NO. 6

REPORT
ON
THE MINERAL EXPLORATION
IN
THE KICHI-SANDYK AREA
THE KYRGHYZ REPUBLIC

(PHASE II)

MARCH 1999

JAPAN INTERNATIONAL COOPERATION AGENCY

METAL MINING AGENCY OF JAPAN

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PREFACE

In response to the request of the Government of the Kyrghyz Republic, the Japanese Government decided to conduct a Mineral Exploration in the Kichi-Sandyk area of western Kyrghyz and entrusted to the Japan International Cooperation Agency (JICA) and the Metal Mining Agency of Japan (MMAJ).

The JICA and the MMAJ sent to the Kyrghyz Republic a survey team headed by Mr. NAKAMURA Kiyoshi from July 7 to October 16, 1998.

The team exchanged views with the State Concern "KYRGHYZALTYN" of the Government of the Kyrghyz Republic and conducted a field survey in the Kichi-Sandyk 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 relations 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

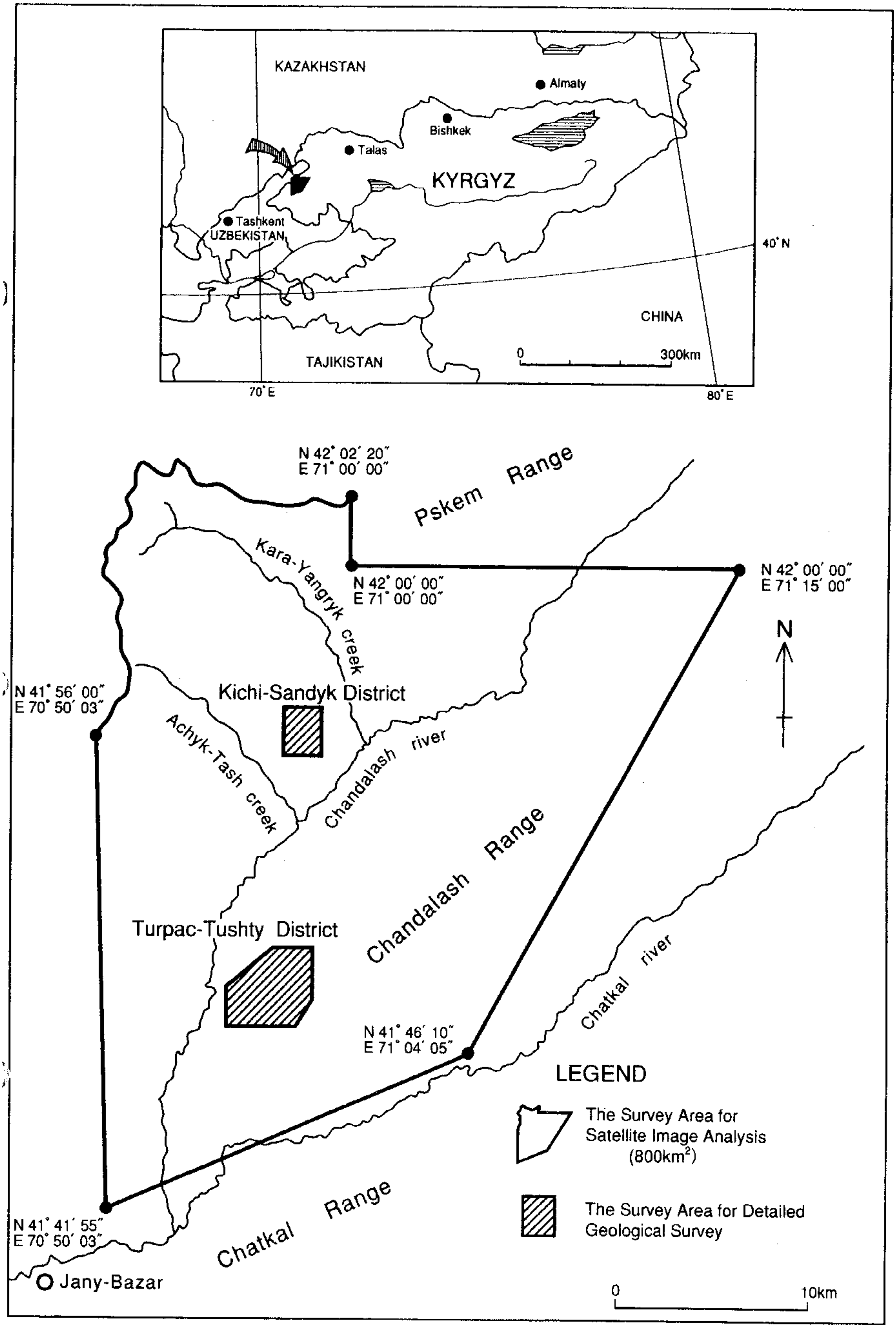

Fig. I -1 Location Map of the Survey Area

РЕЗЮМЕ

Настоящий отчет является кратким изложением результатов второго этапа исследований на площади Кичи-Сандык, Кыргызской Республики. Целью изучения являлось выяснение геологических условий площади, залегания рудных месторождений, а также выявление новых рудных месторождений. Полевые работы проводились с июля по октябрь 1998 года.

На втором этапе изучения проводилась разведка бурением 7 скважин общей длиной 819.4 м на площади Кичи-Сандык. Более того, было пройдено канав общей длиной 500 м на площади Кичи-Сандык и проводилось детальное геологическое изучение площади Турпак-Тушты в 20 км^2. Результаты этих исследований следующие:

На основе результатов предыдущих исследований, проводимых Кыргызской стороной, район Кичи-Сандык выбран в качестве перспективной площади для золотомедных месторождений. Потенциальные запасы руды (C2 +P1) в центральной и северной зонах минерализации оцениваются в 33 тонны золота (среднее содержание золота: 3.85г/т). Однако результаты второго этапа изучения показывают, что потенциальные запасы руды в центральной зоне минерализации не превышают 1 тонну золота и возможность присутствия перспективных золоторудных месторождений в этой зоне очень мала. С другой стороны, обнаружено, что потенциальные запасы руды в северной зоне минерализации составляют 1 тонну золота, но существует возможность, что в этой зоне присутствует золото с высоким содержанием вдоль золотоносного горизонта и предполагает его залегание на обширной территории.

На площади Турпак-Тушты Кыргызской стороной были оценены возможные запасы руды (P1) в 695 тысяч тонн, количество золота – 2,9 тонны (среднее содержание 4,22г/т). Результаты второго этапа исследований подтвердили присутствие руд с высоким содержанием золота на площади Турпак-Тушты и рудопроявлении Ак-Камоу. Существует возможность, что несмотря на мелкий масштаб, рудные тела с высоким содержанием золота присутствуют на обоих рудопроявлениях.

Рекомендации по проведению третьего этапа исследований следующие:

(1) Сделан вывод, что в северной зоне минерализации района Кичи-Сандык скарновое рудное тело (скарновый слой) простирается на глубину. Рекомендуется выяснить протяженность зоны минерализации путем бурения на глубину в северо-западном направлении с целью подтверждения присутствия руды с высоким содержанием и получить необходимую информацию для проведения дальнейших исследований.

(2) В центральной зоне минерализации района Кичи-Сандык рудное тело (скарн жильного типа) имеет низкое содержание и мелкий масштаб, таким образом, в настоящее время нет необходимости проводить дальнейшее детальное изучение этой зоны.

(3) Предполагается, что в районе Турпак-Тушты рудные тела с высоким содержанием присутствуют на рудопроявлениях Турпак-Тушты и Ак-Камоу. Рекомендуется провести бурение на глубину с поверхности рудопроявления и подтвердить реальное состояние минерализации. Геологоразведочные работы на этих рудопроявлениях не являются первоочередной задачей, в связи с невысокими запасами руды.

Summary

This report summarizes the results of the second year mineral exploration survey implemented in the Kichi-Sandyk area, Kyrghyz Republic. The survey was intended to clarify the geological condition of the area and the occurrence of ore deposits in the area and to discover new ore deposits. The field survey was carried out from July 1998 to October 1998.

As the second year survey, the drilling survey was carried out for seven holes, 819.4 m in total, in the Kichi-Sandyk district. Furthermore, the trenching survey was carried out for 500 m in total in the Kichi-Sandyk district and the detailed geological survey was carried out for an area of 20 km^2 in the Turpac-Tushty district. The results of these surveys are as follows:

The Kichi-Sandyk district was selected as a promising area for the gold-copper ore deposits on the basis of the past Kyrghyz-side survey results. The potential ore reserves (C2+P1) in the central and the northern mineralization zones of the district were estimated in all to be 33 tons of gold (average Au-grade: 3.85g/t). However, the result of the present two-year survey shows that the potential ore reserves in the central mineralization zone do not exceed 1 ton of gold and the possibility of the existence of promising gold deposits in the zone is rather low. On the other hand, the potential ore reserves in the northern mineralization zone are revealed to be only about 1 ton of gold but there remains in this zone a possibility that the high-grade gold ore exists along the ore-bearing horizon which is assumed to occur in a wide area.

In the Turpac-Tushty district, possible ore reserve (P1) of 695 thousand tons and gold quantity of 2.9 tons (average Au-grade: 4.22g/t) were estimated by the Kyrghyz side. The result of the second year survey confirms an existence of high-grade ores at the Turpac-Tushty and the Ak-Kamou ore manifestations and suggests a possibility that the high-grade ore bodies, even though of a small scale, exist in both the manifestations.

Recommendations to the third year survey are as follows:

(1) In the northern mineralization zone of the Kichi-Sandyk district, the skarn ore body (layered skarn) is inferred to continue to the deep. It is recommended to clarify the extent of the mineralization zone by the drilling survey to the deep in the northwestern direction and to confirm the possibility of the existence of the high-grade ore in order to obtain information necessary for the judgement on future surveys.

(2) In the central mineralization zone of the Kichi-Sandyk district, the ore body (vein-like skarn) is of low grade and a small scale, so it is not a worthy of mining if

independent. Accordingly, a necessity for further detailed survey in this zone is poor at present.

(3) In the Turpac-Tushty district, high-grade ore bodies are expected to present in the Turpac-Tushty and the Ak-Kamou ore manifestations. It is recommended to carry out the drilling survey to the deep from the surface manifestation and to confirm the actual state of mineralization. Priority of exploration for these manifestations is low because the ore reserves are estimated to be small.

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PART Ⅰ GENERAL REMARKS

CHAPTER 1 INTRODUCTION

1-1 Background and Purpose of Survey

In April 1996, the KYRGHYZALTYN, State Concern of the Kyrghyz Republic, requested cooperation for a mineral exploration survey on the Kichi-Sandyk area to the Japanese government through the State Commission of the Kyrghyz Republic on Foreign Investment and Economic Assistance. In response to this request, the Metal Mining Agency of Japan exchanged the Scope of Work concerning the mineral exploration survey for this area with the Kyrghyz Republic and the KYRGHYZALTYN in July 1997.

The purpose of the survey was to clarify the geological condition and occurrence of ore deposits in the area and to discover new ore deposits.

As the first year survey, the interpretation of satellite images, analysis of existing data and geological survey were carried out in fiscal year 1997. As a result, the following zones and manifestations were selected for promising districts : the central mineralization zone characterized by vein-like skarn within granodiorite porphyry mass in the Kichi-Sandyk district, the northern and the western mineralization zones characterized by layered skarn, and numerous ore manifestations in the Turpac-Tushty district.

1-2 Conclusion and Proposal of the First Year Survey

The interpretation of satellite images was carried out on an area of 800km^2 of the Kichi-Sandyk area in order to clarify the regional geological structure and the actual state of mineralization. Furthermore, geological surveys including trenching survey were carried out in the Kichi-Sandyk district (4 km^2) and the Kichi-Sandyk detailed survey area (0.9 km^2) in order to clarify the relationship between geology- geological structure and mineralization.

1-2-1 Conclusion of the First Year Survey

The conclusions of the first year survey were summarized as follows:

1) The interpretation of satellite images shows that lineaments and the spectral anomalies suggesting the existence of oxidized iron zone are concentrated in the central part of the Kichi-Sandyk area. From the regional viewpoint, the Kichi-Sandyk ore deposit is included in this wide promising area proposed by satellite images.
2) Many vein-like skarns accompanied with gold and copper mineralization were found

in the central mineralization zone of the Kichi-Sandyk ore deposit. These vein-like skarns have a strike of N45°-47° W and a dip of 56°-74° SW. The mineralized part observed on the surface extends to the deep along fracture for about 200 m in the strike direction and at least 100 m in the dip direction.

3) The layered skarns in the northern mineralization zone of the Kichi-Sandyk ore deposit were revealed to extend southwestwards for about 2 km along the boundary between granodiorite porphyry and limestone. These skarns are accompanied with high-grade copper and gold mineralization, and have a tendency to dip to the north.
4) The Turpac-Tushty ore manifestation, located 13 km south of the Kichi-Sandyk ore deposit, was revealed to be situated on the southernmost part of the promising area for exploration where is concentrated the spectral anomalies mentioned above. In addition, it is situated on the southern extension of the NNW-SSE lineament system which probably controlled the mineralization of the Kichi-Sandyk ore deposit. These facts as well as numerous ore manifestations observed on the surface suggest that it is a promising exploration area.

1-2-2 Proposal of the First Year Survey

The proposal for the second year survey based on the result of the first year survey is as follows:

1) Implementation of drilling survey in order to confirm the continuation of the central mineralization zone in the horizontal and vertical direction in the Kichi-Sandyk ore deposit and to clarify the actual state of the mineralization.
2) Implementation of drilling and trench surveys in the northern and the western mineralization zones of the Kichi-Sandyk district in order to clarify the distribution, structure and mineralization of the layered skarn along the boundary between limestone and granodiorite porphyry.
3) Implementation of geological survey for the Turpac-Tushty ore manifestation and promising areas around Kichi-Sandyk district.

1-3 Outline of the Second Year Survey

1-3-1 Survey Area

The survey area, which is about 800 km^2, is located in the westernmost part of the Kyrghyz Republic and situated in the Middle Tien-Shan Range. As for the administrative division, it belongs to Chatkal district, Alabuka region, Dzhalal-Abad State. It extends for about 27 km in the east-west direction, 30 km in the north-south direction (Fig.I-1).

The nearest village, Jany-Bazar, is about 200 km northwest of Dzhalal-Abad. There is an old exploration road (47 km in length) from the village to the survey area. There are two routes from Bishkek, the capital, to Dahalal-Abad: one which passes through Toktogul, Tash-Kumyr, Alabuka and the Chapchama pass (2,814 m in altitude), and the other which goes through Talas, Kirovskoye and the Kara-Buura pass (3,305 m). The distance from Bishkek is 800 km for the first route and 520 km for the second route. Although the first route is longer, it is open all year round. On the other hand, a large part of the second route is mountainous with passes over 3,000 m in altitude, viz. the Kara-Buura pass and others, having poor road conditions and closed during the winter.

1-3-2 Purpose of Survey

The second year survey was carried out according to the high priority items of the preceding year proposal.

1) Kichi-Sandyk District

In order to confirm the continuation of the central mineralization zone to the lower level and clarify the actual state of the mineralization, a drilling survey was carried out. Furthermore, to make clear the size and the structure of layered skarns in the northern mineralization zone, a geological survey and drilling and trenching surveys were carried out along the boundary between limestone and granodiorite porphyry as a target.

2) Turpac-Tushty Area

To confirm the geological structure of the area and the actual state of mineralization of many ore manifestations scattered in the area, a detailed geological survey on a scale of 1:10,000 was carried out.

1-3-3 Method of Survey

Method of the second year survey is as follows:

1) Drilling Survey

Drilling survey was carried out to clarify the actual state of mineralization of layered and vein-like skarns in the Kichi-Sandyk district. Since it is dangerous to transport machinery and materials across the superannuated bridge over the Chandalash River, the bridge was repaired and then used. Water for drilling could be secured in a valley, about 1 km north of the base camp, having a large quantity of water.

2) Geological Survey

In the Kichi-Sandyk district, four trenches totaling 500 m were made and a detailed geological survey was carried out for these trenches in order to clarify the actual state of mineralization of the layered skarn zone.

In the Turpac-Tushty district, a detailed geological survey on a scale of 1:10,000 was carried out in order to clarify the actual state of mineralization for the scattered ore manifestations and geological structure. As the route map, the topographic map which was enlarged to a scale of 1:5,000 was used. For the main ore manifestations, a more detailed survey was carried out in combination with a topographic survey on a scale of 1:2,000.

Table I − 1 Method and Contents of the Survey

1. Drillin Survey (Kichi-Sandyk district)

Hole No.	Length	Direction	Inclination
MJKK-1	107.8m	N13° E	-75°
MJKK-2	100.0m	N23° E	-75°
MJKK-3	124.6m	N13° E	-75°
MJKK-4	84.0m	N13° E	-75°
MJKK-5	100.0m	−	-90°
MJKK-6	210.0m	−	-90°
MJKK-7	93.0m	−	−
Total	819.4m		

2. Geologial Survey

District	Content	Volume
Kich-Sandyk	Trench Survey	500m
Turpac-Tushty	1/10,000 Route Mapping	Area 20km ^{2} Route Length 80km

3. Laboratory Studies

(unit:samples)

Method	Drilling Survey	Geological Survey	Total
Thin Section	10	20	30
Polished Thin Section	10	20	30
Fluid Inclusion	5	5	10
Chemical Assay (Au,Ag,Cu,Pb,Zn,Mo,As,Sb)	230	200	430
X-ray Diffration	10	20	30

1-3-4 Survey Team

A survey team was dispatched from July 7 to October 16, 1998. Only a member (geologist) was dispatched from July 7 to August 26, 1998.

The names of the members of the Japanese survey team and their counterparts in Kyrghyz are as follows:

Japan

NAKAMURA Kiyoshi (Head/General)	MINDECO *)
YAMASAKI Tatsuo (Geologist)	MINDECO
YAMAMOTO Nobuhiko (Drilling engineer)	MINDECO

Kyrghyz Republic

YARKOV Alexander V (Chief coordinator)	KYRGHYZALTYN
SAVCHENKO Gennady A. (Chief geologist)	KYRGHYZALTYN
DZHUMAGULOV Ryskul (Coordinator)	KYRGHYZALTYN
APOG Igor (Field coordinator)	KYRGHYZALTYN
NIKITIN Andrey (Geologist)	KYRGHYZALTYN
REZNICHENKO Gennady (Geologist)	KYRGHYZALTYN

*) Mitsui Mineral Development Engineering Co., Ltd.

1-3-5 Period of Survey

Period of the survey is shown in Table I-2

Table I -2 Period of the Survey

Items	1998						1999	
	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb
Field Survey	7			16				
Laboratory Works				20			29	
Making Report		27						26

CHAPTER 2 GEOGRAPHY OF THE SURVEY AREA

2-1 Topography and Drainage System

The Tien-Shan Mountains are divided into three parts : Northern, Central and Southern. Our survey area is located in the southern part of the Central Tien-Shan Mountains. In the north of our survey area are Pskem Mountains, which are the border with Uzbekistan and the watershed of the area, running from southwest to northeast.

The surveyed area is on the southern side of Pskem Mountains with the altitude between 2,600m and 3,000m. Mineral showings are distributed at the altitude between 2,800m and 2,950m. General topography of the area is a near flat plateau with slight ups and downs and sharply eroded valleys. The largest river in the area is Chatkal River, which originates in the Chandalash and Chatkal Mountains and runs from north-east-east to south-west-west.

2-2 Climate and Vegetation

Most part of the survey area lies between 2,000m and 3,000m in altitude, and its climate is of high mountain. The coldest month of the year is January with the temperature as low as -40 degrees Celsius, and the warmest month is August with the temperature higher than 28 degrees. Daily fluctuation of the temperature is great, which is typical for the inland area. The winter is cold with heavy snowfalls. The first snow of the season falls in the beginning to the middle of October, and the annual precipitation amounts to 740mm-1200mm. The average monthly temperature of the survey area (3,000m in altitude) is shown in Table I -2. The areas with mineral showing, which are about 2,800m in altitude, have poor development of soils with little vegetation - just some grasses and Alpine plants. Development of foliage, mainly bushes with some broadleaf trees such as white birch and poplars and conifers similar to pines, is seen only along the rivers at the altitude lower than 2,000m.

Table I -3 Temperature & Humidity in the Kichi-Sandyk Area

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ave. Temp (°C)	-19.5	-15.7	-8.0	-0.8	3.8	6.6	9.1	8.4	4.1	-2.1	-11.0	-17.8
Humidity*	60%	-	-	-	-	-	22%	-	-	-	-	-

* : relative humidity(%)

CHAPTER 3 GENERAL GEOLOGY

3-1 General Geology of the Survey Area

The survey area is situated in the western Kyrghyz, or west of the dividing Talas-Fergansky fault, within the Middle Tien-Shan folding zone of the Hercynian folding system which extends from the central Kyrghyz to the western Kyrghyz. It lies on the southern slopes of Pskem Mountains.

The Middle Tien-Shan folding zone lies between Northern Tien-Shan folding zone of the Caledonian folding system and Southern Tien-Shan folding zone of the Hercynian folding zone. By middle Proterozoic (Ripheian) it is believed that the geosyncline had been formed to produce land at least partially. In this area, the Middle Proterozoic groups consisting mainly of glacial sediments, volcanic rocks and carbonaceous sediments and the Paleozoic groups consisting of flysch, terrigenic and volcanic sediments are underlain as the basement rocks, and the Cenozoic of lake sediments and molasse lies on top of them.

Various types of igneous activities in Kyrghyz, such as the ones caused by subduction of the plate and alkaline magma of the inner continent, are known to have existed from Proterozoic era to the late Paleozoic era. In the survey area, granite of late Paleozoic (Carboniferous and Permian) is distributed among the basement rocks. Major geological stratigraphy in the Kichi-Sandyk area is shown below. A regional tectonic map is shown in Fig. I -3-1 and a schematic geological column is shown in Fig. I-3-2, respectively.

3-2 Characteristics of gold mineralization in the Survey Area

In the survey area including Kichi-Sandyk deposit, Skarn has been often formed at the contact between the Lower Carboniferous limestone and the Carboniferous and Permian intrusive rocks such as diorite, granodiorite, monzonite and granodiorite porphyry. Mineralization of copper-gold, antimony, tungsten and molybdenum are observed in the skarn. It is suggested that the skarn related with early Permian granodiorite porphyry (Chalmansay complex) contains gold with higher quality than that with the Chandalash-Chatkal complex.

Two ore showing areas of Kichi-Sandyk and Turpak-Tushty are identified as promising for copper-gold deposits in this area. Furthermore, several ore showings have been also entrapped. According to the results of the previous explorations by the Kyrghyz, 200 tons of gold (140t in Kichi-Sandyk district and its surrounding areas) and 350 thousand tons of copper have been assessed as the potentials for this area.

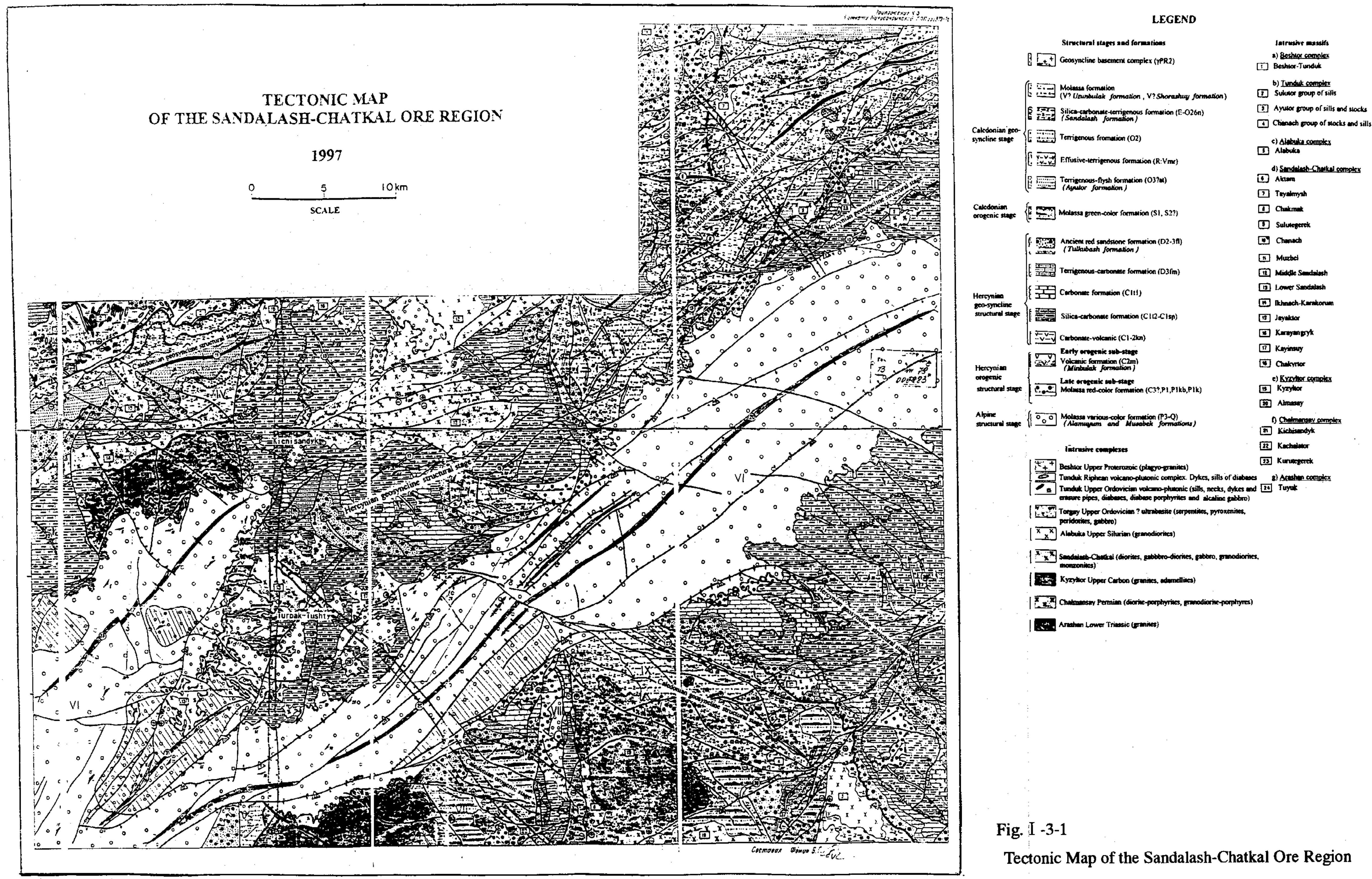

Fig. I -3-1

Tectonic Map of the Sandalash-Chatkal Ore Region

Age			Formation	Lithology
Cenozoic	Quaternary	Pleistocene		alluvium
		Holocene		terrigenic sediments
	Tertiary	Neogene	Alamuyum/Musabek	terrigenic sediments
Paleozoic	Permian			
	Carboniferous	upper		
		middle	Minbulak	andesite, trachyandesite, tuff
		lower/middle		molasse, limestone
		lower		limestone, silt
				limestone, silt, dolomite, slate
				silt, limestone, dolomite
	Devonian	upper		limestone, marl
		lower/middle	Tulkubash	conglomrlate, sandstone
	Ordovician	upper/middle	Ayutor	sandstone, shale
		middle	Chandalash	shale, limestone, dolomite
	Cambrian	lower	Chandalash	shale, limestone, dolomite
Proterozoic	Vendian	upper	Shorashuy	mudstone, carbonate rock
			Mursash	tuff, shale, trachybasalt, trachyandesite, sandstone
	Ripheian	middle	Uzunbulak	sandstone, silt, shale

Fig. I -3-2 Schematic Geologic Column of the Survey Area

CHAPTER 4 COMPREHENSIVE ANALYSIS

4-1 Kichi-Sandyk District

4-1-1 Characteristics of geological structure and mineralization

1) Geology

The geology of Kichi-Sandyk district mainly consists of crystalline limestone of Late Cambrian to Early Carboniferous (Visean) age and the Permian granodiorite porphyry (Chalmansay complex) intruding the limestone. Conglomerate of unknown age covers all of the above rocks.

2) Geological structure

The contact plane between calcareous sediments and granodiorite porphyry gently dips north or west and layered skarns often occur near the contact.

Topographic feature indicates the presence of parallel faults trending NW- SE. A number of fissures and joints which have the same trends and a steep southward dip were developed in the central mineralization zone. Cu-Au-bearing vein-like skarns were formed along these fractures.

3) Mineralization

(1) Types of mineralization

Two types of mineralization described below are recognized in the survey district.

① Endoskarn: As mentioned above, a number of fissures and joints striking NW -SE and steeply dipping SW were formed within granodiorite porphyry. These endoskarns occur in the central mineralization zone and, also, below the layered skarns in the northern mineralization zone.

② Exoskarn: Layered skarns were formed in limestone at the contact with intrusives. This type of skarn occurs in the northern mineralization zone.

(2) Size of ore body

Width of each vein-like skarns is in an order of 10～100 cm and they form together several Au-Cu ore bodies with the width of a few meters to a maximum of 25 m. Ore bodies seem to be of stockwork type as a whole, trending NW-SE parallel to the major fracture system. The extent of the central mineralization zone as an aggregate of Au-Cu ore bodies is presumed to be 300 m by 300 m. The downward extension of the mineralization zone is inferred to be in an order of 10-20 m with maximum of 30 m.

Outcrop of the layered skarns extends intermittently for 2 km in the NW-

SE direction along the contact of limestone and granodiorite porphyry. The layered skarns are presumed to continue to a considerable depth and their width is in an order of 10-20 m.

(3) Model of mineralization

From the above-mentioned facts, the following model on the mineralization of this district is proposed.

① As a result of intrusion of the granodiorite porphyry into the limestone, layered skarns were formed along the contact plane. At the same time, the vein-like skarns were formed along the fractures of the NW-SE system in the granodiorite porphyry, mostly within the distance of 10～20 m from the contact plane.

② Ore solution passed along the fractures of the NW-SE system and deposited copper and gold ores in the pre-existing skarns.

③ The Kichi-Sandyk district was then tectonically deformed and was divided into small blocks by thrust faults.

④ In the central mineralization zone, the vein-like skarns were exposed on the surface due to intense erosion of limestone which was lying on the intrusives with gently dipping boundary. Reconcentration of copper and gold by meteoric water led to the formation of a secondary enrichment zone characterized by green copper minerals at shallow depth.

4-1-2 Potential for ore deposits

1) Central mineralization zone

The results of the drilling survey show that the underground mineralization is weaker than the surface mineralization (3 ore bodies; total 4,944 ㎡, 1.94 g/t・Au) srevealed by the last year's trenching survey.

- Potential ore reserves and grade

  (Ore reserves) Area 4,944 m^2 × Depth 30 m × Specific gravity 2.6

  =385,630 t

  (Gold content) Ore reserves 385,630 t × Grade 1.94 g/t= 748 kg

2) Northern mineralization zone

Though the grade of layered skarns is presumed to be 1-2 g/t Au, there is the possibility of existence of high-grade ore bodies because the previous exploration was done in a very limited area of the vast mineralization area.

Since the ore body of this type is a gently dipping stratiform, underground mining method will probably be adopted in case of mining. Considering poor infrastructure of this district for the transportation and electric power, the mineable ore grade is required to be at least 6-8 g/t Au

- Potential ore reserves and grade

(Ore reserves) Thickness 10 m × Width 100 m× Length 1,500 m ×
Specific gravity 2.6 × Percentage of existence 20% = 780,000 t

(Gold content) 780,000 t × 1 g/t= 780 kg Au (in case of 1 g/t Au)
780,000 t × 2 g/t= 1,560 kg Au (in case of 2 g/t Au)
780,000 t × 6 g/t= 4,680 kg Au (in case of 6 g/t Au)

4-2 Turpac-Tushty District

4-2-1 Characteristics of geological structure and mineralization

1) Geology

The Carboniferous limestone and the Carboniferous to Permian intrusive rocks such as granodiorite and diorite are widely distributed in the survey area. Tertiary sediments cover all these rocks.

2) Geological structure

The limestone occurs as a roof on the intrusive rocks.

A prominent fault of the NE-SW direction runs from the Turpac-Tushty ore manifestation to the Ak-Kamou ore manifestation resulting in considerable displacement of Tertiary sediments. The faults trending E-W and N-S are also recognized.

The NW-SE lineament extending from the Kichy-Sandyk district was selected by satellite image analysis in the first year. The results of this year's survey show that a series of small diorite stock intruded along the above lineament but no significant fault was found.

3) Mineralization

A number of ore manifestations are distributed in the survey area. Major ore manifestations are located in Turpac-Tushty, Ak-Kamou, Kok-Kaiky, Jety-Zinden, Perevalnoe and Bismutovoe.

Mineralization in the district is classified into the following three types.

① Skarn-type mineralization: Skarns occur along the contact of limestone roof and intrusives with 5-30 m thickness. They are composed of garnet, clinopyroxene, and wollastonite, and accompanied with gold-copper mineralization and, in part, polymetalic mineralization. These ore manifestations are widely distributed on the surface. However, its thickness is thin and metal grade is low, so it is hard to expect a promising mineral deposit.

② Vein-type mineralization: Gold-copper mineralization occurs in association with major faults of NE-SW trend and subordinate faults of ENE-WSW trend. Pyrite-quartz-sericite vein (so-called beresitized vein) and hematite-quartz vein, both in association with the faults of ENE-WSW trend, as well as the breccia-like veins in association with fault-fracture zone of NE-SW trend often accompany a copper-gold mineralization. Vein-type ore manifestation is characterized by beresitized vein or hematite-quartz vein where high-grade ores over 10 g/t Au are often detected.

③ Placer-type mineralization: Placer gold deposits occur in Tertiary conglomerate and Quaternary sand and gravel beds. The latter is said to have been mined long ago.

4-2-2 Potential for ore reserves

As a result of this survey, it is concluded that small but high-grade vein-type ore deposits may be expected in both the Turpac-Tushty and the Ak-Kamou ore manifestations.

Kyrgyzstan side has previously estimated 695,000 t of possible ore reserves (P1) with 2.9 t Au (average grade: 4.22 g/t) for the Turpac-Tushty ore manifestation. In this survey, it is not sufficient up to now to make an estimation of the potential ore reserves. If assuming that the potential ore zone in the Turpac-Tushty ore manifestation has 2 km length, 2 m width, 100 m depth, 5 g/t Au and 30% rate of existence, 0.7 t of gold reserves may be estimated.

We recommend that further exploration to confirm potential of ore reserves be conducted.

CHAPTER 5 CONCLUSIONS AND RECOMMENDATIONS

5-1 Conclusions

The Kichi-Sandyk district was selected as a promising area for the gold-copper ore deposits on the basis of the past Kyrghyz-side survey results. The potential ore reserves (C2+P1) in the central and the northern mineralization zones of the district were estimated in all to be 33 tons of gold (average Au-grade: 3.85g/t). However, the result of the present two-year survey shows that the potential ore reserves in the central mineralization zone do not exceed 1 ton of gold and the possibility of the existence of promising gold deposits in the zone is rather low. On the other hand, the potential ore reserves in the northern mineralization zone are revealed to be only about 1 ton of gold but there remains in this zone a possibility that the high-grade gold ore exists along the ore-bearing horizon which is assumed to occur in a wide area.

In the Turpac-Tushty district, possible ore reserve (P1) of 695 thousand tons and gold quantity of 2.9 tons (average Au-grade: 4.22g/t) were estimated by the Kyrghyz side. The result of the second year survey confirms an existence of high-grade ores at the Turpac-Tushty and the Ak-Kamou ore manifestations and suggests a possibility that the high-grade ore bodies, even though of a small scale, exist in both the manifestations.

5-2 Recommendations for the PhaseIII Survey

(1) In the northern mineralization zone of the Kichi-Sandyk district, the skarn ore body (layered skarn) is inferred to continue to the deep. It is recommended to clarify the extent of the mineralization zone by the drilling survey to the deep in the northwestern direction and to confirm the possibility of the existence of the high-grade ore in order to obtain information necessary for the judgement on future surveys.

(2) In the central mineralization zone of the Kichi-Sandyk district, the ore body (vein-like skarn) is of low grade and a small scale, so it is not a worthy of mining if independent. Accordingly, a necessity for further detailed survey in this zone is poor at present.

(3) In the Turpac-Tushty district, high-grade ore bodies are expected to present in the Turpac-Tushty and the Ak-Kamou ore manifestations. It is recommended to carry out the drilling survey to the deep from the surface manifestation and to confirm the actual state of mineralization. Priority of exploration for these manifestations is low because the ore reserves are estimated to be small.

PART II PARTICULARS

CHAPTER 1 KICHI-SANDYK DISTRICT

1-1 Drilling Survey

1-1-1 Purpose of Survey

In this fiscal year, seven holes (MJKK-1 to 7), 819.4m in total, were drilled in the Kichi-Sandyk district. Among these, MJKK-1 to 4 were drilled for copper-gold-bearing vein-like skarn zones in granodiorite of the central mineralization zone as a exploration target. MJKK-5 to 7 were drilled for layered skarn zone around the contact of granodiorite and limestone in the northern mineralization zone as a target.

1-1-2 Method of Survey

1) Outline of Work

(1) Seven holes were drilled for a total of 819.4 m

(2) Three drilling machines, CKB-40, CKB-41E and CKB-5E, which were made by Russian, were used. Bulldozers, cranes and large trucks were used for road construction, drilling sites leveling and preparation, and transportation and setting up of drilling machines. The drilling operation was performed in two 12-hour shifts in principle. Locations of the drilling points are shown in Fig, II-1-1.

(3) A wire-line drilling method was used for the improvement of the core recovery and the work progress. For the surface soil drilling, metal crowns of 93mm, 112mm and 132mm and diamond bit of 93mm NQ-WL were used. After reaching the bedrock, the drilling was conducted by diamond bit of 93mm NQ-WL to the hole bottom.

(4) Water for the drilling works was conveyed by two 3m^3 tank trucks from the nearest valley, 1.1km northeast of the camping site.

2) Drilling Work

The drilling work lasted for 102 days from July 7 to October 16, 1998. The drilling length, core recovery and drilling efficiency are given by each hole in Table II-1-1. The main equipment used, results of the work, and consumption of drilling articles and diamond bits used are listed in Appendix 14 to 18.

1-1-3 Results of Survey

The results of drilling survey conducted in the central mineralization zone of the Kichi-Sandyk district show that copper-gold-bearing vein-like skarns occur within granodiorite in the deep but the grade of skarnization is lower than that observed on the

Table II-1-1 General Results of Drilling Works

Item		MJKK-1	MJKK-2	MJKK-3	MJKK-4	MJKK-5	MJKK-6	MJKK-7	Sub total
Period of drilling									
Starting date		24 Jul.'98	18 Sep.'98	30 Jul.'98	17 Sep.'98	26 Aug.'98	31 Aug.'98	1 Sep.'98	
Finishing date		25 Aug.'98	1 Oct.'98	30 Aug.'98	1 Oct.'98	17 Sep.'98	29 Sep.'98	16 Sep.'98	
Total days		32.5	13.5	31.5	14.5	22.0	29.5	16.0	159.5
Drilling machine		CKB-5E	CKB-5E	CKB-4D	CKB-4D	CKB-5E	CKB-41E	CKB-4D	
Direction		N13°E	N23°E	N13°E	N13°E	-	-	-	
Inclination		-75°	-75°	-75°	-75°	-90°	-90°	-90°	
Length of drilling(m)		107.8	100.0	124.6	84.0	100.0	210.0	93.0	819.4
Length of core(m)		102.3	97.05	118.3	80.8	94.75	200.75	90.9	784.85
Core recovery(%)		94.9	96.9	94.9	95.6	94.4	95.6	97.6	95.6
Bit	φ132mm	-	2.0m	-	4.8m	-	-	11.5m	18.3
	φ112mm	1.5m	0.5m	1.0m	-	2.4m	1.0m	4.6m	11.0
	φ 93mm	0.8m	0.8m	1.2m	12.4m	-	15.3m	-	30.5
	NQ	105.5m	96.9m	122.4m	67.3m	98.0m	193.7m	77.0m	760.8
Casing	φ127mm	-	-	-	4.8m	2.4m	-	13.0m	20.2
	φ108mm	1.5m	17.0m	1.0m	-	24.0m	1.0m	-	44.5
	φ 89mm	-	53.0m	3.8m	32.0m	48.0m	30.0m	56.0m	222.8
Drilling(day)*		28.5	13.5	30.5	14.5	22.0	29.5	16.0	154.5
Drilling(day)**		32.5	13.5	31.5	14.5	22.0	29.5	16.0	159.5
Efficiency(m/day)*		3.8	7.4	4.1	5.8	4.6	7.1	5.8	5.3
Efficiency(m/day)**		3.3	7.4	4.0	5.8	4.6	7.1	5.8	5.1

* working days

** including no-working days for regain of accident and others surface and ore minerals are present only in a small amount. Gold grade of the drill cores is generally lower (<1 g/t) than that on the surface, with an exception of 1.2 g/t for 8m along MJKK-2 hole.

The results of drilling survey conducted in the northern mineralization zone of the Kichi-Sandyk district show that garnet skarn with copper and gold ores occurs as a gently dipping layer between granodiorite porphyry and limestone and, furthermore, copper-gold-bearing vein-like skarns occur within granodiorite in the deep. Gold grade is generally low (<1 g/t) with an exception of 35.8 g/t for calcite vein, 30cm in width, which penetrates skarnized granodiorite porphyry along MJKK-5 hole.

Core samples for assay were collected at an interval of 1m in principle from the rocks having any indication of mineralization such as skarn and ore minerals. These samples, 231 in total, were cut into pairs of half-core, then half cores were analyzed and the other half cores were preserved in the core case. Chemical analysis was performed for eight components (Au, Ag, Cu, Pb, Zn, Mo, As, Sb) by the Alex Stewart (Assayers) Kyrghystan Ltd.

Location map of drillholes and trenches, geologic core log of the drillings, summary of core log and geological cross sections along drillholes are shown in Fig. II-1-1, Appendix 11, Fig. II-1-5 and Fig. II-1-6(1)~(6), respectively.

1) Geology and mineralization of each drillhole

(1) MJKK-1 hole (direction 13 °, inclination -75 °, drilling length 107.8m)

(a) Geology

Granodiorite porphyry accompanied with vein-like skarns occurs from the mouth of the hole to the bottom, 107.8 m in depth. Granodiorite porphyry underwent silicification and skarnization in general.

(b) Alteration

Vein-like skarns occur along fissures filled with calcite, and is generally of small scale with a maximum width of 1.9 m. Granodiorite porphyry is strongly silicified especially from the mouth of the hole to the depth of 50 m, so that the identification of the original rock is difficult for this part. Granodiorite porphyry is more or less crushed in general. Particularly, cores between 80.2 m and 83.8 m in depth and between 103.6 m and the bottom, 107.8 m in depth, are strongly crushed into a size of sand or clay.

(c) Mineralization

A very small amount of green copper minerals is observed in crushed granodiorite porphyry at the depth of 7.0 m. Under the microscope, a very small amount of pyrite and chalcopyrite is observed in silicified garnet skarn at the depth of 94.2 m. Gold is detected only for 3 samples from weakly skarnized and strongly silicified granodiorite porphyry with Au-grade=0.2 g/t.

(2) MJKK-2 hole (direction 23 °, inclination -75 °, drilling length 100.0m)

(a) Geology

Granodiorite porphyry accompanied with vein-like skarns occurs from the mouth of the hole to the bottom, 100.0 m in depth.

(b) Alteration

Vein-like skarns occur between 16.8 m and 25.0 m in depth and between 75.2 m and 88.2 m in depth, and are mainly of fine-grained garnet skarn. Within these skarns, steeply dipping fractures filled with calcite vein are observed. Silicification is generally weak except for some parts of the above-mentioned skarns where are observed silicification zones of 2 m to 4 m width. Granodiorite porphyry and vein-like skarns were crushed into a size of granule as a whole, and especially, those between 32.3 m and 38.3 m in depth (6.0 m length) and between 55.6 m and 68.4 m (12.8 m length) were strongly crushed into a size of sand.

(c) Mineralization

Green copper minerals are observed at the depth of 13.0 m, 60.2 m, 69.7 m, 71.2 m and between 84.2 m and 86.8 m in depth. Assay result shows 1.18 g/t Au-grade for vein-like skarn between 83.2 m and 91.2 m in depth with highest Au-grade of 3.47 g/t between 85.2 m and 86.2 m in depth, and 0.90 g/t Au-grade for vein-like skarn between 21.8 m and 23.2 m in depth.

(3) MJKK-3 hole (direction 13 °, inclination -75 °, drilling length 124.6m)

(a) Geology

Granodiorite porphyry accompanies with vein-like skarns occurs from the mouth of the hole to the bottom, 124.6 m in depth.

(b) Alteration

Main vein-like skarns occur between 99.9 m to 104.8 m in depth and between 112.8 m and 119.6 m in depth. Besides these, ten or more small vein-like skarns with 1 m to 2 m width occur at various depths. These vein-like skarns are mainly of fine-grained garnet skarn. Within these skarns, steeply dipping fractures with filled with calcite veins are observed. Silicification is observed between 32 m and 49 m in depth, between 56 m and 61 m in depth, and between 104 m and 113 m in depth.

Granodiorite porphyry and vein-like skarn between 36.4 m and 39.4 m in depth, between 89.6 m and 90.6 m in depth and between 121.2 m and 121.4 m in depth were strongly crushed into a size of granule or sand, although the crushed part occupies a comparatively lower proportion than that of MJKK-1 and MJKK-2 holes.

(c) Mineralization

Green copper minerals are observed at the depth of 17.6 m and around 30 m, 53 m and 88 m in depth. Assay result shows 0.50 g/t Au-grade for 2.0 m between 28.8 m and 30.8 m in depth and 0.55 g/t Au-grade for 4.2 m between 50.0 m and 54.2 m within skarn or skarnized granodiorite porphyry bearing visible green copper minerals.

(4) MJKK-4 hole (direction 13 °, inclination -75 °, drilling length 84.0m)

(a) Geology

Detritus composed of gravel of granodiorite porphyry and skarn occur from the mouth of the hole to the depth of 29.8 m. From the depth of 29.8 m granodiorite porphyry continues to the bottom, 84.0m in depth. Vein-like skarns are only locally observed.

(b) Alteration

Five or more vein-like skarns are observed for 15.5 m between 29.8 m and 45.3 m in depth. These skarns, maximum 15 cm in width, occur along gently dipping (20 ° to 30 °) fractures filled with calcite and/or quartz. Silicification is weak in general, but strongly silicified parts are observed for about 3 m around the depth of 31 m, for 2 m around the depth of 43 m and for 5m between 43.5 m and 48.5 m in depth. Drill cores were more or less crushed in general. Especially between 45.3 m in depth and the bottom of the hole, cores were mostly crushed into a size of sand and granule.

(c) Mineralization

Green copper minerals are not visible. Assay results show gold grade is generally low except for 0.10 to 0.38 g/t Au-grade for 3.1 m between 39.5 m and 42.6 m in depth around vein-like skarn accompanied with quartz vein.

(5) MJKK-5 (direction — , dip-90 °, drilling length 100.0 m)

(a) Geology

White crystalline limestone occurs from the mouth of the hole to the depth of 25.2 m, and granodiorite porphyry does from 25.2 m to the bottom with a xenoblock of crystalline limestone for 2.4 m between 71.8 m and 74.2 m in depth. The limestone in the shallow is strongly crushed but not skarnized. The limestone xenoblock is accompanied with skarn, 1.9 m in width, on the lower side. Near the boundary between limestone and granodiorite porphyry at the depth of 25.2 m, any crushed part or fault clay is not observed and nearby granodiorite porphyry is skarnized.

(b) Alteration

Within the skarnized granodiorite porphyry near the contact with limestone at the depth of 25.2 m, skarn minerals such as garnet, wollastonite and clinopyroxene are observed under the microscope (K5-25.9). Vein-like skarns accompanied with calcite vein, dipping in various degree (10 °~75 °), occur for 10.4 m between 29.1 m and 39.5 m in depth. Fine-grained skarn immediately under the limestone xenoblock (K5-74.7) consists mainly of garnet, clinopyroxene and calcite, and subordinately of actinolite, pyrite and hematite. Silicification is only observed for 1.0 m between 25.2 m and 26.2 m within granodiorite porphyry immediately under the limestone xenoblock. Drill cores are crushed in general and, especially for 1.1 m between 16.3 m and 17.4 m in depth, for 13.4 m between 58.4 m and 71.8 m in depth and for 12.9 m between 87.1 m in depth and the bottom, 100.0 m in depth, cores are strongly crushed into a size of sand, clay and, partly, granule.

(c) Mineralization

Green copper minerals are observed between 25.2 m and 40 m in depth within granodiorite porphyry and vein-like skarns. Near the depth of 52 m, a very small amount of green copper minerals are also observed. Assay result shows a high-grade gold of 35.77 g/t for 0.3 m between 35.9 m and 36.2m in depth within calcite vein cutting granodiorite porphyry. Average grade of mineralized part including the above-mentioned high-grade ore is 1.05 g/t for 13.0 m between 25.2 m and 38.2 m in depth.

(6) MJKK-6 hole (direction — , inclination -90 °, drilling length 210.0 m)

(a) Geology

Detritus composed mainly of white crystalline limestone gravel and subordinately of skarn gravel occur from the mouth of the hole to the depth of 16.3 m. After reaching the bedrock, granodiorite porphyry occurs between 16.3 m and 66.2 m in depth, brecciated white crystalline limestone between 66.2 m and 95.9 m in depth, a thin clay bed containing gravel of granodiorite porphyry and limestone between 95.9 m and 96.6 m in depth, and conglomerate between 96.6 m in depth to the bottom, 210 m in depth.

The conglomerate consists mainly of limestone gravel and subordinately of sandstone, granodiorite porphyry and skarn gravel. Most of this gravel is round to subround, ranging from 3 cm to 20 cm across, and some gravel is angular, ranging from 1 cm to 3 cm across. Matrix of the conglomerate is calcareous and its relative content to the conglomerate markedly varies from 10 % to 95 %. In the shallower depth than 140 m, gravel occupies more than a half of conglomerate but in the deeper than 140m matrix occupies more than a half of conglomerate. For 3.0 m between 207.0 m and 210.0 m in depth, the conglomerate consists mainly of biogenic (?) calcite and weathered biotite and subordinately of quartz and pyrite, and this facies may represents a basal part of the conglomerate lying immediately upon the granodiorite porphyry.

(b) Alteration

A few vein-like skarns are observed between 16.3 m and 66.2 m in depth within granodiorite porphyry along the gently dipping fissures filled with clay and calcite. Brecciated white crystalline limestone is sporadically skarnized between 66.2 m and 95.9 m in depth. Silicification is only observed for about 2 m near the depth of 17 m and for about 4 m near the depth of 51 m. Drill cores are crushed between 25 m and 30 m, and strongly crushed into a size of sand between 56 m and 64 m. The shallow part of the hole, where was presumed to exist a layered skarn, is revealed to be made up not of bedrock but of detritus, suggesting the possibility that the ore zones were excavated out in the past.

(c) Mineralization

A very small amount of green copper minerals is observed around the depth of 55 m. Assay results show that the gold grade is generally low in this hole with the exception of 0.23 g/t Au for 1m between 36.8 m and 37.8 m in depth within vein-like skarn associated with calcite vein, 20c m in width. On the other hand, silver grade attains 30.0 g/t for 1.9 m between 94.7 m and 96.6 m in the crushed zone of limestone which corresponds to the thrust fault under the limestone, even though the ore minerals are not visible in this zone.

(7) MJKK-7 hole (direction —, inclination -90 °, drilling length 93.0m)

(a) Geology

Detritus composed mainly of white crystalline limestone gravel and subordinately of clay occur from the mouth of the hole to the depth of 23.2 m.

After reaching the bedrock, white crystalline limestone accompanied with skarn occurs between 23.2 m and 59.6 m, and granodiorite porphyry between 59.6 m and the bottom.

(b) Alteration

Layered skarns are found for 4.8 m between 42.5 m and 47.3 m in depth, for 1.1 m between 50.2 m and 51.3 m in depth and for 0.6 m between 56.2 m and 56.8 m in depth. Limestone occurring between 24.4 m and 42.5 m in depth are also slightly skarnized. These skarns are composed mainly of wollastonite and garnet and subordinately of clinopyroxene and actinolite (K7-34.7, K7-37.6, and K7-38.8). Within granodiorite porphyry, skarnization is not observed. Silicification is only observed on a some degree around the depth of 50 m. Crushing of drill cores are weak in general, but limestone for 0.6m between 52.5 m and 53.1 m in depth and for 1.1 m between 58.5 m and 59.6 m in depth and granodiorite porphyry for 1.8 m between 91.2 m in depth and the bottom of the hole are crushed into a size of granule.

(c) Mineralization

A very small amount of pyrrhotite and oxidized pyrite which are visible with the naked eye and chalcopyrite which is observed under the microscope occur at the depth of 34.7 m (K7-34.7). Assay results show that the gold grade is generally low in this hole with the exception of 0.16 g/t Au for 2 m between 28.4 m and 30.4m in depth within weakly skarnized limestone.

2) Homogenization temperatures measurement of fluid inclusions

The results of measurement for homogenization temperatures are shown in Appendix 6 and 7. Measured samples from the Kichi-Sandyk district (No.1～6) are calcite(3 samples) and quartz(3 samples), which are collected from drill cores of vein-like skarn within granodiorite porphyry.

Average homogenization temperatures is, in an increasing order, 121°C, 128°C and 214°C for calcite and 200°C, 273°C and 281°C for quartz, respectively. Generally, formation temperatures of vein-type Au-Ag ore deposits are estimated to be between about 100°C and 250°C (Iiyama, 1989). Accordingly, these drillholes are thought to correspond to the temperature range appropriate for the formation of gold ore deposit with the exception of the high temperature zone (>250°C) under about 100m in depth for MJKK-3 hole and of all the depth for MJKK-4 hole. It is generally pointed out that the homogenization temperatures for calcite have a tendency to be lower than quartz. If only the homogenization temperatures for quartz are cited, these drillholes represent rather high temperatures such as 273°C and 281°C, suggesting a possibility that these ore deposits correspond to deeper level of mineralization zone.

3) Assay results of ore grade

Chemical analysis of eight elements (Au, Ag, Cu, Pb, Zn, Mo, As, Sb) was carried out for ore samples, totaling to 231 samples, collected from drill cores. Result of the analysis is shown in Appendix 8 and it is summarized in Table II-1-2 for layered skarn derived from limestone (53 samples) and for vein-like skarn within granodiorite porphyry (178 samples), separately.

Concerning the correlation between Au and Ag, only the samples having a content more than the detection limit were used. Among analytical results, high-grade ore sample (35.77 g/t Au: 8K-510) for 0.3 m between 35.9 m and 36.2 m along MJKK-5 hole is regarded as an anomaly from the viewpoint of statistics, so the correlation coefficients for the analyzed elements were obtained from 177 samples excluding this anomalous sample.

Average gold grade of 178 samples from vein-like skarns within granodiorite porphyry is so low as 0.34 g/t. High-grade ore (Au: 35.77 g/t, Ag: 70.8 g/t, Cu: 27.55 g/t) was found for a calcite vein within granodiorite porphyry along MJKK-5 hole (8K-510). In addition, gold grade higher than 1 g/t was detected for 3 samples from MJKK-2 hole (1.25 g/t for 8K-236, 2.06 g/t for 8K-239 and 3.47 g/t for 8K-249). Gold grades of all other samples are lower than 1 g/t

Average gold grade of 53 samples from layered skarns within limestone is so low as 0.03 g/t. Silver grade is generally low with the exception of 30 g/t (8K-648) for 1.9 m along MJKK-6 hole which corresponds to the crushed part of limestone by thrust fault.

For the vein-like skarn within granodiorite porphyry, high positive correlation (0.842) exists between Cu and Zn about 177 samples. For the layered skarn, somewhat high positive correlation (0.767) is obtained between Cu and Zn. Between other elements, striking correlation is not recognized.

Table II-1-2 Summary of Assay Result of Boring Core in the Kichi-Sandyk District

1) Vein-like Skarn of Drilling Core in the Kichi-Sandyk District

	Au	Ag	Cu	Pb	Zn	Mo	As	Sb
	g/t	g/t	%	ppm	ppm	ppm	ppm	ppm
Sample Number	178	178	178	178	178	178	178	178
Max.	35.770	70.800	0.2755	90.94	1216.00	29.87	451.70	44.00
Min.	<0.03	<0.4	0.0001	<1.4	6.96	<0.2	<1.5	<1.0
Ave.	0.343	0.866	0.0040	10.05	76.47	1.74	25.53	1.29

Correlation coefficient	Ag	Cu	Pb	Zn	Mo	As	Sb
Au	-0.060	0.272	-0.091	0.078	-0.069	0.029	-0.085
Ag		-0.012	0.065	0.056	0.409	-0.112	-0.013
Cu			0.065	0.842	-0.074	-0.049	0.229
Pb				0.099	0.074	-0.060	0.144
Zn					-0.025	-0.058	0.259
Mo						-0.058	-0.012
As							0.392

Except Sample No. 8K510 (Au : 35.77 g/t, Ag : 70.8 g/t)

*) Sample Number (pieces); Au-Ag : 25, Au-x : 112, Ag-x : 29, Others : 177

2) Layered Skarn of Drill Core in the Kichi-Sandyk District

	Au	Ag	Cu	Pb	Zn	Mo	As	Sb
	g/t	g/t	%	ppm	ppm	ppm	ppm	ppm
Sample Number	53	53	53	53	53	53	53	53
Max.	0.200	30.000	0.0137	57.64	282.00	1.36	64.66	2.95
Min.	<0.03	<0.5	0.0002	<3.5	5.95	<0.5	<1.5	<2.5
Ave.	0.026	0.931	0.0033	7.65	62.25	0.44	9.90	1.37

Correlation coefficient	Ag	Cu	Pb	Zn	Mo	As	Sb
Au	#DIV/0!	0.618	0.032	-0.089	-0.389	-0.211	-0.235
Ag		1.000	1.000	1.000	1.000	1.000	#DIV/0!
Cu			-0.013	-0.082	0.147	0.270	-0.014
Pb				0.767	-0.169	0.245	0.023
Zn					-0.364	0.225	-0.094
Mo						-0.186	0.107
As							-0.088

*) Sample Number (pieces); Au-Ag : 1, Au-x : 9, Ag-x : 2, Others : 53

***) Assay result of Au and Ag less than assay limit are excluded in calculaion for correlation coefficient.**

1-2 Geological Survey

1-2-1 Purpose of Survey

In order to clarify the geological structure of the layered skarn formed between limestone and granodiorite porphyry and the actual state of mineralization in the Kichi-Sandyk district, trenching survey for 4 trenches, totaling 500 m in length, was carried out together with the drilling survey (MJKK-5 to 7) described in the preceding section.

1-2-2 Method of Survey

Trenches were excavated by bulldozers at first, and thereafter detritus were removed by manpower in principle until the bedrock crops out. Where the indications of mineralization such as skarns and ore minerals were observed, assay samples were collected at intervals of 1 m in principle by means of trench sampling. In addition, geological survey and assay sampling were carried out along the road cuts which were excavated in 1998 from the neighborhood of MJKK-5 hole to the neighborhood of MJKK-7 hole, because indications of mineralization were found here and there on the road cuts.

Location of the trenches are shown in Fig.II-1-1, and geological sketches of trenches and road cuts are shown in Plate II-1-4, Plate II-1-5 and Appendix 12, 13.

1-2-3 Result of Survey

1) Geological Survey of Trenches and Road Cuts

(1) Trench I

(a) Geology

The wall of this trench I consists of granodiorite porphyry, white crystalline limestone and layered skarn which contains green copper minerals. Some parts of the wall are made up only by thick detritus and these parts possibly represent the ore-bearing parts which were mined out in the past.

(b) Alteration

Vein-like skarns occur within granodiorite porphyry along fractures which strike NE and gently dip NW. Layered skarns occur as two layers intercalating a layer of white crystalline limestone in-between, and consist mainly of garnet and clinopyroxene.

(c) Mineralization

Green copper minerals and a very small amount of bornite are recognized in vein-like skarns and layered skarns. Under the microscope, ore minerals such as malachite, chrysocolla, hematite, goethite and pyrite are observed (KT1-14). Green copper minerals are often observed on the detritus of skarn where the bedrock does not crop out. Assay result shows a gold grade of 1.29 g/t (KT1-04) near the fracture accompanied with green copper minerals and bornite within granodiorite porphyry and a gold grade higher than 0.2 g/t for several samples from vein-like skarns. Gold grade within layered skarns is generally low with maximum of 0.39 g/t for sample with green copper minerals (KT1-14).

(2) Trench II

(a) Geology

The wall of this trench consists of granodiorite porphyry, layered skarn and white to gray-white crystalline limestone. Layered skarn occurs between granodiorite porphyry and limestone with gently dipping boundary.

(b) Alteration

Granodiorite porphyry is locally skarnized along fractures without a definite orientation. Layered skarn consists mainly of garnet and clinopyroxene. Limestone is partly silicified and skarnized.

(c) Mineralization

Green copper minerals and a small amount of bornite are recognized in vein-like skarn within granodiorite porphyry and layered skarn. Under the microscope, ore minerals such as malachite, chrysocolla, hematite and chalcopyrite are observed (KT2-10). Assay result shows a gold grade of 1.65 g/t for a sample (KT2-10) from granodiorite porphyry near the contact with skarn and a gold grade of 0.66 g/t for a sample (KT2-14) from garnet-rich layered skarn containing green copper minerals.

(3) Trench III

(a) Geology

This trench was excavated in ESE-WNW direction. The wall of it consists of granodiorite porphyry, layered skarn and skarn-bearing limestone intercalating chert in part.

(b) Alteration

Granodiorite porphyry was weakly silicified and skarnized. Under the microscope, a large quantity of garnet and clinopyroxene is observed for a sample (KT3-11) from layered skarn.

(c) Mineralization

Ore minerals are not recognized in granodiorite porphyry and layered skarn. Under the microscope, malachite, chrysocolla, chalcopyrite, bornite and a very small amount of native bismuth, covelline and chalcocite as well as garnet and clinopyroxene are observed for a sample (KT3-02) from crushed zone within skarn-bearing limestone. Gold grade higher than 0.2 g/t was not detected from this trench.

(4) Trench Ⅳ

(a) Geology

Trench Ⅳ was excavated in NNW-SSE direction. In the northern half of this trench, the wall is made up of thick detritus and the bedrock does not crop out. In the southern half, the wall is made up of white crystalline limestone which was partly skarnized.

(b) Alteration

Weak skarnization is observed in limestone.

(c) Mineralization

Besides skarnization, mineralization is not observed in this trench.

(5) Road Cuts between the Neighborhood of MJKK-5 Hole and the Neighborhood of MJKK-7 Hole (R-1)

The transportation road (R-1) was excavated for about 950 m in length from the neighborhood of MJKK-5 hole to the neighborhood of MJKK-7 hole in 1998. Because many ore manifestations were detected on the road cuts of this road, geological survey totaling about 250 m in length and assay analysis of 70 samples from the road cuts were carried out.

(a) Geology

On the eastern part of the road cuts, layered skarn with dominant limestone crops out for about 110 m. On the western part of the road cuts, layered and vein-like skarns occur near the boundary between limestone and granodiorite porphyry. Other parts of the road cuts are occupied by granodiorite porphyry and detritus.

(b) Alteration

Granodiorite porphyry was weakly skarnized in general. Under the microscope, garnet is dominant in skarns derived from limestone (R1-17, -28, and -70), and clinopyroxene is dominant in skarns derived from granodiorite porphyry (R1-49, -56).

(c) Mineralization

Layered skarns in the eastern part of the road cuts contain green copper minerals which are determined as chrysocolla, malachite, chalcocite and goethite under the microscope (R1-17). Assay result on these skarns shows an average gold grade of 1.33 g/t for 16.2 m(R1-01～R1-08) and 1.10 g/t for 9.8 m (R1-13～R1-17). If the high-grade part is selected from these parts, an average gold grade attains to 2.01 g/t for 6.1m (R1-01～R1-07) and 2.14 g/t for 2.0 m (R1-14). Assay result on vein-like skarns in the western part of the road cuts shows an average gold grade of 1.16 g/t for 7.6 m(R1-56～R1-59) including high-grade part of 2.58 g/t for 2m(R1-59).

2) Assay results of ore samples

Chemical analysis for eight elements (Au, Ag, Cu, Pb, Zn, Mo, As, Sb) were carried out on 135 ore samples. Results of analysis are shown in Appendix 9 and summarized in Table II-1-3 for layered skarns derived from limestone (73 samples) and for vein-like skarns derived from granodiorite porphyry (62 samples), separately.

As for the examination of correlation between Au and Ag, only samples having a content higher than the detection limit were used.

Average gold grade of 62 samples from vein-like skarns within granodiorite porphyry is so low as 0.25 g/t. The highest grade of gold, 2.58 g/t was obtained for a sample (R1-59) from the western part of the road cuts.

Average gold grade of 73 samples from layered skarns derived from limestone is so low as 0.36 g/t. The highest grade of gold, 2.67 g/t was obtained for a sample (R1-07) from the eastern part of the road cuts. Grade of zinc is 1.3 % (R1-01) and 1.2 % (R1-13) for layered skarns from the eastern part of the road cuts. Average grade of zinc is rather high as 1,081 ppm, while the average grade of lead is so low as 7 ppm.

Correlation coefficient between Ag and Cu is rather high as 0.805 for samples from vein-like skarns and so high as 0.918 for samples from layered skarns.

Table II-1-3 Summary of Assay Result of Rock Samples from Trenches in the Kichi-Sandyk District

3) Vein-like Skarn of Trenches in the Kichi-Sandyk District

	Au	Ag	Cu	Pb	Zn	Mo	As	Sb
	g/t	g/t	%	ppm	ppm	ppm	ppm	ppm
Sample Number	62	62	62	62	62	62	62	62
Max.	2.580	8.900	0.6545	52.00	1884.00	6.30	36.00	3.28
Min.	<0.03	<0.5	0.0006	<1.75	7.80	<0.3	2.00	<1.25
Ave.	0.249	0.738	0.0673	17.01	86.73	1.56	15.92	0.88

Correlation coefficient	Ag	Cu	Pb	Zn	Mo	As	Sb
Au	0.247	0.578	0.256	0.265	-0.042	0.380	0.187
Ag		0.805	0.646	0.014	0.314	0.170	0.278
Cu			0.492	0.553	0.199	0.132	0.294
Pb				-0.053	0.415	-0.103	-0.084
Zn					-0.083	0.008	0.239
Mo						-0.177	0.165
As							-0.126

*) Sample Number (pieces); Au-Ag : 15, Au-x : 44, Ag-x : 15, Others : 62

4) Layered Skarn of Trenches in the Kichi-Sandyk District

	Au	Ag	Cu	Pb	Zn	Mo	As	Sb
	g/t	g/t	%	ppm	ppm	ppm	ppm	ppm
Sample Number	73	73	73	73	73	73	73	73
Max.	2.670	18.500	1.0410	36.00	13000.00	11.20	72.00	119.10
Min.	<0.03	<0.5	0.0021	<1.75	4.70	<0.3	1.00	<1.25
Ave.	0.363	1.605	0.1230	7.17	1080.77	0.64	24.78	2.70

Correlation coefficient	Ag	Cu	Pb	Zn	Mo	As	Sb
Au	0.347	0.356	-0.162	0.343	0.029	0.337	-0.041
Ag		0.918	0.218	0.615	0.042	0.283	-0.115
Cu			0.008	0.616	0.152	0.379	-0.028
Pb				-0.025	0.020	-0.025	0.186
Zn					0.504	0.601	-0.014
Mo						0.281	-0.047
As							0.364

*) Sample Number (pieces); Au-Ag : 33, Au-x : 52, Ag-x : 34, Others : 73

*) Assay result of Au and Ag less than assay limit are excluded in calculaion for correlation coefficient.