrghyz side every morning

(iii) Training system for foreseeing dangers

(iv) Keeping 2 vehicles for an emergency at the site

(v) Equipped 2 INMARSAT for telecommunication.

1-5 Result of survey

Progress of the survey is shown in TableⅡ-1-1 and number of days for the

tunnel works is shown in Table II-1-4.

1-5-1 Efficiency of excavation

Progress record of the tunnel survey is shown in Fig II-1-5 and efficiency of tunnel survey is shown in Table II-1-5. Efficiency of each tunnel type is as below.

(i) Type I : 2.3 m/day
(ii) Type II : 3.0 m/day
(iii) Type III : 3.6 m/day
Average : 3.3 m/day

The efficiency of tunnel survey is influenced by transportation distance of waste from a face, rock hardness and flooding. The biggest influence is distance as shown below.

Cross Cut I (Average distance from the mine mouth is 290m) : 2.3 m/day(Type II)
Cross Cut II (Average distance from the mine mouth is 400m) : 2.9 m/day(Type III)

There were two problems in excavation.

(i) Misfire by inundation: around tunnel II 139m point, water began to flood and the volume of water reached 950 l/min in the side track II.

(ii) Decrease of blasting length by hard rock: from the tunnel III 65m point, garnet skarn became very hard. It caused slower drilling speed and shorter blasting length, but this problem was settled by technical improvement.

In spite of lower efficiency of excavation in the deeper part of the tunnel, the tunneling was completed in the planed term, because the first half operation was done smoothly.

1-5-2 Rock conditions

The length of tunnel Type I, Type II and Type III were 30m, 130.8m and 394.8m, respectively. Tunnel types and its completion date are shown in Fig. II-1-6.

(i) Tunnel I : The rock was granodiorite. From the mouth to 30m point, Type I was adopted because the rock is loosen by the weathering. Type II was adopted for the rest of this tunnel segment, because of fracture zone.

(ii) Side track I : The rock was hard fresh granodiorite. Type III was adopted except a junction.

(iii) Tunnel II : From 0m to 72m point, the rock was granodiorite and there were some crush zones. Type II was adopted in the crush zone. From 72m to 172m point, the rock was gabbro. From 139m point, Type II was adopted for 9.6m in

length because of water flood from the roof. From 172m to 185m points, the rock was skarn.

(iv) Side track II : From 0m to 10m point, the rock was gabbro. From 10m to 19m points, the rock was skarn. The face of this segment was shear zone. Type II was adopted for 2.4m in length before the face.

(v) Cross Cut I : The rock was marble. Type II was adopted for 9.6m in total at some crack zones.

(vi)TunnelIII : The rock was skarn. Type II was adopted for only boundary with hangingwall (17m～20.6m point).TypeIII was adopted for the rest part of this segment.

(vii) Cross CutII : From 0m to 13m point, the rock was skarn, and from 13m to 50m point, the rock was marble. TypeIII was adopted for this segment.

1-5-3 Supply and consumption of materials

Among the main materials, drilling rods and bits are produced in Kyrghyz. Explosives are imported from Tajikistan. Timbers are from Russia and fuel is from Uzbekistan. All materials are gathered at Osh. The distance between Osh and the site is 220km and the road condition between Sokh Village and the site is not good. The inventory of the materials and the maintenance of the road were very important for supply of materials. Consumed materials are shown in Table. II -1-6.

1-5-4 Technical transfer

(1) Improvement of drilling pattern

From the tunnelIII 65m point, garnet skarn became very hard and blasting length became shorter as 0.6m～0.8m/blast. The improvement of drilling pattern shown below resulted in 1.2m/blast efficiency.

	Before improvement	Improved (Fig. II -1-7)
Center cut	V-cut	Burn-cut
Number of holes	30	23
Length of hole	1.6m	1.2m

(2) Reinforcement of safety

Kyrghyz side had keen awareness to prevent an accident. Following items were enforced to keep safety.

(i) Daily meeting for safety.

(ii) Training for a foreknowledge of danger.

(iii) Periodical scaling for all tunnels.

(iv) Detailed communication to the next shift.

(v) Periodical check for combustion time of fuse.

(vi) Secure run off time from blasting.

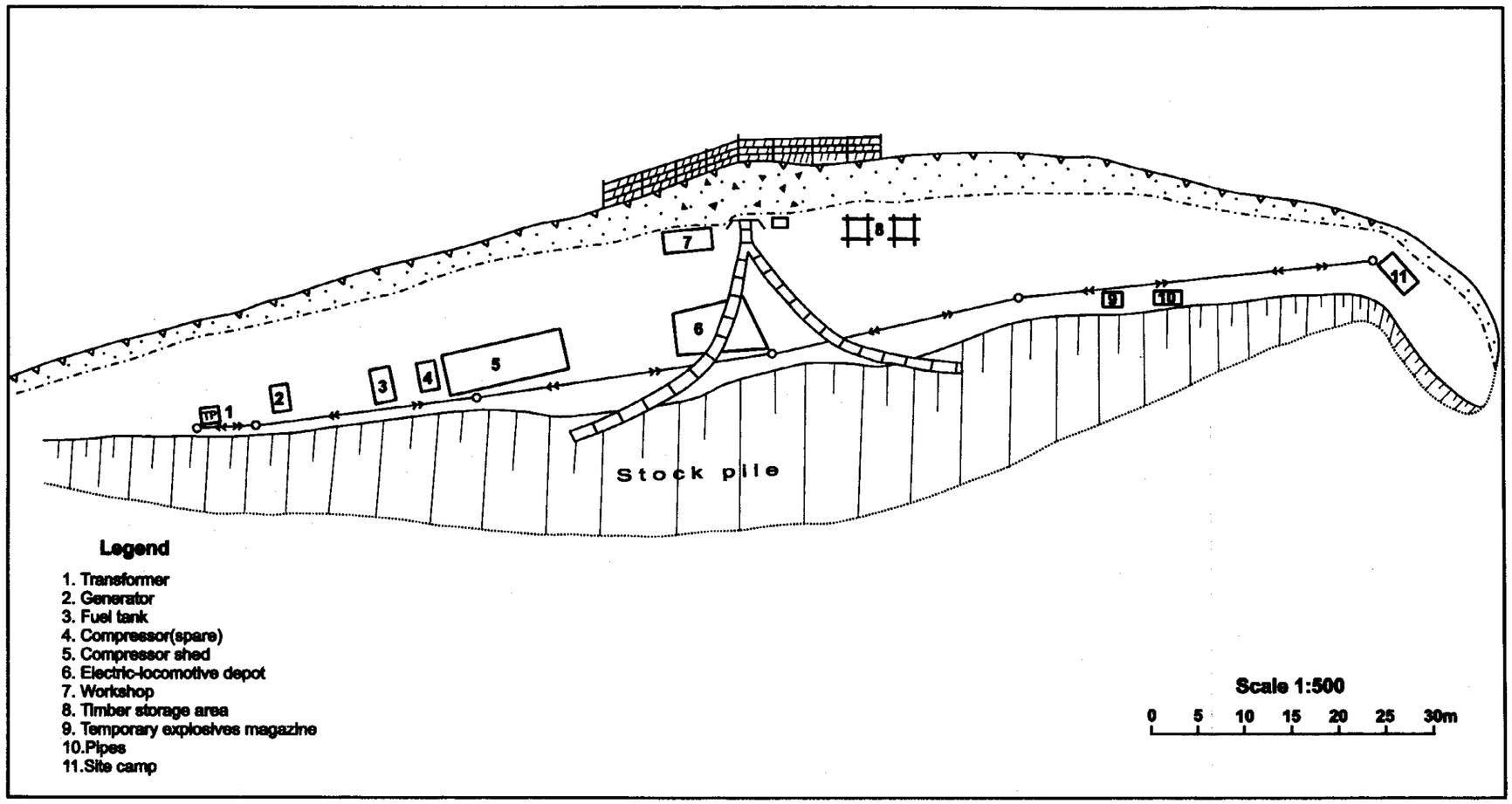


Fig.II-1-1 Surface Facilities around the Tunnel Mouth

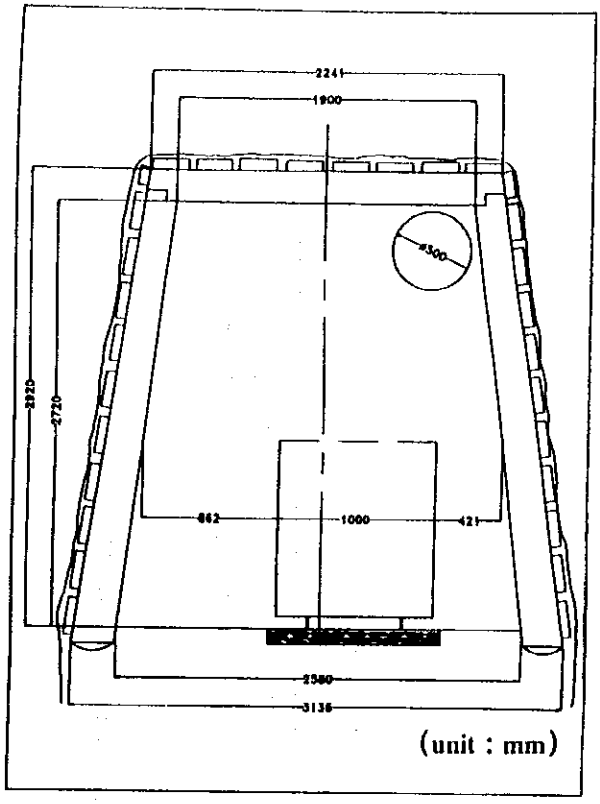


Fig. II -1-2 Cross Section of Tunnel Type I

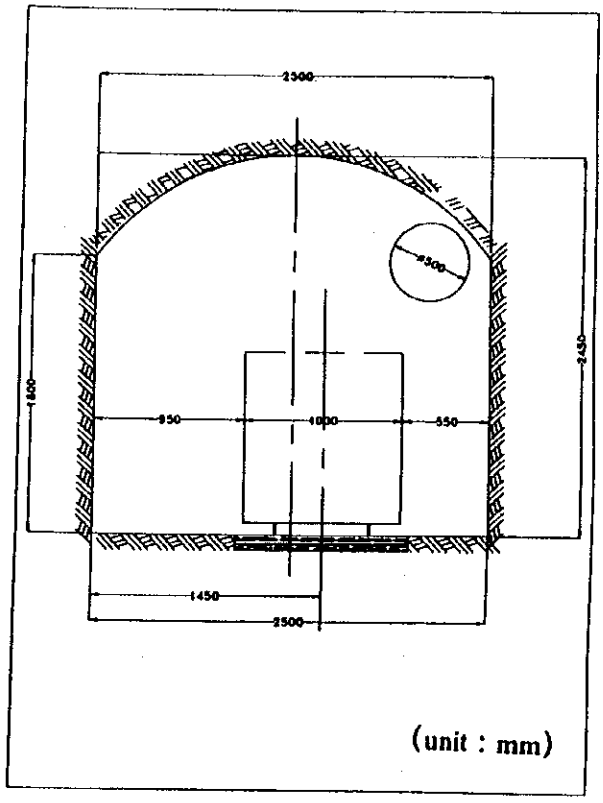


Fig. II -1-4 Cross Section of Tunnel Type III

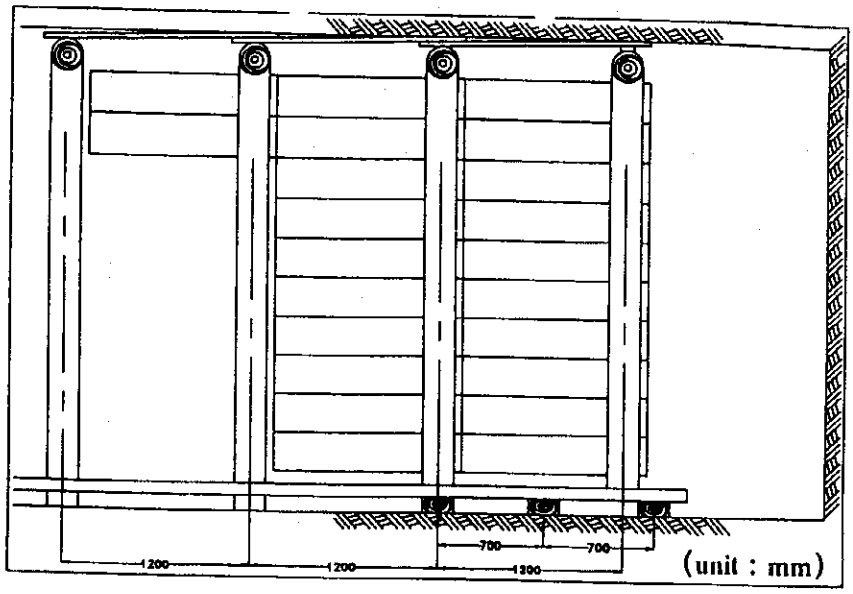


Fig. II -1-3 Section along Tunnel Type II

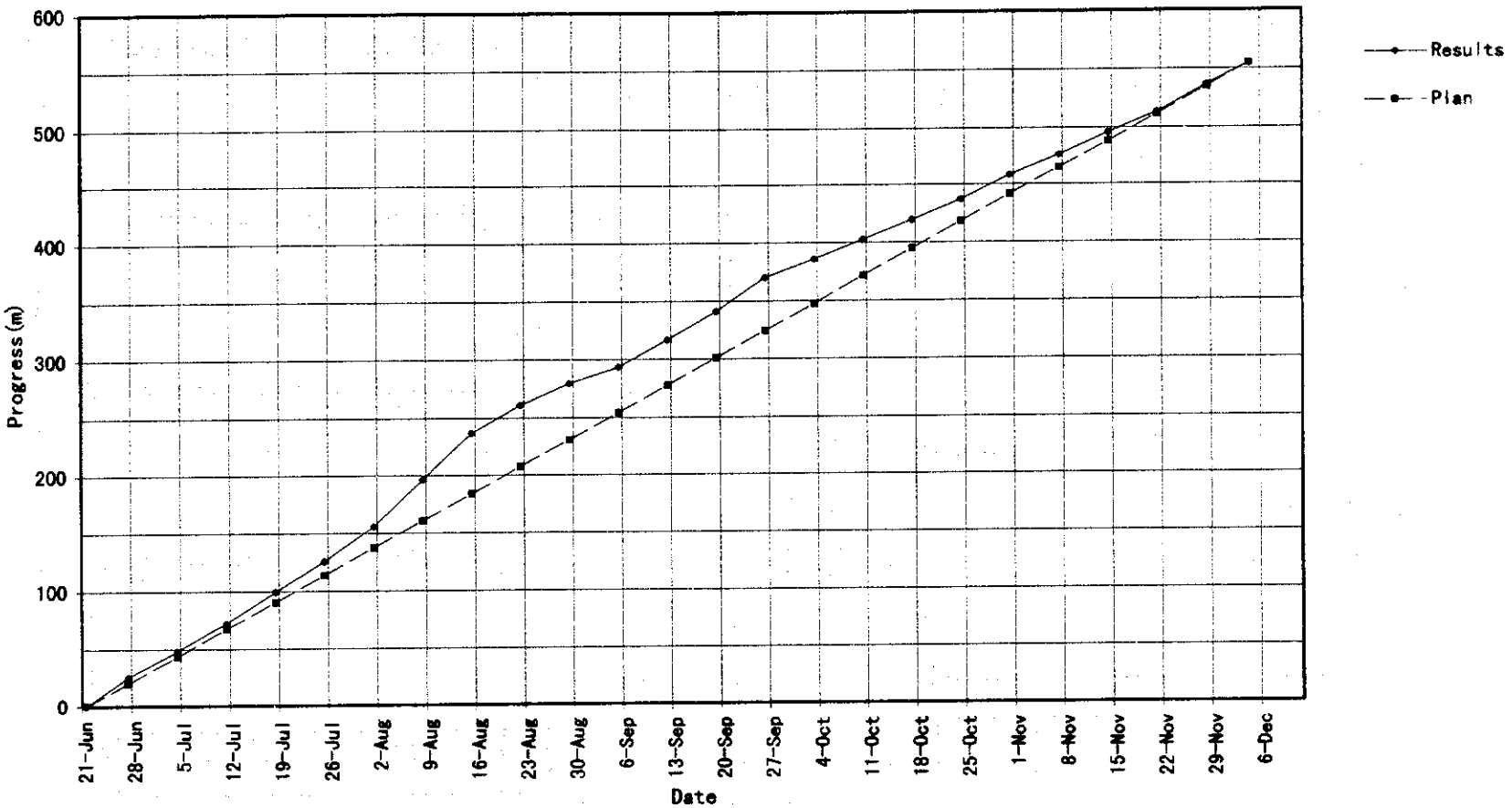


Fig.II-1-5 Progress Record of the Survey

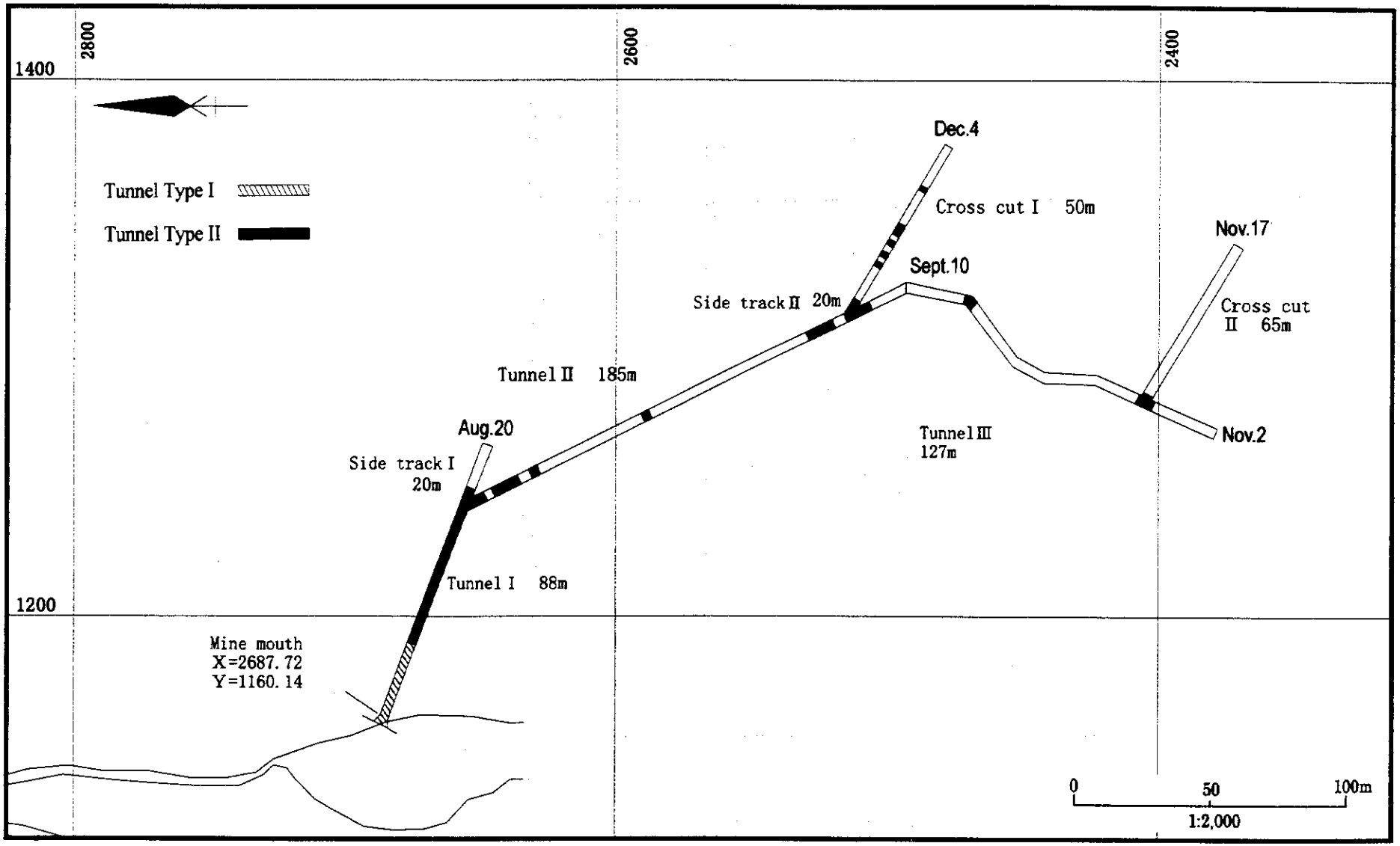


Fig. II -1-6 Tunnel Types and its Completion Date

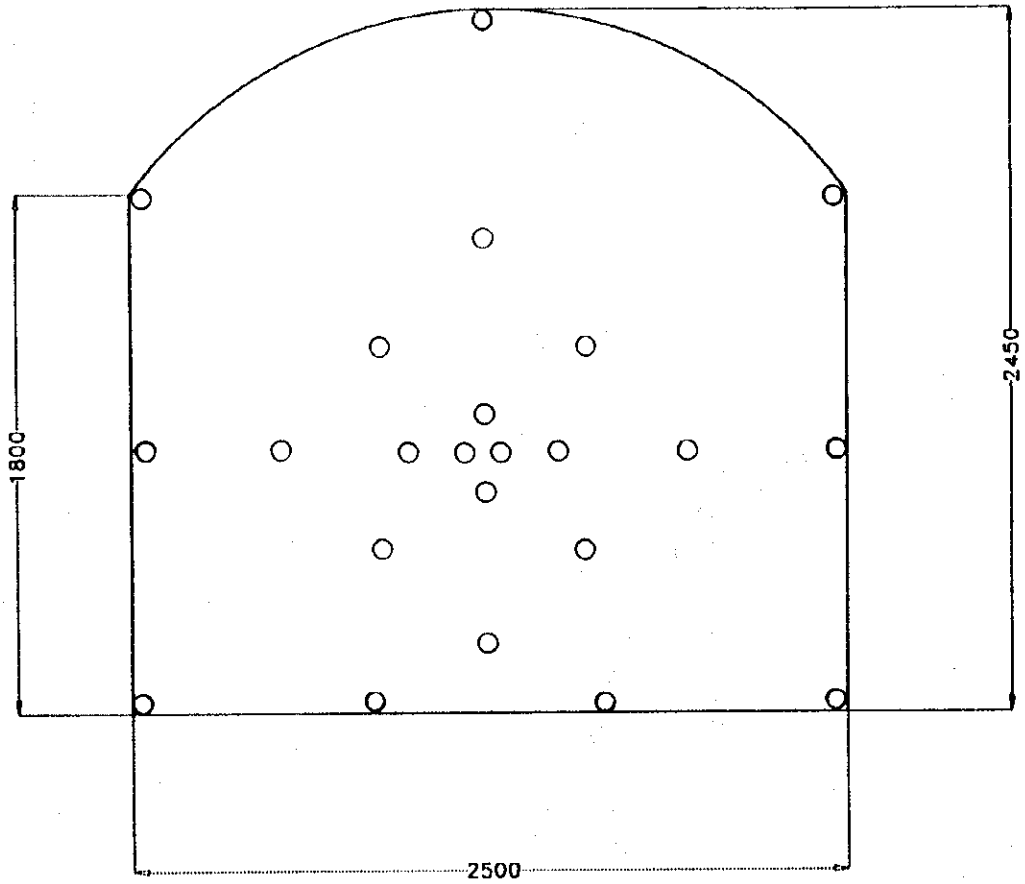


Fig. Ⅱ-1-7 Drilling Pattern of the Tunnel (unit : mm)

Table Ⅱ-1-1 Progress of the Survey

	Contents of Survey	Quantity	June	July	August	September	October	November	December	January	February
1	Trip to Kyrghyz		14 — 18								
2	Transportation of equipment to Kyrghyz		—								
3	Preparation		19 − 20								
4	Tunneling								Plan		
	Tunnel Ⅰ	88.0m	21 —	— 15							
	Side track Ⅰ	20.0		— 20							
	Tunnel Ⅱ	185.0		21 —	—	— 10					
	Side track Ⅱ	20.0			27 —	3					
	Cross cut Ⅰ	50.0						—	4		
	Tunnel Ⅲ	127.0				11 —	— 25	— 2			
	Cross cut Ⅱ	65.0					17 —	— 17			
5	Clean up								− 6		
6	Trip to Japan								7 — 11		
7	Report making						1				26

Table II -1-2 Main Equipment

Equipment	Specifications	Quantity	Note
Compressor	$10m^3/min$	2	RPR-10M
Jack-hammer	30kg class	4	PP63B2
Electric Locomotive	2.0ton	2	AK2U
Truck	$0.8m^3$	20	VO-0.8
Loading Vehicle	12 horse power	2	PPN-1C
Fan	5.5kW	6	VO-5
Generator	200kVA	2	DEA-200
Pump	22kW	2	ANB-22
Brought from Japan			
Compressor	$20m^3/min$	1	PDSG700S
Generator	25kVA	2	SDG25S
Electric Welder	400A	1	BP-400
Engine Welder	250A	1	BLW280SS
INMARSAT		2	

Table II -1-3 Number of Staff

	8 : 00～20 : 00	20 : 00～8 : 00	
Foreman	1		
Mine foreman	1	1	
Mine worker	6	6	
Mechanic foreman	1		
Mechanic	2	2	
Geologist	1		
Surveyor	1		
Sampling man	1		
	1 4	9	
	8 ～ 16	16 ～ 24	24 ～ 8
Japanese	2	1	1
Interpreter	1	1	1

Table Ⅱ -1-4 Detailed List of Tunnel Survey

	Preparation Clean up	Tunneling period and days	Water transportation days	Road maintenance days	Note
	(preparation) '98 6.19 ~ 20			2	
Tunnel Ⅰ		'98 6.21 ~ 7.15 25	25		
Side track Ⅰ		'98 7.16 ~ 7.20 5	5		
Tunnel Ⅱ		'98 7.21 ~ 8.26 37 9. 4 ~ 9.10 7	37 7	2 3	
Side track Ⅱ		'98 8.27 ~ 9.3 8	8	1	
Cross cut Ⅰ		'98 11.18 ~ 12.4 17	17	4	
Tunnel Ⅲ		'98 9.11 ~ 10.16 36 10.25 ~ 11.2 9	36 9	5 1	
Cross cut Ⅱ		'98 10.17 ~ 10.24 8 11.3 ~ 11.17 15	8 15	1 1	
	(clean up) '98 12.5 ~ 12.6			1	
Total (days)	4	167	167	21	

Table Ⅱ-1-5 Efficiency of Tunnel Survey

	Quantity	Type of tunnel	Working days	Efficiency
Tunnel Ⅰ	88.0m	Type Ⅰ 30.0m +Type Ⅱ 58.0m	25	3.5 m/day
Side track Ⅰ	20.0m	Type Ⅱ 3.2m+Type Ⅲ 16.8m	5	4.0 m/day
Tunnel Ⅱ	185.0m	Type Ⅱ 42.0m+Type Ⅲ 143.0m	44	4.2 m/day
Side track Ⅱ	20.0m	Type Ⅱ 5.3m+Type Ⅲ 14.7m	8	2.5 m/day
Cross cut Ⅰ	50.0m	Type Ⅱ 10.3m+Type Ⅲ 39.7m	17	2.9 m/day
Tunnel Ⅲ	127.0m	Type Ⅱ 9.6m+Type Ⅲ 117.4m	45	2.8 m/day
Cross cut Ⅱ	65.0m	Type Ⅲ 65.0m	23	2.8 m/day
Total	555.0m	Type Ⅰ 30.0m +Type Ⅱ 130.8m+Type Ⅲ 394.2m	167	3.3 m/day

Table Ⅱ-1-6 Consumed Materials

Article	Specifications	Quantity	Note
Bit	42m/m ϕ R25	566 pieces	
Rod	25m/mHEX L=1,800	411 pieces	
Explosive			
Ammonite #6		12,962 kg	Imported from
Detonator		9,104 pieces	Tajikistan
Timberings		243 set	
Timber		167 m^3	Imported from Russia
Sleeper		851 pieces	
Diesel Oil		312,900 ℓ	Imported from Uzbekistan