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

(PHASE Ⅲ)

FEBRUARY 2000

JAPAN INTERNATIONAL COOPERATION AGENCY

METAL MINING AGENCY OF JAPAN

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 a survey team to the Kyrghyz Republic headed by Mr. NAKAMURA Kiyoshi from July 17 to August 21, 1999.

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.

February, 2000

Kimio Fujita
President
Japan International Cooperation Agency

Naohiro Tashiro
President
Metal Mining Agency of Japan

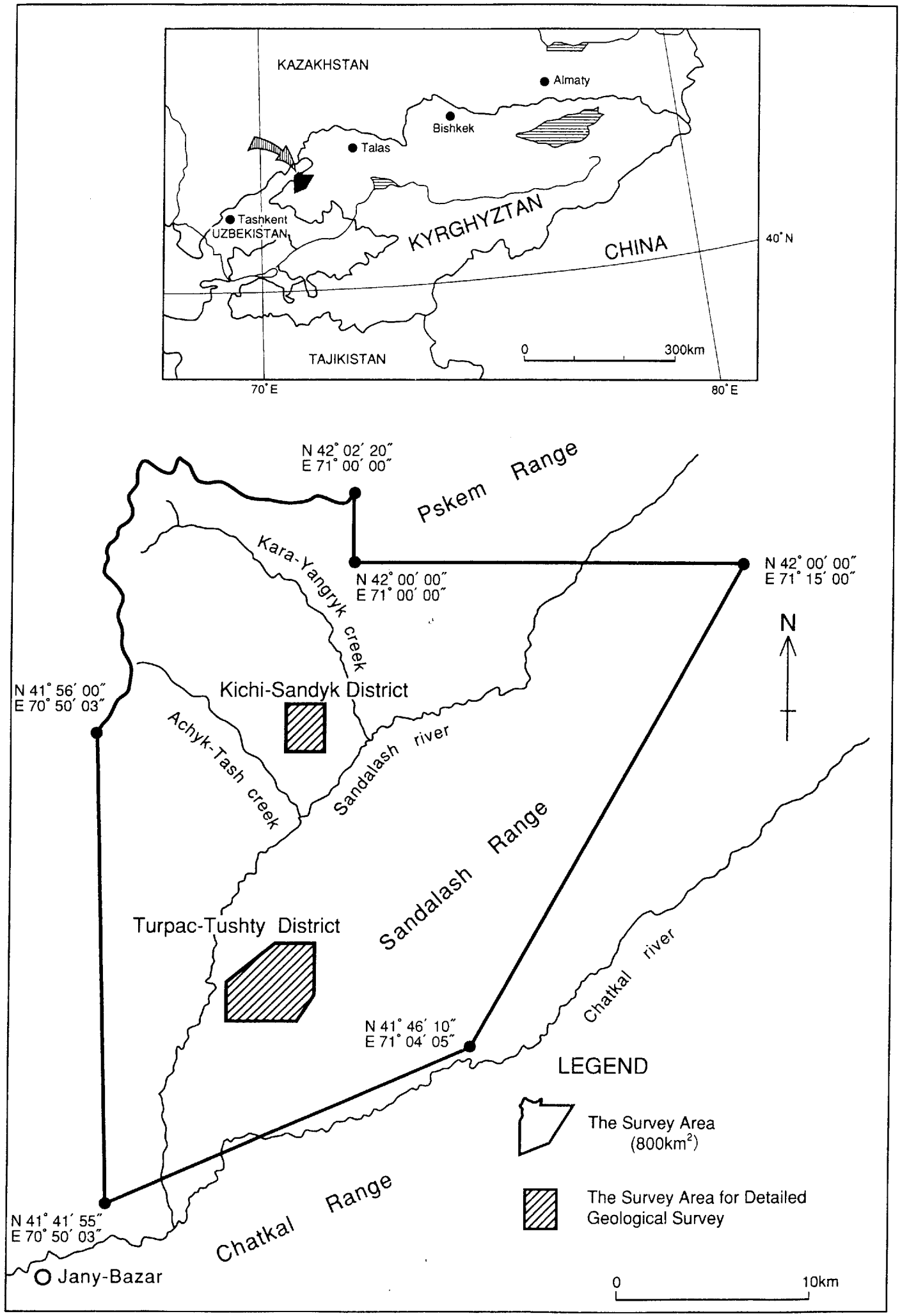

Fig. I -1 Location Map of the Survey Area

Резюме

Данный отчет резюмирует результаты третьего года геологоразведочных работ, проводимых на площади Кичи-сандык Кыргызской Республики. Целью исследований являлось изучение геологии площади и залегания рудных месторождений, и затем выявление новых месторождений. Полевые работы выполнялись с июля 1999 г. по август месяц 1999 года.

Для признания минерализации на глубине месторождений экзогенных скарнов и детального выявления золотой минерализации на третьем этапе геологоразведочных работ проводилось алмазное бурение в направлении контакта поверхности известняков и гранодиоритовых порфиров в зоне северной минерализации района Кичи-Сандык. Было выполнено бурение трех скважин с общим объемом бурения 450 м.

В результате исследований, проведенных в этом году, пришли к выводу, что хотя минерализация широко распространена вблизи контакта известняков и гранодиоритовых порфиров в северных зонах минерализации Кичи-Сандыкского района, а руда с высоким содержанием залегает только на поверхности или вблизи зоны окисления. При этом существование перспективного рудного месторождения едва ли предполагается в этом районе.

Первоначально, по данным геологоразведочных работ, проводимых кыргызскими геологами в 1976 году, предполагалось существование перспективного рудного месторождения, прогнозные запасы (C2+P1) которого были оценены в 33 тонны золота со средним содержанием золота 3,85 г/т в центральной и северной зонах минерализации Кичи-Сандыкского района.

Однако, было выявлено, что протяженность рудного тела очень ограничена как вертикально, так и горизонтально, а содержания золота в руде внезапно уменьшаются с глубиной. Поэтому существование перспективных рудных месторождений едва ли возможно в обоих зонах минерализации.

Мы рекомендуем следующее:

(1) Рудное тело (жилообразный скарн) с низким содержанием (около 1г/т золота) мелкого масштаба в центральной зоне минерализации района Кичи-Сандык. Таким образом, присутствие рудного месторождения для разработки не предполагается. Минерализация широко распространена в районе, но существование участков с высокими содержаниями весьма ограничено. Соответственно, нет необходимости в дальнейшем детальном изучении этой зоны.

(2) В северной зоне минерализации района Кичи-Сандык содержание золота в слоистом скарне очень низкое, менее 1 г/т золота. Хотя, предыдущие геологоразведочные работы на этой огромной территории были очень ограничены, существование промышленных рудных месторождений с высокими содержаниями золота не предполагается. В случае разработки требуется, чтобы содержание золота в руде составляло не менее 6-8 г/т. Следовательно, дальнейшее изучение этой зоны не требуется.

(3) Возможно существование мелкомасштабных рудных тел с высокими содержаниями золота на рудопроявлениях Турпак-Туштьі и Ак-Камоу вдоль северо-восточных и юго-западных сбросов. Рекомендуются дальнейшие геологоразведочные работы в этом районе и на

прилегающих участках, направленные на поиски рудных тел с высокими содержаниями золота. Также необходимо выяснение условий существования рудных тел с высокими содержаниями золота. Однако, так как инфраструктура этой зоны минерализации очень бедна, как и в районе Кичи-Сандык, для промышленной разработки требуется рудное месторождение с высоким содержанием золота.

SUMMARY

This report summarizes the results of the third year mineral exploration survey conducted in the Kichi-Sandyk area, Kyrghyz Republic. The purpose of the survey was to clarify the geological setting of the area and occurrence of ore deposits, then discover new ore deposits. The field survey was carried out from July 1999 to August 1999.

In order to recognize the mineralization at the depth of exogenetic skarn deposits and clarify the gold mineralization in detail, the third year's survey diamond drilling has been carried out aiming for the contact plane of limestone and granodiorite porphyry in the northern mineralization zone of the Kichi-Sandyk district. The amount of drilling was three drill holes totaling 450 m.

As a result of this year's survey, it is concluded that although the mineralization is widely distributed near the contact of limestone and granodiorite porphyry in the northern mineralization zone of Kichi-Sandyk district, as the high-grade ore occurs only on the surface or near the surface oxidation zones. Therefor the existence of a promising ore deposit is hardly expected.

Initially, the existence of a promising ore deposit was expected due to the 1976 Kyrghyz survey estimated potential ore reserves (C2+P1 ore reserves) of 33 tons Au with an average grade of 3.85 g/t Au in the central and northern mineralization zones in the Kichi-Sandyk district. However, it was revealed that the extension of the ore body is very limited both laterally and vertically, and the ore gold grade suddenly decreases underground. Therefore the existence of a promising ore deposit is hardly expected in both mineralization zones.

We recommend the following:

(1) The ore body (vein-like skarn) is low grade (about 1 g/t Au) and small in the central mineralization zone of the Kichi-Sandyk district, so that the presence of a minable ore deposit is not expected. Accordingly, a further detailed survey in this zone is not necessary.

(2) In the northern mineralization zone of the Kichi-Sandyk district, the gold grade of the layered skarn deposits was low, less than 1 g/t Au. Although the previous exploration for this vast area is very limited, the existence of an economical high-grade ore deposit is not expected. The ore grade is required to be at least 6-8 g/t Au in the case of mining in this district. Therefore, a further survey in this zone is not required.

(3) In the Turpac-Tushty district, the existence of high-grade but small-scale ore bodies

are possible in Turpac-Tushty and Ak-Kamou ore manifestations along NE-SW faults. Further exploration aiming at high-grade ore bodies is recommended in this district and its surrounding area. Also clarifying of conditions on the existence of high-grade ore bodies is necessary. However, since the infrastructure of this mineralization zone is poor as that of Kichi-Sandyk district, considerably higher ore grade is demanded for an economically minable ore deposit.

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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 discover new ore deposits.

In the first year survey, the interpretation of satellite images was carried out on an area of 800 km^2 of the Kichi-Sandyk area, in advance of the field survey. Then a detailed geological survey including trenching was carried out in the Kichi-Sandyk district (4 km^2) and a selected area in the Kichi-Sandyk district (0.9 km^2).

In the second year survey, a further geological survey including trenching and diamond drilling was carried out in the Kichi-Sandyk district, and a geological survey was also conducted in the Turpac-Tushty district.

1-2 Conclusions and Recommendations of the Second Year Survey

In the second year survey in the Kichi-Sandyk district, seven diamond drill holes totaling 819.4 m and trenching of 500 m were carried out in order to recognize the outline of ore deposits for both layered and vein-like skarns.

In the Turpac-Tushty district, geological mapping on a scale of 1/10,000 was conducted to recognize the outline of mineralization and geological structure.

As a result, the following conclusions were obtained.

1-2-1 Conclusions of the Second Year Survey

The government of Kyrghyz Republic estimated 33 tons of gold as the potential reserves (C2 and P1) in two mineralization zones: central and northern mineralization zones in the Kichi-Sandyk district. However, the result of the mineral exploration survey carried out for the past two years shows that the ore reserves of gold in the central mineralization zone is not more than 1 ton of Au with a very small possibility of an existing extensive mineral deposit. While the potential reserve of the northern mineralization zone is also estimated to be about 1 ton at present, the existence of high-

grade ore deposits can be expected as the ore bearing host rock is presumed to be widely distributed in the area.

In the Turpac-Tushty district, the Kyrghyz side estimated 695,000 tons of possible ore reserves with an average grade of 4.22 g/ton (Au content: 2.9 tons). In this year's survey, the presence of high-grade ore was confirmed in the mineralization zones of Turpac-Tushty and Ak-Kamou. Therefore, the existence of a small high-grade ore deposit can be expected.

1-2-2 Recommendations of the Second Year Survey

1) Downward extension of the layered skarn deposits, occur in the northern mineralization zone of the Kichi-Sandyk district, appears to be promising.
   In order to find out the downward extension of the deposits: diamond drilling is recommended, which will also provide us important information for further exploration.
2) Vein-like skarn deposits occur in the central mineralization zone of the Kichi-Sandyk district are small and low grade so that finding a workable ore deposit is not expected. Therefore further exploration is not necessary.
3) The existence of a high-grade mineralization zone can be expected at the Turpac-Tushty and Ak-Kamou manifestations in the Turpac-Tushty district. Diamond drilling to find out the downward extension of the surface manifestation and obtain further information on the mineralization will be conducted. However, the priority of further drilling is not so high, as the possibility of finding large-scale deposits is small.

1-3 Outline of the Third Year Survey

1-3-1 Survey Area

The survey area is located in the western end of the Kyrghyz Republic near the border of Uzbekistan, and topographically situated in the middle Tien-Shan Range. In the administration division, the area belongs to the Chatkal district, Alabuka region, Dzhalal-Abad State. The area extends for about 27 km east-west and 30 km north-south covering about 800 km^2 (Fig. I-1).

The nearest village, Jany-Bazar, is located about 200 km northwest of Dzhalal-Abad. There was an old exploration road from Jany-Bazar to the survey area. The road was improved and maintained for this survey.

There are two routes from Bishkek, the capital city, to Jany-Bazar. One route

passes through Toktogul, Tash-Kumyr, Alabuka and Chapchama Pass (2,814 m in altitude), and the other route goes through Talas, Kirovskoye, and Kara-Buura Pass (3,305 m). Distance from Bishkek to Jany-Bazar using the former route is 800 km, while it is 520 km using the latter route. Although the former route is longer, the road is usable throughout the year. On the other hand, the latter road passes through mountains over 3,000 m high e.g. Kara-Buura pass is closed during the winter due to poor conditions.

1-3-2 Purpose of Survey

In order to recognize the mineralization deep in the exogenetic skarn deposits and clarify the gold mineralizations in detail, diamond drilling has been carried out aiming at the contact plane of limestone and granodiorite porphyry in the northern mineralization zone of the Kichi-Sandyk district.

1-3-3 Method of Survey

Diamond drilling with the target of obtaining further information on the mineralization of the layered skarn deposits was been carried out in the Kichi-Sandyk district. The amount of exploration was three diamond drill holes totaling 450 m. A base camp was set up in the Kichi-Sandyk district near a pond. Communication from the base camp to the related agencies in Tokyo and Bishkek was made by a satellite telephone. Water for diamond drilling was secured in a creek, about 1 km north of the base camp.

Table Ⅰ-1 Methods and Contents of the Survey

1. Drilling Survey (Kichi-Sandyk district)

Hole No.	Length	Direction	Inclination
MJKK-8	220.0 m	—	-90°
MJKK-9	87.0 m	—	-90°
MJKK-10	143.0 m	—	-90°
Total	450.0 m		

2. Laboratory Studies

Method	Total
Thin Section	10
Polished Thin Section	10
Fluid Inclusion	5
Chemical Assay (Au, Ag, Cu, Pb, Zn, Mo, As, Sb)	108
X-ray Diffraction	5

1-3-4 Survey Team

A survey team was dispatched from July 13 to August 21, 1999.

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

Japan

NAKAMURA Kiyoshi (Head/General)	MINDECO *)

Kyrghyz Republic

YARKOV Alexander V. (Chief coordinator)	KYRGHYZALTYN
SAVCHENKO Gennady A. (Chief geologist)	KYRGHYZALTYN
APOG Igor (Coordinator)	KYRGHYZALTYN
NIKITIN Andrey (Field coordinator)	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	1999						2000	
	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb
Field Survey	13 —	— 21						
Laboratory Works		23 —	—	—	—	— 28		
Making Report		23 —	—					— 29

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. North of our survey area is the Pskem Mountains, which are on the border with Uzbekistan and the watershed of the area, running from southwest to northeast.

The surveyed area is on the southern side of the Pskem Mountains with altitudes between 2,600 m and 3,000 m. Mineral showings are distributed at an altitude between 2,800 m and 2,950 m. 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 the Chatkal River, which originates in the Chandalash and Chatkal Mountains and runs from east-north-east to west-south-west.

2-2 Climate and Vegetation

Most part of the survey area lies between 2,000 m and 3,000 m in altitude, and its climate is of high mountain. The coldest month of the year is January with the temperature as low as -40° C, and the warmest month is August with the temperature higher than 28° C. 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 740 mm-1200 mm. The average monthly temperature of the survey area (3,000 m in altitude) is shown in Table I -2. The areas with mineral showing, which are about 2,800 m in altitude, have poor development of soils with little vegetation - just some grass and Alpine plants. Development of foliage, mainly bushes with some broadleaf trees such as white birch, poplars and conifers similar to pines, is seen only along the rivers at an altitude lower than 2,000 m.

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

The Middle Tien-Shan folding zone lies between the Northern Tien-Shan folding zone of the Caledonian folding system and Southern Tien-Shan folding zone of the Hercynian folding zone. By the 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, 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 the 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 geological map of the Sandalash-Chatkal region 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 (140 t in Kichi-Sandyk district and its surrounding areas) and 350 thousand tons of copper have been assessed as the potentials for this area.

Scale 1:200,000

0 4 8km

UZBEKISTAN REPUBLIC

Kara-Korum (woll.)

Kichi-Sandyc (Au,Cu)

Chaarat (Au,Sb)

Turpac-Tushty (Au)

Akkamou (Au)

Sandalash r.

Chatcal river

Sandalash river

Ter r.

A

B

Legend

Sedimentary and volcanic formations

Cenozoic

- Quaternary: alluvium (Q_{II-IV})
- Cenozoic molasse: conglomerate, sandstone, mudstone (P_3-Q_1)

Paleozoic

- Minbulak formation: andesite, dacite (C_2mb)
- Limestone,dolomite, limestone with flints (D_3-C_1)
- Tulkubash formation: red sandstone, siltstone ($D_{2-3}tl$)
- Ayutor formation: grey sandstone,siltstone ($O_{2-3}at$)
- Chandalash formation: conglomerate,flints, limestone, black slate, sandstone (Є-O_2sn)

Proterozoic

- Shorashu formation: sandstone , siltstone (Vsr)
- Uzunbulak formation: conglomerate, sandstone (Vuz)

Intrusive complexes

- Permian: Diorite; Granodiorite ($\gamma\delta P$)
- Upper Carboniferous Almasay complex: Granite (γC_2)
- Middle Carboniferous Chandalash-Chatkal complex: Granodiorite, diorite ($\delta,\gamma\delta C_2$); Diorite(δC_2)
- Middle-upper Riphean Beshtor complex: Plagio-granite (γR_{2-3})

Intrusive massifs

① Beshtor ② Middle Chandalash ③ Kara-Korum
④ Lower Chandalash ⑤ Kajinsuu
⑥ Chukursu ⑦ Almasai ⑧ Kichi-Sandyk

- Dip, strike
- Fault
- Thrust
- Chaarat (Au,Sb) Mineral showing and/or ore deposite
- The Survey Area

(After Mezgin, 1999)

Section A-B

Horizontal scale 1:200,000
Vertical scale 1:100,000

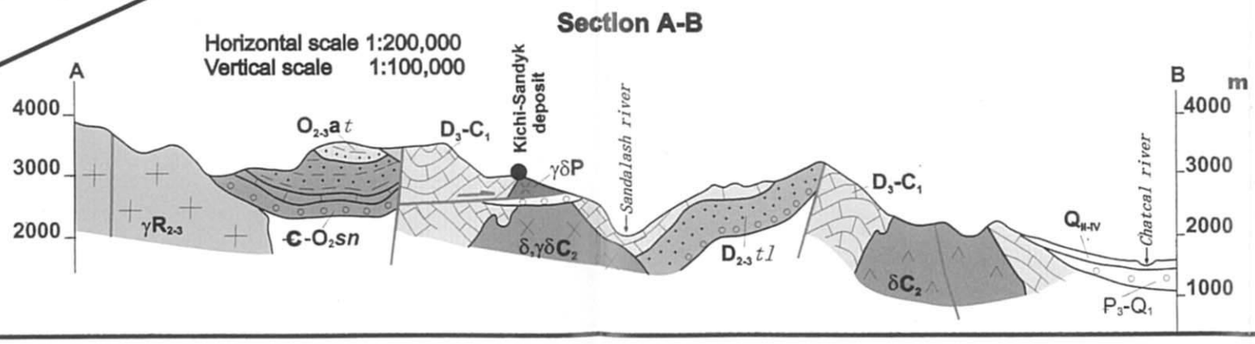
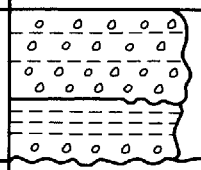
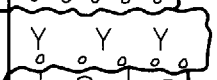
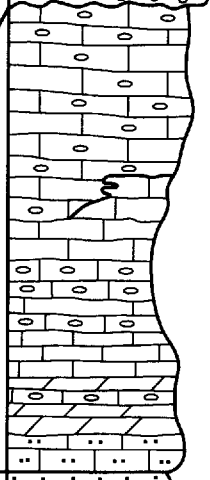
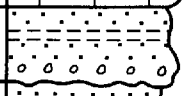
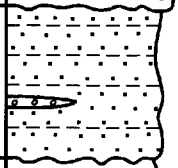
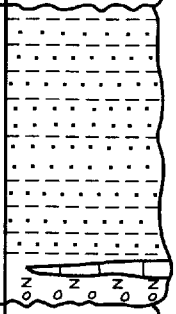
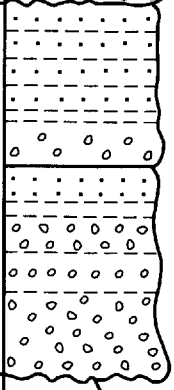
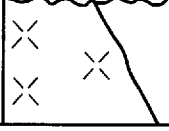


Fig. Ⅰ-3-1 Geological Map of the Sandalash-Chatkal Region

Age (Thickness)			BRIEF DESCRIPTION OF ROCKS
Cenozoic	P_3-Q (>500 m)		Interbedded gray conglomerates, loam & clay. Basement of the section consists of red conglomerate and clay.
Paleozoic	C_2 *mb* (250 m)		Minbulak formation. Dark coloured andesite lava. Basement contains conglomerate with boulders of limestone C_1.
	D_3-C_1 (2900 m)		Grey, dark-grey, light grey limestone, dolomite limestone and dolomite. In upper portion of this section, limestone consists of nodular and banded inclusions of chert. Tulkubash formation
	D_{2-3} *tl* (600 m)		Sandstone consists of pinky-grey and grey quartz. Basement consists of conglomerate.
	O_{2-3} *at* (950 m)		Ayutor formation. Flysch, interbedded greenish-grey sandstone, siltstone, rare interlayers of gritstone and conglomerate.
	C- O_2 (1850 m)		Chandalash formation. Grey & dark-grey conglomerate sandstone, dark-grey siltstone. Lower portion of this section consits of dark chert and massive limestone horizons.
Proterozoic	V (2200 m)		Shoroshuy formation. Tillite-like conglomerate. Upper portion expresses rhythmic interbedding of sandstone with silt-argillaceous shales of dark-grey colour. Uzunbulak formation. Conglomerate, gritstone with sandstone,siltstone and schist.
	R_{2-3} (930 ± 15 m.y.)		Beshtor intrusive complex. Plagiogranite.

(after Mezgin, 1999)

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

2) Geological structure

The limestone is intruded by the granodiorite porphyry. The contact plane between the limestone and granodiorite porphyry gently dips north or west and layered skarns often occur near the contact.

Conglomerates of Miocene are tectonically overlain by the granodiorite porphyry and limestone with a thrust fault that gently dips SW in the eastern part of the district. Topographic features indicate the presence of parallel faults trending NW-SE.

3) Mineralization

(1) Types of mineralization

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

① Endoskarn: A number of fissures and joints striking NW-SE and steeply dipping SW were formed within the granodiorite porphyry. Along these fractures near the boundary of limestone, vein-like skarns containing copper and gold, closely associated with calcite-quartz veinlets were often formed. These endoskarns occur in the central mineralization zone and below the layered skarns in the northern mineralization zone.

② Exoskarns: Layered skarns were formed in limestone at the contact with intrusives. This type of skarn occurs in the northern mineralization zone. In addition, pale green or pale brown limestone containing minor skarn minerals such as wollastonite, (weakly skarnized limestone) is widely distributed in the survey district, although they are barren.

(2) Minerals

Garnet, clinopyroxene and wollastonite are the main skarn minerals, which are accompanied with minor amounts of prehnite. Chrysocolla, malachite and minor amounts of chalcopyrite, bornite, chalcocite, covelline and electrum are identified as ore minerals. Also iron minerals of goethite, hematite and minor amount of pyrite are

observed.

(3) Size of ore body

Width of individual vein-like skarns is on the order of 10-40 cm, and in the aggregate, they form several copper gold ore bodies with a width of a few meters to a maximum of 25 m. Deep ore bodies have a width on the order of 10-40 m. Ore bodies appear to be stockwork type as a whole, trending NW-SE, parallel to the major fracture system. The extent of the central mineralization zone as the aggregate of the above described ore bodies is presumed to be 300 m by 300 m. The downward extension of the mineralization zone is inferred to be on the order of 10-20 m and a maximum of 30 m. Mineralized part of 1.29 g/t Au was detected in the 7.0 m drill core from 90 m depth of MJKK-2, although it is not expected to extend to the surface.

Outcrop of the layered skarns extends intermittently for 2 km in the NE-SW direction along the contact of limestone and granodiorite porphyry. The layered skarns are presumed to extend to a considerable depth and their width is on the order of 10-40 m.

(4) Ore grade

In the northern mineralization zone, the highest assay results in this year's survey are detected as 0.62 g/t Au in sample K904 of drill hole MJKK-9, and 0.34% Cu in sample K032 of drill hole MJKK-10. Assay result of this year was generally low grade.

On the surface in the central mineralization zone, three ore bodies of total 4,944 m^2, 1.94 g/t Au on average were calculated. However these ore bodies is inferred not to continue to a sufficient depth.

4) Model of mineralization

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

① As a result of intrusion of the granodiorite porphyry into the limestone, the layered skarns of 5-40 m thick were formed in the limestone along the contact plane. On the other hand, 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. At the same time, wollastonite was formed widely in the limestone.

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

③ The Kichi-Sandyk district was then tectonically deformed and divided into small blocks by thrust faults, striking N-S or NW-SE and dipping gently.

④ In the central mineralization zone, the vein-like skarns were exposed on the surface

due to intense erosion of limestone which was laying on the intrusives having a 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 in oxidized zones at shallow depths.

4-2 Potential for ore deposits

Taking the three years survey results into consideration, potential for ore deposit in the central and northern mineralization zones in the Kichi-Sandyk district is as follows.

1) Central mineralization zone

- On the surface, three ore bodies total 4,944 m^2, 1.94 g/t Au on average were calculated, adopting cut-off grade of 1 g/t Au.
- As a result, the following probable ore reserves (C1 or C2) are calculated.

  (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

- The layered skarns are distributed near the contact of the granodiorite porphyry and limestone. The vein-like skarns same as that of the central mineralization zone are also distributed in the granodiorite porphyry under the contact.
- In layered skarns in the trenches on the surface, 1.33 g/t Au in 16.2m and 1.10 g/t Au in 9.8 m were detected.
- The existence of a copper-gold bearing layered skarns is expected in the area of 1.5 km by 0.7 km.
- Drilling survey revealed that the ore grade of the downward extension of these ore bodies were very low, 0.25 g/t Au (9K044) was the highest and most of the assay were reported as less than 0.1 g/t Au in layered skarns. In vein-like skarns, two samples of 36.77 g/t Au (8K510) and 0.62 g/t Au (9K904) was detected, but other mineralized parts were low grade less than about 1 g/t Au.
- According to the results of the drilling survey, the ore grade of the northern mineralization zone is inferred as lower than 1 g/t Au. And ore reserves can not be calculated, though 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.

3) Discussion on potential ore reserves in 1976 study

- Initially, the existence of a promising ore deposit was expected due to the 1976 Kyrghyz survey estimated potential ore reserves (C2+P1 ore reserves) of 33 tons Au with an average grade of 3.85 g/t Au in the central and the northern mineralization zones in the Kichi-Sandyk district.
- However, it was revealed that the extension of the ore body is very limited both laterally and vertically, and the ore gold grade suddenly decreases underground.
- Therefore the existence of a promising ore deposit is hardly expected in both mineralization zones.

CHAPTER 5 CONCLUSIONS AND RECOMMENDATIONS

5-1 Conclusions

In order to recognize the mineralization at the depth of exogenetic skarn deposits and clarify the gold mineralization in detail, the third year's survey diamond drilling has been carried out aiming for the contact plane of limestone and granodiorite porphyry in the northern mineralization zone of the Kichi-Sandyk district. The amount of drilling was three drill holes totaling 450 m.

As a result of this year's survey, it is concluded that although the mineralization is widely distributed near the contact of limestone and granodiorite porphyry in the northern mineralization zones of Kichi-Sandyk district, as the high-grade ore occurs only on the surface or near the surface oxidation zones. Therefore the existence of a promising ore deposit is hardly expected.

Initially, the existence of a promising ore deposit was expected due to the 1976 Kyrghyz survey estimated potential ore reserves (C2+P1 ore reserves) of 33 tons Au with an average grade of 3.85 g/t Au in the central and the northern mineralization zones in the Kichi-Sandyk district. However, it was revealed that the extension of the ore body is very limited both laterally and vertically, and the ore gold grade suddenly decreases underground. Therefore the existence of a promising ore deposit is hardly expected in both mineralization zones.

5-2 Recommendations for the future

Concerning the results of these three years' survey, we recommend the following for the future:

(1) The ore body (vein-like skarn) is low grade (about 1 g/t Au) and small in the central mineralization zone of the Kichi-Sandyk district, so that the presence of a minable ore deposit is not expected. Accordingly, a further detailed survey in this zone is not necessary.

(2) In the northern mineralization zone of the Kichi-Sandyk district, the gold grade of the layered skarn deposits was low, less than 1 g/t Au. Although the previous exploration for this vast area is very limited, the existence of an economical high-grade ore deposit is not expected. The ore grade is required to be at least 6-8 g/t Au in the case of mining in this district. Therefore, a further survey in this zone is not required.

(3) In the Turpac-Tushty district, the existence of high-grade but small-scale ore bodies are possible in Turpac-Tushty and Ak-Kamou ore manifestations along the NE-SW

faults. Further exploration aiming at high grade ore bodies is recommended in this district and surrounding area of this district. Also clarifying of conditions on the existence of high-grade ore bodies is necessary. However, since the infrastructure of this mineralization zone is poor same as that of Kichi-Sandyk district, considerably higher ore grade is demanded for economically minable ore deposit.

PART II PARTICULARS

CHAPTER 1 KICHI-SANDYK DISTRICT

1-1 Purpose of Survey

In this fiscal year, three diamond drill holes (MJKK-8 to 10) totaling 450.0 m were drilled only in the Kichi-Sandyk district. The drilling was aimed at the layered skarn deposits that occur at the contact of limestone and granodiorite porphyry in the northern mineralization zone.

Location of the diamond drill holes is shown in Fig. II-1-1.

1-2 Method of Survey

1) Three diamond drill holes totaling 450.0 m were drilled. Drilling was efficiently carried out due to the bedrock was not so hard and brittle as was expected before drilling.

Efficiency was 10.8 m/day compared with the planned efficiency of 6.5 m/ day. Leakage of drilling water happened very frequently. Accordingly the fractures were sealed by bentonite, CMC and other chemicals throughout the drilling period. However, no serious trouble happened and the drilling work was satisfactorily performed.

Summary of the diamond drilling is shown in Table II-1-1.

Table II-1-1 General Results of Drilling Works

Hole No.	MJKK 8	MJKK 9	MJKK 10	Total
Direction	-	-	-	-
Inclination	-90°	-90°	-90°	-
Length of drilling	223.2 m	87.3 m	143.0 m	453.5
Core recovery (%)	98.0%	96.4%	99.4%	98.1%
Efficiency (m/day)	11.2	7.9	13.0	10.8

2) Period of the survey was 46 days form July 13 to August 21, 1999. Period of the diamond drilling was 24 days from July 18th to August 10th.

Table II-1-2 shows the progress of diamond drilling.

Table II-1-2 Period of the Drilling Survey

	1999	
	July	August
Mobilization	13 18	
Drilling survey	18	10
Withdrawal		11 21

3) Two Russian diamond drills (CBK-5) were used for diamond drilling. Table II-1-3 shows the drilling equipment used in this survey.

Table II-1-3 List of the Equipment Used for Drilling

Item	Model	Quantity	Capacity, type and specification
Drilling machine	CKB-5	1	capacity 93mm : 300m, 59mm : 500m inner diameter of spindle : ϕ 76mm
Pump	HB3-120/140	2	piston ϕ 60mm, capacity 110 liter/min pressure 60 kg/cm^2
Generator	SDG-25S	1	25 KVA, 200~220V
Mud mixer		2	3KW, 1,600 r.p.m.

4) Bulldozers, cranes and large trucks were used for road construction, leveling and preparation of drill sites, and transporting and setting up the drills.
5) Diamond drilling was performed in two shifts per day. Each shift was 12 hours.
6) In order to improve core recovery and drilling efficiency wireline coring was adopted. Metal crown bits of 112 mm and 93 mm, and diamond bits of HQ and NQ-WL were used for the soil surface, and diamond bits of HQ and NQ-WL were used for the bedrock.
7) Water for drilling was transported by two 3 m^3 tank trucks from the pond, 1.1 km northeast of the base camp.

The actual drilling data such as drill hole length, core recovery and drilling efficiency are shown in Table II-1-1. Progress of each drill hole, consumption of

consumable articles and diamond bits are listed in Appendixes 14-18.

1-3 Result of Survey

In this year like last year, the results of the diamond drilling conducted in the northern mineralization zone of the Kichi-Sandyk district disclosed the existence of Cu, Au-bearing layered and vein-like skarn deposits. The former occurs in the gently dipping contact plane of the limestone and granodiorite porphyry, and consists of mainly garnet and clinopyroxene. The latter occurs in the granodiorite porphyry beneath the former. The mineral deposit was intersected by drill hole MJKK-10 for about 50 m. However, the grade of ore was low, less than 1 g/ton Au.

One hundred eight samples of drill cores were collected and assayed for Au, Ag, Cu, Pb, Zn, As, Sb, and Mo. The samples were collected from the drill core of the mineralized rock every 1 m. The drill cores were split and half was used for assay and the other half was kept in core boxes. For the As laboratory tests, 10 thin sections were prepared from various rock types and observed under the microscope. Ten ore specimens were polished and microscopically observed, 5 samples were tested by X-ray analysis and 5 samples were used for measurement of the homogenization temperature of the fluid inclusions.

Location of the diamond drill holes is shown on Fig. II-1-1. Columnar sections of the drill holes, summarized columnar sections and geological sections along the diamond drill holes are shown in Appendix 10, Fig. II-1-4 and Fig. II-1-5 (1)~(3), respectively.

1) Geology and mineralization of each drill hole

(1) MJKK-8 (inclination : -90°, drilling length 220.0 m)

(Geology) Limestone appeared from 3.6 m where the bedrock was encountered to 170.3 m. Fracture zone and skarn with green copper minerals appeared down to 175 m, and then limestone continued down to 223.2 m, the bottom of the hole.

The limestone down to the 100 m depth is pale gray with a black zebra pattern. The black portion, probably consists of carbonaceous matter, occupies 10 to 40% of the whole rock and gently dips from 0 to 20°. The limestone gradually changes into a pale color and becomes white below 150 m.

The zebra pattern also changes to pale gray and reduces the amount to 10%. From 201.9 m to the bottom of the hole, the limestone is brecciated and associated with white clay. The breccia is 1 to 5 cm in diameter, consisting of gray to pale gray limestone.

(Alteration) Several weakly silicified zones for a length of 2 m were observed in the limestone at depths of 10 m, 40 m, 110 m, 150 m, and 160 m. In the sample (K-8-118.2) collected from the silicified zone, a minor amount of wollastonite was observed under the microscope. Therefore, a considerable amount of wollastonite is, possibly contained in the weakly silicified zone, classified by the naked eye. A fractured zone, associated with white clay, was encountered at 164 m, and then skarn appeared from 170.3 m. Pinkish calcite-like minerals were observed in garnet skarn. X-ray analysis showed that they are composed of halloysite and a small amount of smectite (K-8-170.9).

(Mineralization) Garnet skarn with remnants of limestone appeared from 170.3 m to 175.7 m, in which a small amount of green copper mineral was observed by the naked eye. However, under the microscope (K-8-174.3) only hematite was identified. The assay of the core from 173.3 m to 175.7 m shows 0.10 g/t Au and 0.06% Cu. Table II-1-4 shows the average assay of the mineralized zones.

(2) MJKK-9 (inclination: -90°, drilling length 87.3 m)

(Geology) Limestone appeared from 11.8 m, where the bedrock was encountered, down to 40.6 m. Then granodiorite porphyry continued down to 87.3 m, the bottom of the hole.

A dacite dyke of 80 cm thick appeared at a depth of 47.3 m. The limestone is white to pale gray, highly fractured and associated with white clay. The sample collected from 27.8m (K-9-27.8) was weakly skarnized limestone accompanied with a small amount of wollastonite and garnet under microscopic observation.

Granodiorite porphyry is gray, containing phenocrysts of amphibole and biotite. The sample collected from 84.2 m (K-9-84.2) was composed of hornblende-biotite granodiorite porphyry with a small amount of wollastonite and clinopyroxene under microscopic observation. Dacite is pale green. In the sample collected from 47.6 m (K-9-47.6), garnet skarn was identified under the microscope.

(Alteration) Weak skarnization containing wollastonite is observed in the white portion of the limestone. Granodiorite porphyry is often fractured but generally fresh seen by the naked eye.

(Mineralization) A part of the limestone at a depth of 30.8 m is weakly skarnized for 10 cm. A small amount of green copper bearing garnet with a remnant of limestone appeared for 20 cm at a depth of 49.5 m. The assay for the 20 cm showed 0.62 g/t Au and 0.07% Cu. The gold value of this assay was the highest among the assays conducted for the diamond drill cores this year. A very small

amount of chrysocolla was observed between garnet crystals and some amounts of pyroxene were observed under a microscope in the sample (K-9-49.6) taken from this portion. X-ray analysis identified a small amount of goethite.

The granodiorite at a depth of 51.6-58.5 m is weakly skarnized. Clinopyroxene skarn formed in the sample (K-9-49.6) taken from this part. However, the assay showed only 0.06 g/t Au and 0.05% Cu in the sample taken from 58.1～58.5 m, that was observed green-copper minerals by the naked eye.

(3) MJKK-10 (inclination: -90°, drilling length 143.0 m)

(Geology) Limestone appeared from 7.8 m, where the bedrock was encountered down to 130.1 m. Then granodiorite continued to 143.0 m, the bottom of the hole. Altered andesite dykes of 80 cm and 120 cm thick were intersected at the depths of 54.6 m and 70.8 m.

The limestone is white to pale gray. Skarnization and mineralization are observed in the limestone below the 50 m depth. The granodiorite porphyry is greenish gray, containing a small amount of hornblende phenocrysts and weakly skarnized. The andesite is brownish gray and altered. In the samples of K-10-54.9, K-10-71.7, phenocrysts of hornblende, minor amount of hematite and a very small amount of chlorite, prehnite, clinopyroxene and epidote were identified under the microscope.

(Alteration) The limestone is highly fractured down to the depth of 50 m accompanied by white clay. White hard alteration zones are widely distributed in the limestone from 30 m to the boundary of the granodiorite porphyry. Microscopic study revealed that it is formed by silicification and wollastonization.

As described above, the limestone is highly fractured to the 50 m depth and accompanied by white clay.

Fracturing is not so intense below the 50 m depth.

Result of the X-ray analysis on the sample of the 92.9 m depth (K-10-92.9) showed that the white clay is composed of chlorite, smectite, quartz, sericite and a small amount of halloysite.

Minor amounts of quartz, potash feldspar and chlorite were identified in sample (K-10-71.6) taken from andesite at a depth of 71.6 m.

(Mineralization) Weak skarnization was recognized in the limestone at a depth of 51.8-54.6 m. A gently banded, weak skarnization zone is observed in the limestone at a depth of 75-105 m.

A number of quartz calcite veinlets which contain a small amount of bornite,

chalcopyrite, chalcocite and covelline are recognized at a depth of 91-135 m. Assay result of this portion shows that the highest value of Au (0.30 g/t Au, 0.01% Cu) was obtained in the sample (K072) taken from 135.0-136.0 m. And the highest value of Cu (<0.03 g/t Au, 0.34% Cu) was obtained in sample (K032) taken from 95.0-95.8m. Average ore grade for 50.5m at a depth of 95.0-141 m was 0.07 g/t Au and 0.03% Cu.

2) Result of homogenization temperature measurement of fluid inclusions

The result of homogenization temperature measurement of fluid inclusions is shown in Appendixes 6 and 7.

Five samples of quartz and or calcite taken from MJKK-10 were measured in this test. Four samples are taken from the quartz calcite veins (K-10-91.6, 115.0, 116.1 and 126.6) in the limestone and one sample was taken from the quartz vein (K-10-140.4) in the granodiorite porphyry. All of the crystals were very fine grained so the homogenization temperature measurement was very difficult.

In two test pieces, taken from one sample (K-10-140.4), their average homogenization temperature were 170° C and 198° C, respectively. In three samples taken from the quartz calcite veins in the limestone (K-10-115.0, 116.1 and 126.6), the fluid inclusions were formed of only one phase (liquid) without solid crystals so that the homogenization temperature is considered to be normal temperature. In sample K-10-91.6, crystals for the test are too fine so that a measurable fluid inclusion was not found.

Formation temperature of primary gold-silver deposit is estimated from 100 to 250° C (Iiyama 1989). The homogenization temperature of the fluid inclusion of sample K-10-140.4 is within the range of the above temperatures. Contrary with this, since the homogenization temperature of the three samples (K-10-115.0, 116.1 and 126.6) taken from quartz calcite vein in the limestone is too low, secondary enrichment by meteoric water could have taken place.

3) Assay result of ore

The 108 ore samples taken from drill cores were assayed for Au, Ag, Cu, Pb, Zn, As, Sb, and Mo. Assay results are shown in Appendix 8 and summarized in Table II-1-4.

The highest grade of Au was obtained in sample K904 of MJKK-9 showing 0.62 g/t Au and the highest grade of Cu was obtained in sample K032 of MJKK-10 showing 0.34% (3,419 ppm). In a statistical study, the assay value lower than the detection limit is treated as half of the detection limit.

Correlation coefficients between the elements were calculated and shown in the

following table. This calculation was based on 36 samples except for 72 samples of which the Au value is lower than the detection limit (<0.03). The correlation coefficient on Ag was not calculated, as all the assay values of Ag of these 36 samples were lower than the detection limit. Between the elements of Au-Zn, Zn-As, Cu-As, As-Mo and Cu-Zn, the correlation coefficients are positive and over 50%. Between Au-Cu, it was 45.6% suggesting there is a significant correlation between copper and gold mineralizations.

Table II-1-4 Summary of Assay Results of Drill Cores

1. Average ore grade of each mineralized zone

Hole No.	Depth (m)			Width (cm)	Au (g/t)	Cu (%)
MJKK-8	173.3	~	175.7	240	0.10	0.06
MJKK-9	49.5	~	49.7	20	0.62	0.07
MJKK-9	58.1	~	58.5	40	0.06	0.05
MJKK-10	95.0	~	100.0	500	<0.03	0.14
MJKK-10	101.0	~	105.0	400	<0.03	0.03
MJKK-10	105.0	~	116.0	1100	0.10	0.02
MJKK-10	122.0	~	130.0	800	0.06	0.01
MJKK-10	130.0	~	141.0	1100	0.13	0.02

2. Statistical table

	Au	Ag	Cu	Pb	Zn	As	Sb	Mo
	g/t	g/t	ppm	ppm	ppm	ppm	ppm	ppm
Max.	0.62	4.0	3418	26.00	520.6	22.00	4.00	10.40
Min.	<0.03	<1	7	<3.5	4.8	0.75	1.25	0.25
Ave.	0.05	0.5	197	6.52	40.8	1.53	1.56	0.86

Sample Number : Total 108 pieces

3. Correlation coefficient

	Ag	Cu	Pb	Zn	As	Sb	Mo
Au	#DIV/0!	45.9	6.1	75.8	28.3	−13.7	6.1
Ag		#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Cu			−31.3	53.5	59.4	−3.5	29.0
Pb				6.0	−12.0	−15.2	23.8
Zn					67.0	−2.3	35.1
As						19.8	54.3
Sb							17.6

Sample Number : Total 36 pieces

Except samples having a content lower than Au detection limit (Au<0.03)

1-4 Consideration

The geology and mineralization in the Kichi-Sandyk district is considered as follows by the results of the three years survey.

1-4-1 Characteristics of geological structure and mineralization

The geological map of the Kichi-Sandyk district is shown in Plate II-1-1 and Fig. II-1-2, and the geological sections are shown in Plate II-1-2 and Fig. II-1-3.

1) Geology

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

Calcareous sediments are widely distributed in the northern and western parts of the district. They are mostly crystalline limestone and partially contain chert beds. Brecciated zones probably formed by thrust faulting are occasionally observed. Layered skarns occur along the contact of limestone and intrusives.

The granodiorite porphyry is leucocratic and has widely undergone hydrothermal alteration such as argillization, carbonization, chloritization and silicification. It is accompanied with vein-like skarns trending NW-SE.

The conglomerate is mainly composed of round to sub-rounded gravel of crystalline limestone, granodiorite porphyry, skarn and sandstone which are 3-10 cm in diameter. The matrix is composed of sand and clay, the former being the same materials as gravel.

2) Geological structure

The limestone is intruded by the granodiorite porphyry. The contact plane between the limestone and granodiorite porphyry gently dips north or west and layered skarns often occur near the contact. A part of the limestone occurs as a large xenolith captured within the granodiorite porphyry. Conglomerates of Miocene are tectonically overlain by the granodiorite porphyry and limestone with a thrust fault that gently dips SW in the eastern part of the district.

Topographic features indicate the presence of parallel faults trending NW-SE. A number of fissures and joints which have the same trends and dip steeply southward were developed in the central mineralization zone. Cu-Au bearing vein-like skarns were formed along these fractures. A number of fractured zones containing granule- or sand-size fragments with clayey materials have been detected by the second year's drilling and they are possibly part of the above-mentioned thrust fault system.

3) Mineralization

(1) Types of mineralization

Two types of mineralization described below are recognized in the survey district. Among them, exoskarn was the main target of this year's survey.

① Endoskarn: As mentioned above, a number of fissures and joints striking NW-SE and steeply dipping SW were formed within the granodiorite porphyry. Along these fractures near the boundary of limestone, vein-like skarns containing copper and gold, closely associated with calcite-quartz veinlets were often formed. These endoskarns occur in the central mineralization zone and below the layered skarns in the northern mineralization zone.

② Exoskarns: Layered skarns were formed in limestone at the contact with intrusives. This type of skarn occurs in the northern mineralization zone. In addition, pale green or pale brown limestone containing minor skarn minerals such as wollastonite, (weakly skarnized limestone) is widely distributed in the survey district, although they are barren.

(2) Minerals

Garnet, clinopyroxene and wollastonite are the main skarn minerals, which are accompanied with minor amounts of prehnite. Chrysocolla, malachite and minor amounts of chalcopyrite, bornite, chalcocite, covelline and electrum are identified as ore minerals. Also iron minerals of goethite, hematite and minor amount of pyrite are observed.

Bornite is frequently observed in calcite-quartz vein-lets in MJKK-10. Measurement of homogenization temperature of these veinlets suggests that the formation temperature of them are very low and bornite might be formed by the second-enrichment.

(3) Size of ore body

Width of individual vein-like skarns is on the order of 10-40 cm, and in the aggregate, they form several copper gold ore bodies with a width of a few meters to a maximum of 25 m. Deep ore bodies have a width on the order of 10-40 m. Ore bodies appear to be stockwork type as a whole, trending NW-SE, parallel to the major fracture system. The extent of the central mineralization zone as the aggregate of the above described ore bodies is presumed to be 300 m by 300 m. The downward extension of the mineralization zone is inferred to be on the order of 10-20 m and a maximum of 30 m. Mineralized part of 1.29 g/t Au was detected in the 7.0 m drill core from 90 m depth of MJKK-2, although it is not expected to extend to the surface.

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

direction along the contact of limestone and granodiorite porphyry. The layered skarns are presumed to extend to a considerable depth and their width is on the order of 10-40 m.

(4) Ore grade

In the northern mineralization zone, the highest assay results in this year's survey are detected as 0.62 g/t Au in sample K904 of drill hole MJKK-9, and 0.34% Cu in sample K032 of drill hole MJKK-10. Assay result of this year was generally low grade.

Assay result of garnet skarn with some limestone remnants in drill hole MJKK-8 at a depth of 173.3 m for a length of 240 m was 0.10 g/t Au and 0.06% Cu.

The assay result of garnet skarn in the drill hole MJKK-9 at a depth of 49.5 m for the length of 20 cm showed 0.62 g/t Au, which was the highest Au value in the drill hole assay conducted this year. Assay of weakly skarnized granodiorite porphyry in the same drill hole at a depth of 58.1 m for a length of 40 cm showed 0.06 g/t Au and 0.05% Cu.

In drill hole MJKK-10, the average grade of the ore for 50.5 m for depths between 90.5 and 141.5 m, where a number of Cu-Au bearing quartz calcite veinlets are observed, was 0.07 g/t Au and 0.03% Cu. The highest grade of Au in the same hole was 0.30 g/t Au at depths of 135.0-136.0 m.

Correlation coefficient between the assays for Au and Cu is +45.6% that suggests there is a close relation between copper and gold mineralizations.

Average ore grade of each major mineralized zone of drill cores in the second and the third year are shown on Table II-1-5.

High grade zones were reported as 1.20 g/t Au in 7.0 m of MJKK-2, and 35.77 g/t Au in 0.30 m of MJKK-5, although other zones were very low grade less than 1 g/t Au.

On the surface in the central mineralization zone, three ore bodies of total 4,944 m^2, 1.94 g/t Au on average were calculated. However these ore bodies are inferred not to continue to a sufficient depth.

4) Model of mineralization

From the above-described facts, the following model of mineralization of this district is proposed. Fig. II-1-6 shows the model illustration of mineralization.

① As a result of intrusion of the granodiorite porphyry into the limestone, the layered skarns of 5-40 m thick were formed in the limestone along the contact plane. On the other hand, 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

Table II-1-5 Average Ore Grade of Each Major Mineralization Zone of Drill Cores
(Phase II～III)

1. Vein-like skarn type

Hole No.	Depth (m)			Width (m)	Au Ave. (g/t)	Cu Ave. (%)	Reference
MJKK-1	45.0	～	46.1	1.10	0.23	0.00	
MJKK-1	93.8	～	94.8	1.00	0.20	0.03	
MJKK-1	100.6	～	102.5	1.90	0.13	0.03	
MJKK-2	7.3	～	13.2	5.90	0.27	0.04	
MJKK-2	16.8	～	23.2	6.40	0.43	0.05	
MJKK-2	73.7	～	84.2	10.50	0.17	0.02	
MJKK-2	84.2	～	91.2	7.00	1.29	0.05	max 3.47g/tAu(1.00m)
MJKK-3	17.2	～	18.2	1.00	0.10	0.03	
MJKK-3	28.8	～	30.8	2.00	0.50	0.06	
MJKK-3	47.9	～	54.2	6.30	0.41	0.02	
MJKK-3	87.5	～	89.0	1.50	0.13	0.01	
MJKK-3	95.5	～	97.7	2.20	0.23	0.00	
MJKK-3	99.9	～	102.0	2.10	0.10	0.00	
MJKK-3	110.8	～	112.8	2.00	0.17	0.00	
MJKK-4	39.5	～	42.6	3.10	0.19	0.01	
MJKK-5	25.2	～	33.1	7.90	0.24	0.13	
MJKK-5	35.9	～	36.2	0.30	35.77	2.76	
MJKK-5	36.2	～	38.2	2.00	0.44	0.07	
MJKK-9	49.5	～	49.7	0.20	0.62	0.07	
MJKK-9	58.1	～	58.5	0.40	0.06	0.05	
MJKK-10	130.0	～	141.0	11.00	0.13	0.02	

2. Layered skarn type

Hole No.	Depth (m)			Width (m)	Au Ave. (g/t)	Cu Ave. (%)	
MJKK-6	22.8	～	23.8	1.00	0.11	0.01	
MJKK-6	35.7	～	37.8	2.10	0.18	0.02	
MJKK-6	65.4	～	66.0	0.60	0.12	0.04	
MJKK-7	28.4	～	30.4	2.00	0.16	0.01	
MJKK-8	173.3	～	175.7	2.40	0.10	0.06	
MJKK-10	95.0	～	100.0	5.00	<0.03	0.14	
MJKK-10	105.0	～	116.0	11.00	0.10	0.02	
MJKK-10	122.0	～	130.0	8.00	0.06	0.01	

plane. At the same time, wollastonite was formed widely in the limestone.

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

③ The Kichi-Sandyk district was then tectonically deformed and divided into small blocks by thrust faults, striking N-S or NW-SE and dipping gently.

④ In the central mineralization zone, the vein-like skarns were exposed on the surface due to intense erosion of limestone which was laying on the intrusives having a 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 in oxidized zones at shallow depths.

1-4-2 Potential for ore deposits

Taking the three years survey results into consideration, potential for ore deposit in the central and northern mineralization zones in the Kichi-Sandyk district is as follows.

1) Central mineralization zone

- Copper-gold mineralization accompanied with aggregation of vein-like skarn in granodiorite porphyry is observed.
- On the surface, three ore bodies of total 4,944 m^2, 1.94 g/t Au on average were calculated, adopting a cut-off grade of 1 g/t Au.
- Drilling survey revealed that the ore grade of the downward extension of these ore bodies were very low, 0.90 g/t Au (8K212) was the highest and most of the assays were reported as less than 0.1-0.2 g/t Au.
- As the result, following probable ore reserves (C1 or C2) are calculated.

  (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

- The existence of a copper-gold bearing layered skarns is expected in the area of 1.5 km by 0.7 km.
- According to the results of the drilling survey, the ore grade of the northern mineralization zone is inferred as lower than 1 g/t Au. Ore reserves can not be calculated, though there is the possibility of the existence of high-grade ore bodies because the previous exploration was done in a very limited area of the vast mineralization area.

3) Discussion on potential ore reserves in 1976 study

- Initially, the existence of a promising ore deposit was expected due to the 1976 Kyrghyz survey estimated potential ore reserves (C2+P1 ore reserves) of 33 tons Au with an average grade of 3.85 g/t Au in the central and the northern mineralization zones in the Kichi-Sandyk district.
- However, it was revealed that the existence of a promising ore deposit is hardly expected in both mineralization zones. The reason of this difference is studied as follows.

(1) The systematic prospecting on the Kichi-Sandyk area were carried out in 1974-1976 in USSR period and following ore reserves were expected.

zone	category	ore reserves	gold grade	gold amount
Central	C 2	3,710,700t	4.03g/tAu	15.0t Au
	P 1	4,203,400t	3.63g/tAu	15.3t Au
	Total	7,914,100t	3.82g/tAu	32.8t Au
Northern	C 2	403,400t	4.30g/tAu	1.7t Au
	P 1	201,700t	4.30g/tAu	0.7t Au
	Total	605,100t	4.30g/tAu	2.6t Au
Total	C 2	4,114,200t	4.06g/tAu	16.7t Au
	P 1	4,405,100t	3.66g/tAu	16.1t Au
	Total	8,517,000t	3.85g/tAu	32.8t Au

These ore reserves are calculated as follows.

- Assay results of 3,300 samples from trenches and pits are adopted.
- 87 ore bodies were set up.
- Ore bodies were presumed as board like shaped and extending to 200-450 m horizontally.
- Size of ore bodies were determined 0.3-4.4 m in width, and 100 m in depth collectively.
- Waste rocks between ore bodies are not considered.

(2) The results of our three years survey are as follows.

- Downward extension is expected less than 30 m.
- Horizontal extensions are recognized less than 150 m.
- Ore gold grades are the highest on the surface and suddenly decrease underground.

- Adopting bulk mining method, waste rocks between ore bodies are difficult to separate from ore. So that the gold grade of crude ore will become very low, less than half of the ore reserves.

(3) The following points are considered as reasons for the difference in ore reserves.

- Smaller horizontal extension than 1976 study
- Smaller vertical extension than 1976 study

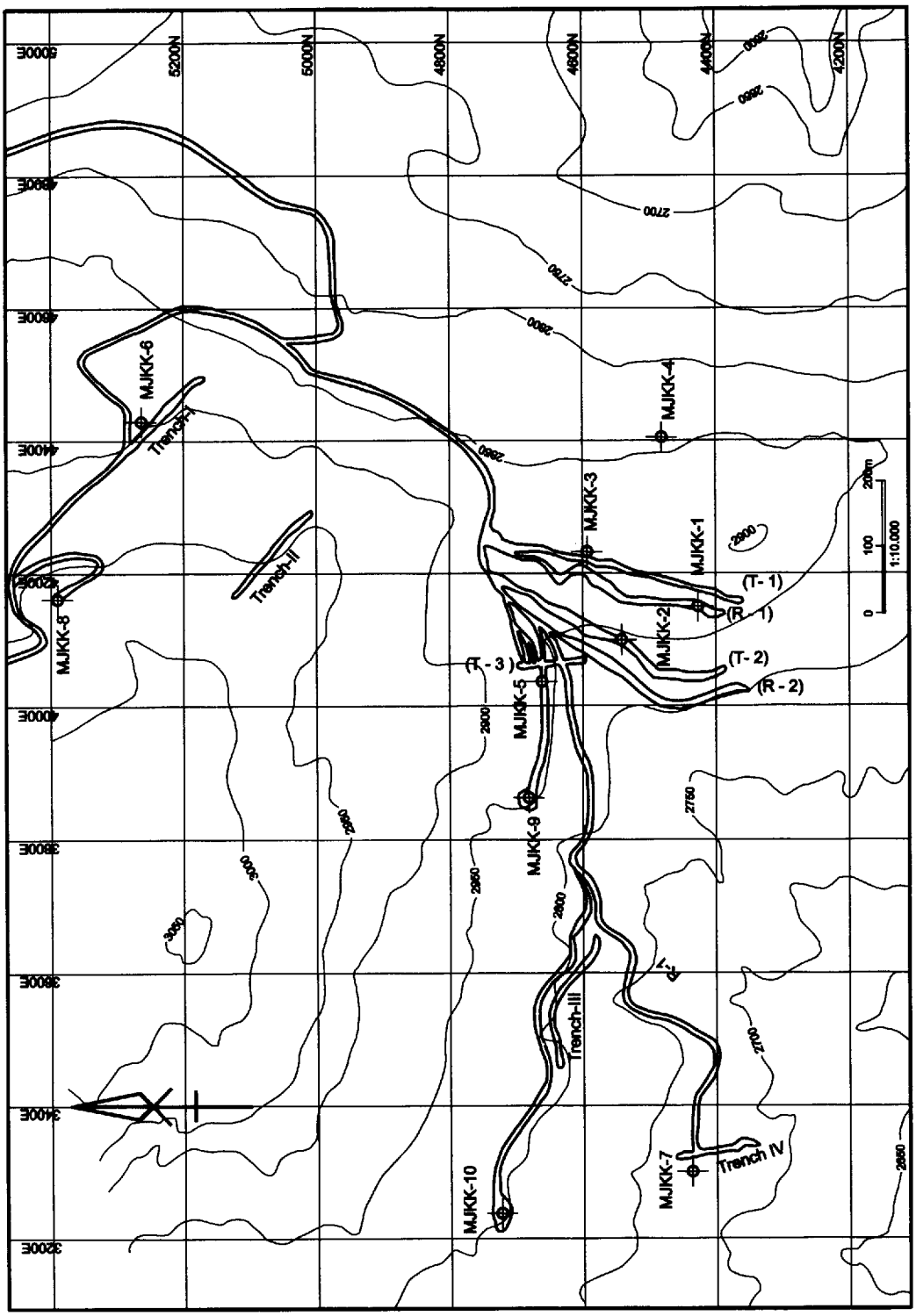


Fig. II-1-1 Location Map of Drill Holes (1:10,000)

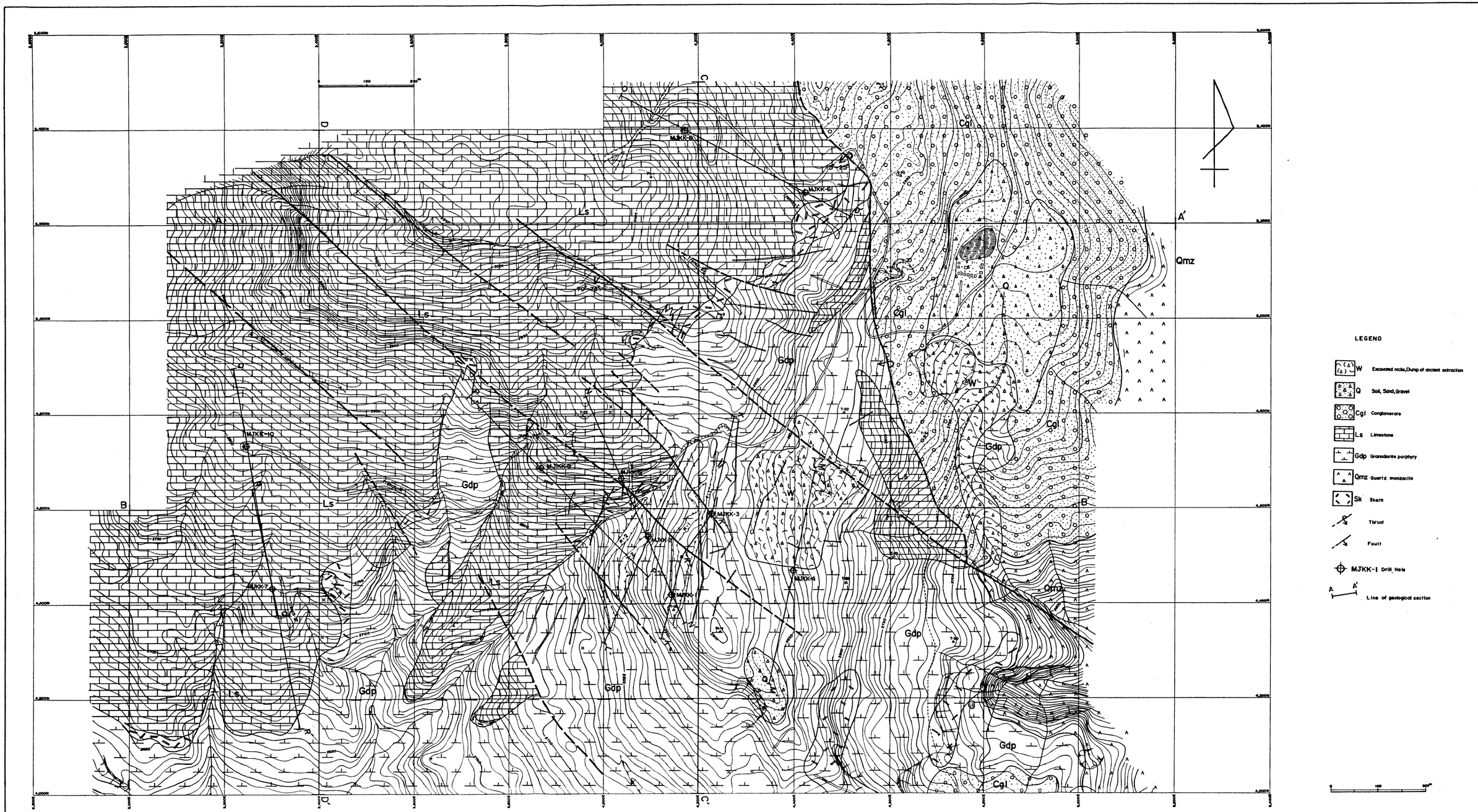


Fig. II -1-2 Geological Map of the Kichi-Sandyk District (1:6,000)

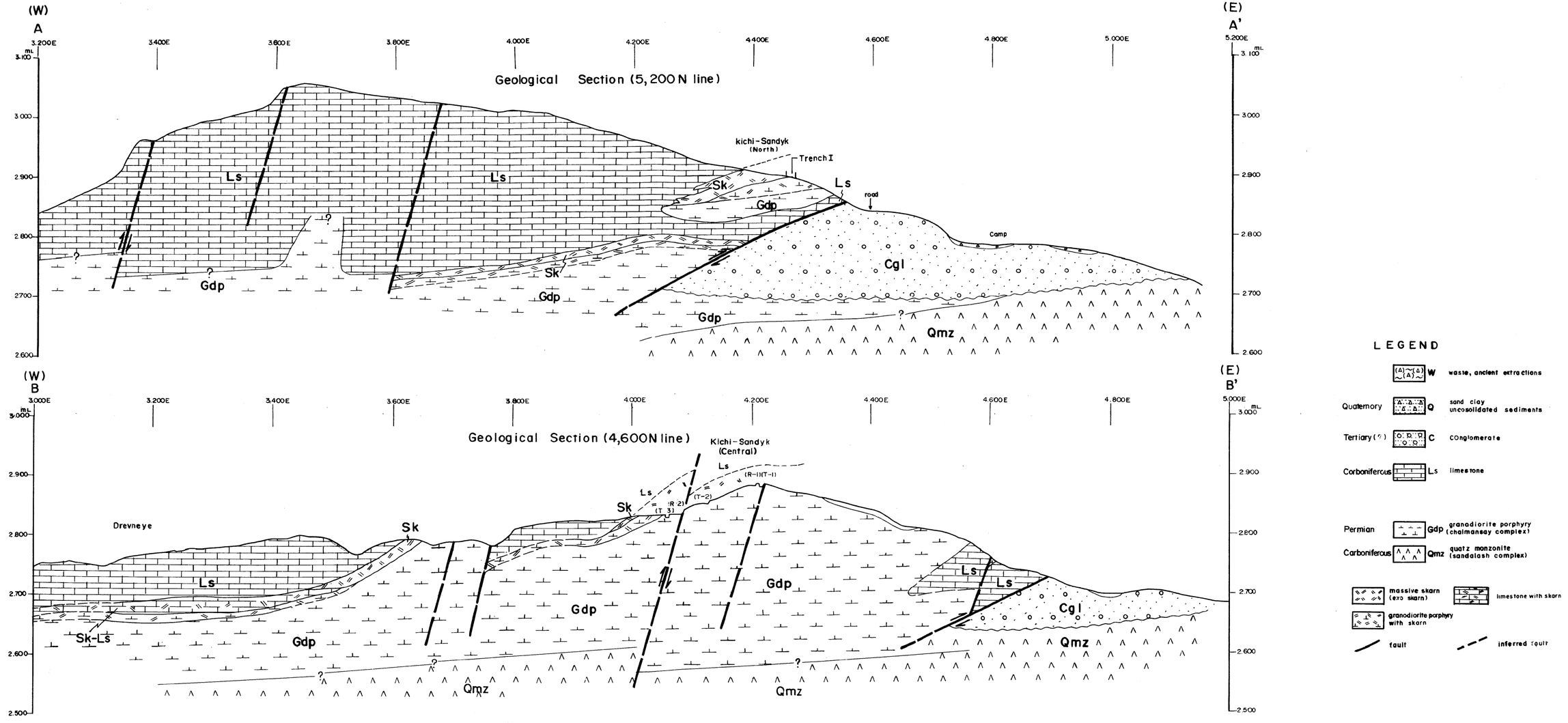
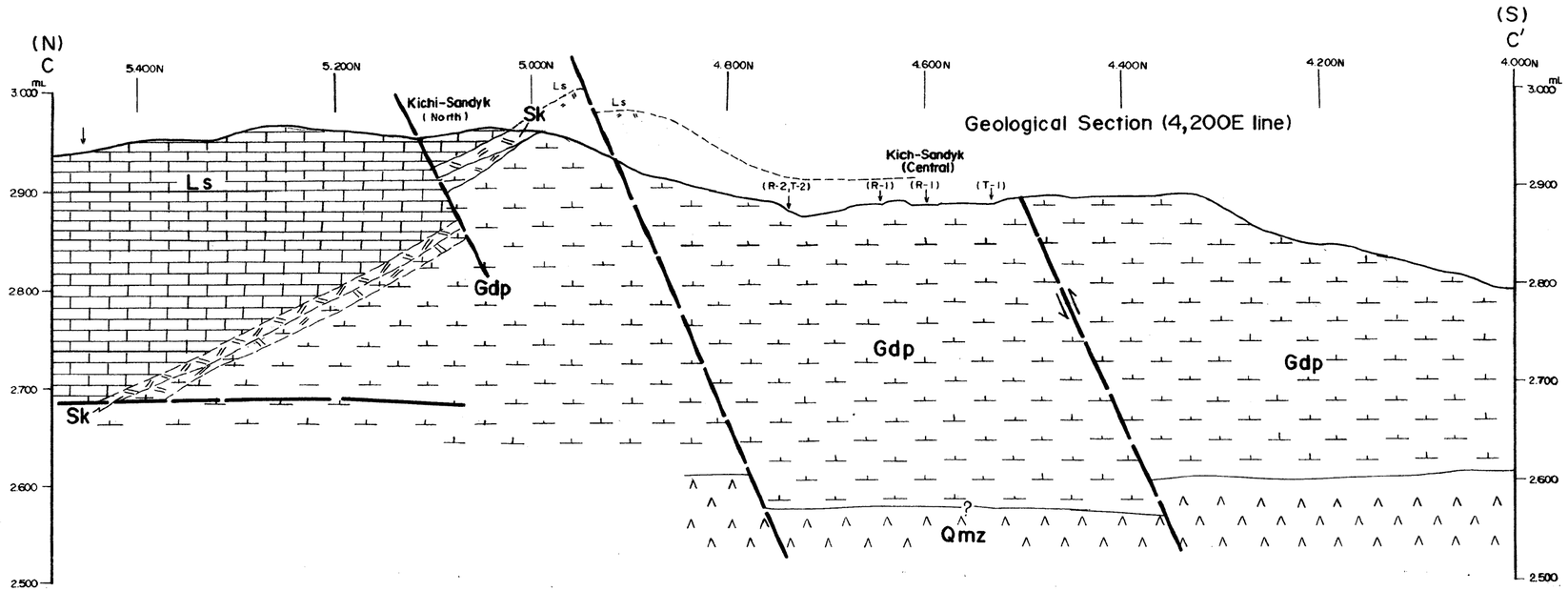
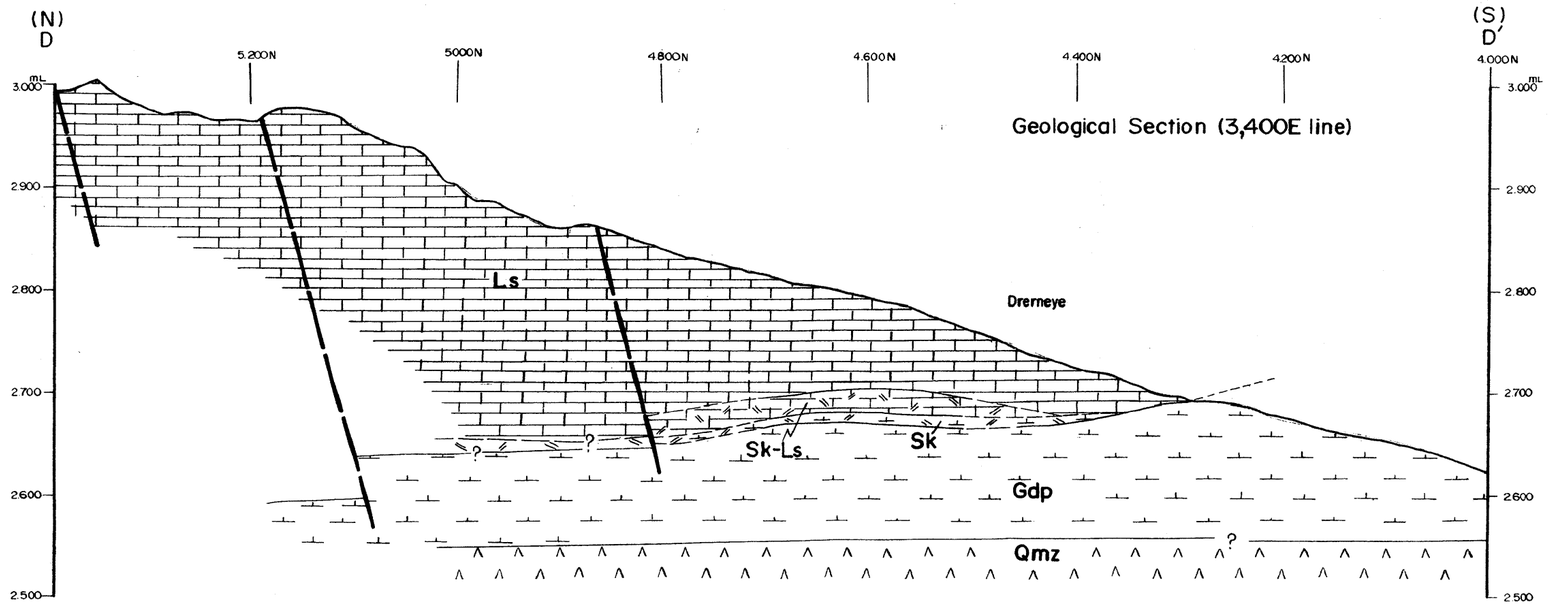


Fig. II-1-3 (1) Geological Cross Section of the Kichi-Sandyk District (1:6,000)





LEGEND

- W — waste, ancient extractions
- Quaternary — Q — sand, clay, unconsolidated sediments
- Tertiary (?) — C — conglomerate
- Carboniferous — Ls — limestone
- Permian — Gdp — granodiorite porphyry (chalmansay complex)
- Carboniferous — Qmz — quatz monzonite (sandaksh complex)
- massive skarn (exo skarn)
- limestone with skarn
- granodiorite porphyry with skarn
- fault
- inferred fault

0 100 200m
1 5,000

Fig. II-1-3 (2) Geological Cross Section of the Kichi-Sandyk District (1:6,000)

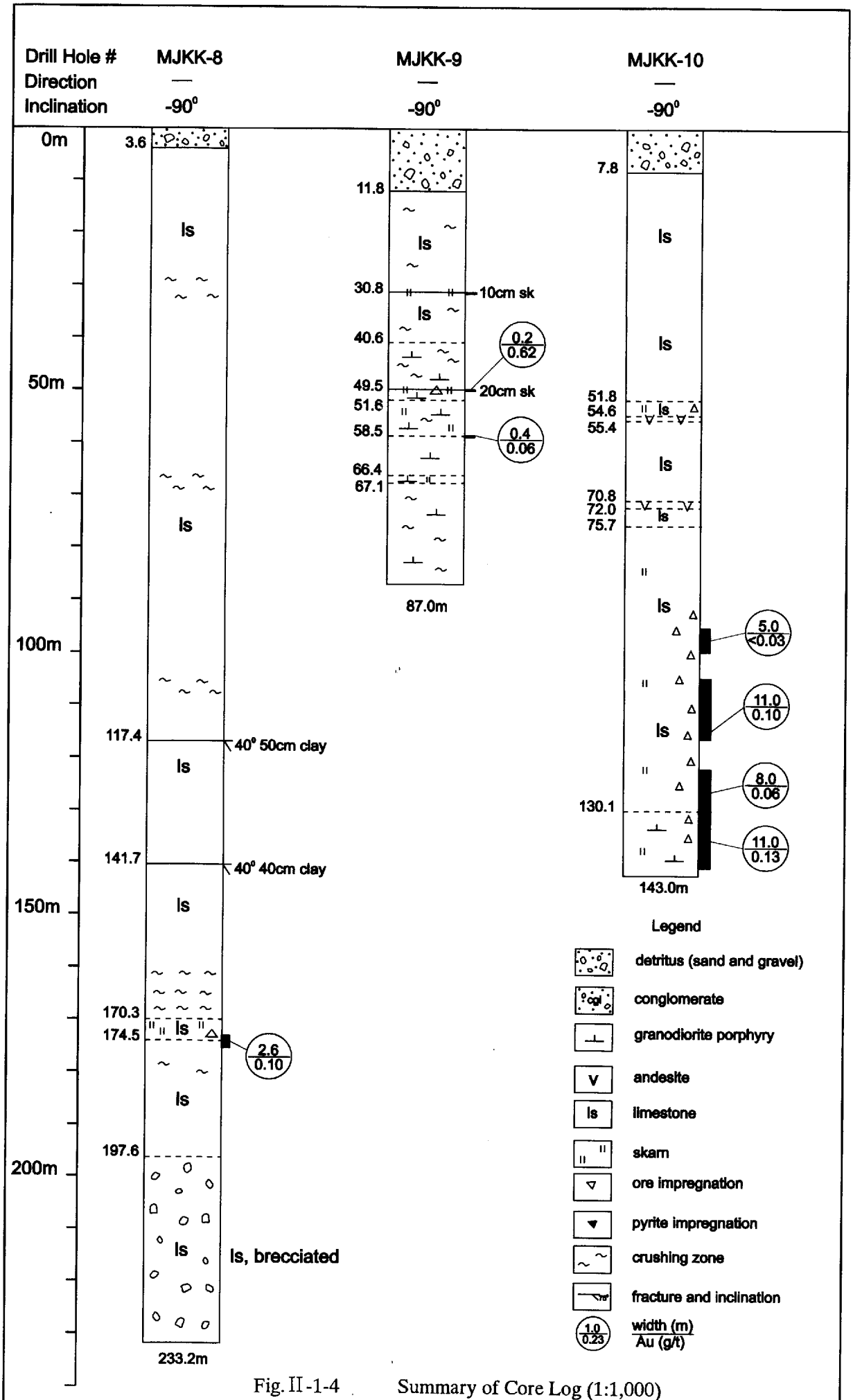


Fig. II-1-4 Summary of Core Log (1:1,000)

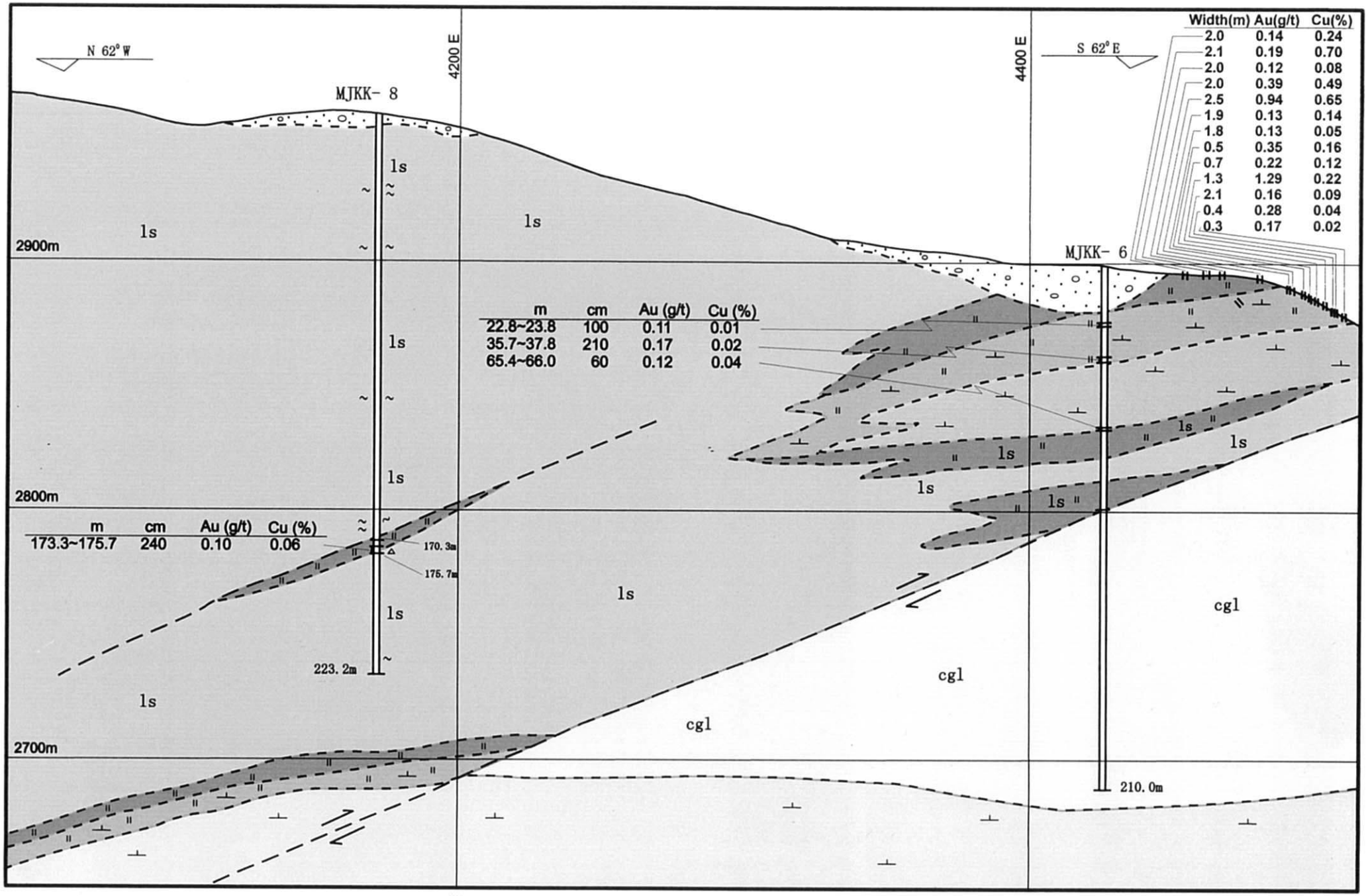


Fig. II-1-5 (1) Geological Cross Section along MJKK-8 (1:2,000)

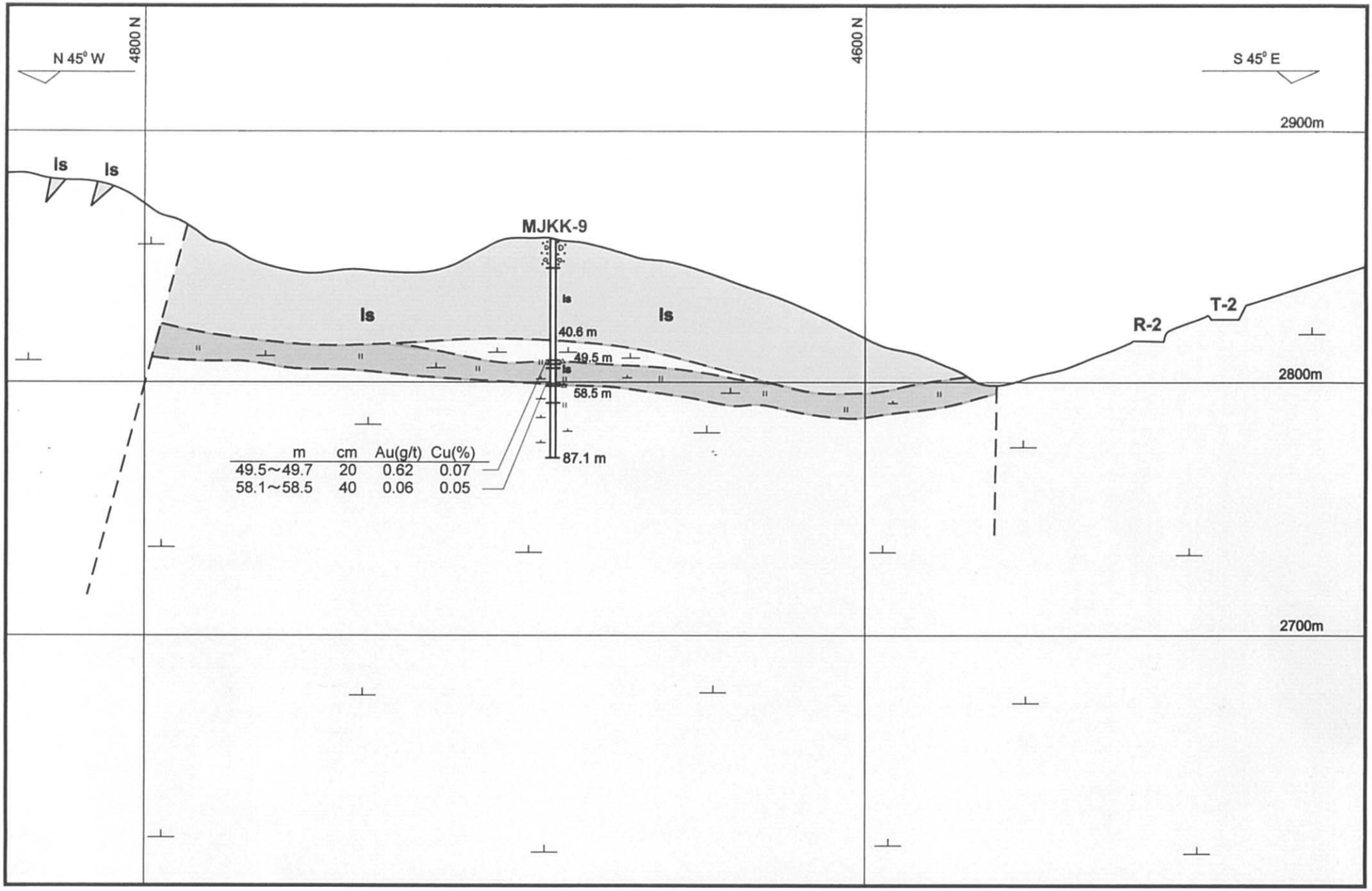


Fig. II-1-5 (2) Geological Cross Section along MJKK-9 (1:2,000)

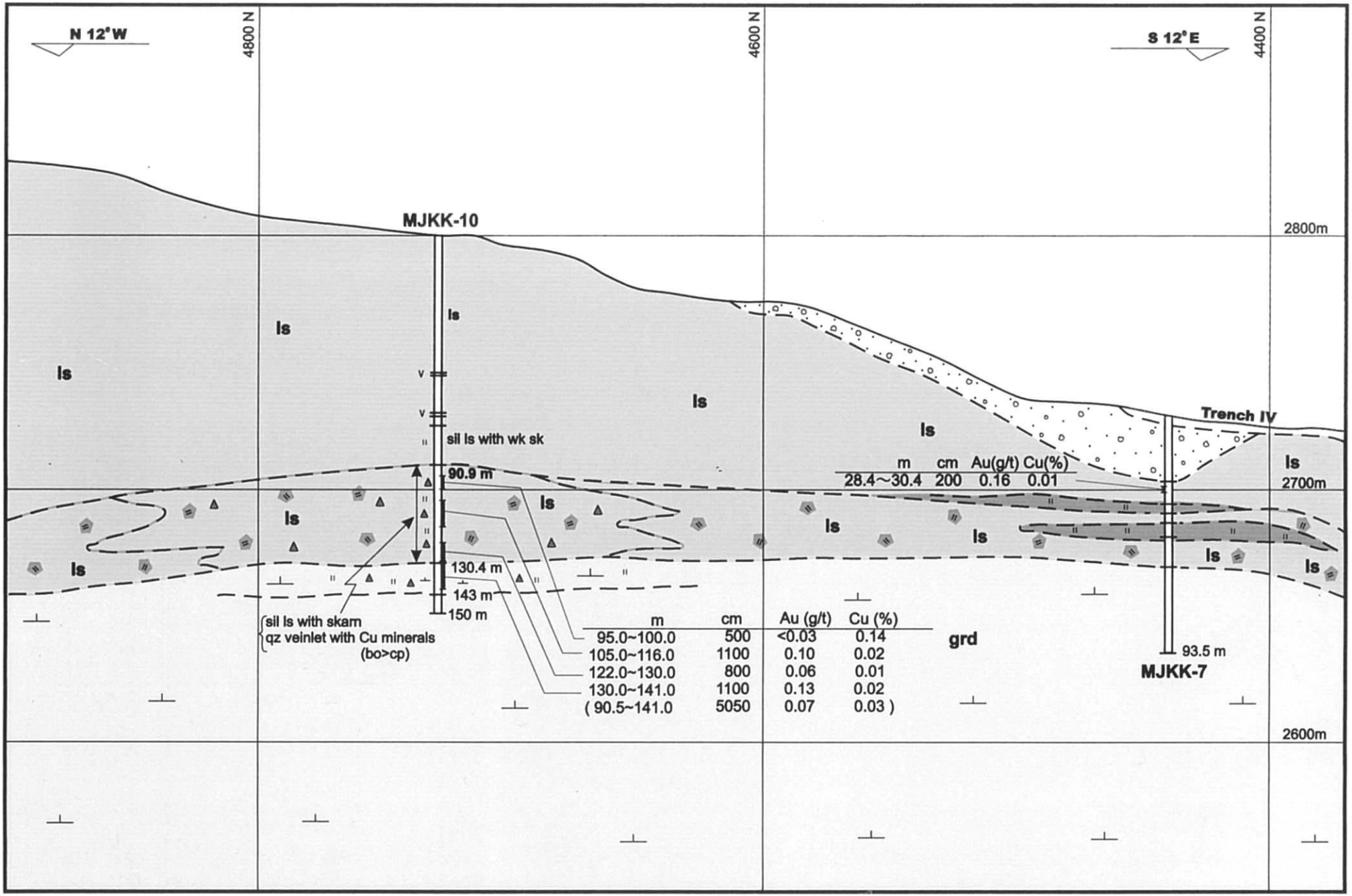
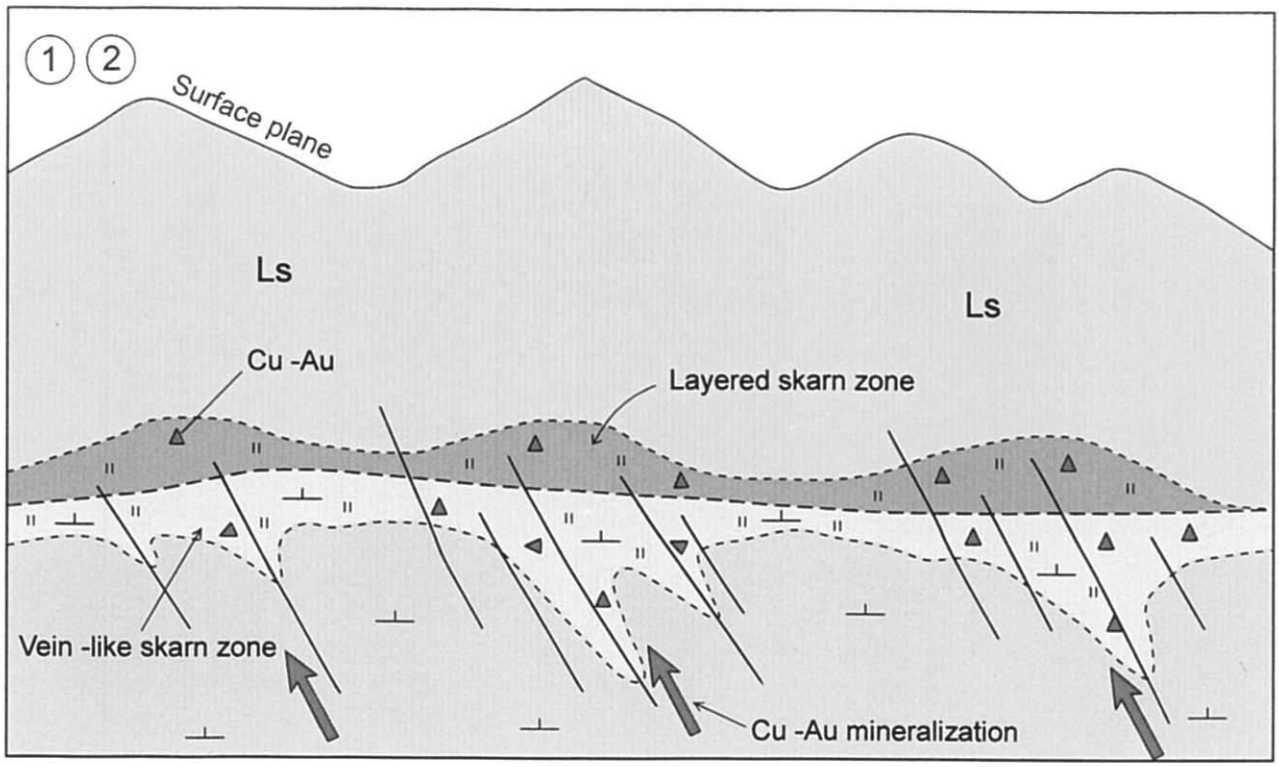


Fig. II-1-5 (3) Geological Cross Section along MJKK-10 (1:2,000)



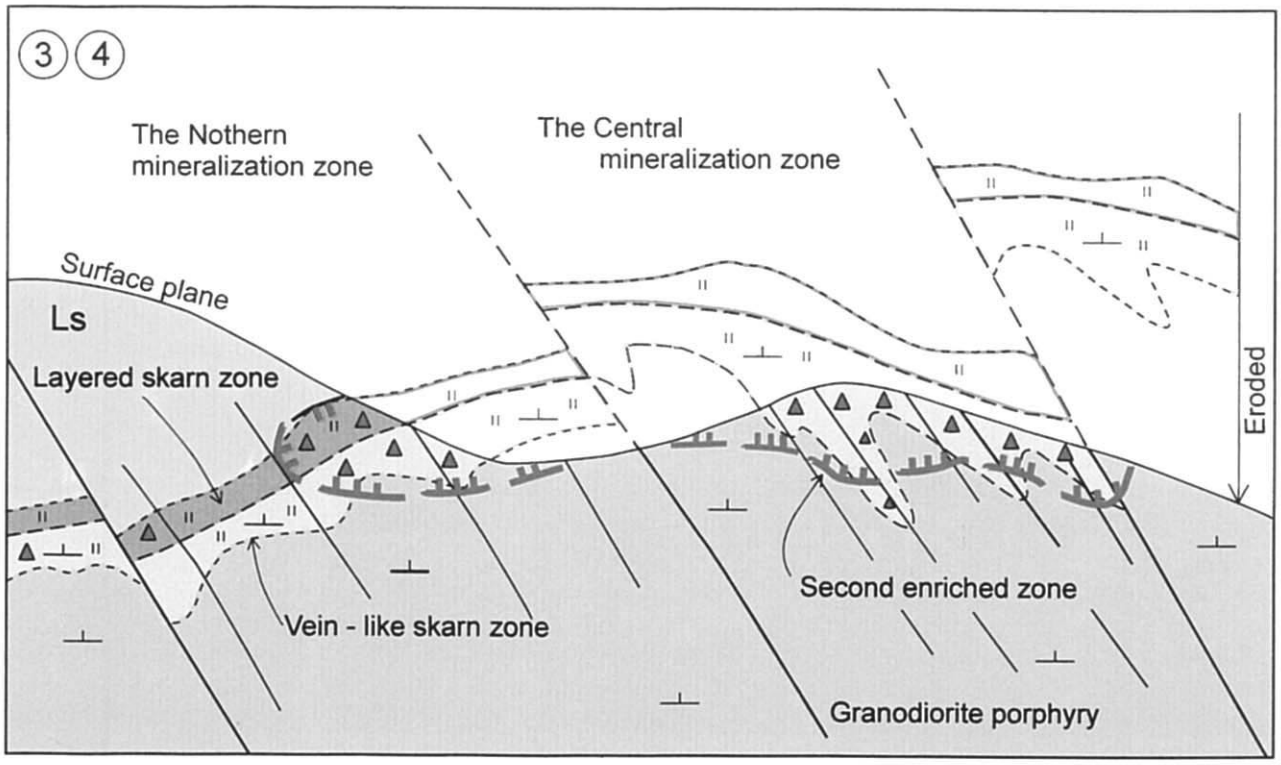


Fig. II-1-6 Model of the Mineralization of the Kichi-Sandyk District

PART III CONCLUSIONS

CHAPTER 1 CONCLUSIONS

In order to recognize the mineralization at the depth of exogenetic skarn deposits and clarify the gold mineralization in detail, the third year's survey diamond drilling has been carried out aiming for the contact plane of limestone and granodiorite porphyry in the northern mineralization zone of the Kichi-Sandyk district. The amount of drilling was three drill holes totaling 450 m.

As a result of this year's survey, it is concluded that although the mineralization is widely distributed near the contact of limestone and granodiorite porphyry in the northern mineralization zones of Kichi-Sandyk district, as the high-grade ore occurs only on the surface or near the surface oxidation zones. Therefore, the existence of a promising ore deposit is hardly expected.

Initially, the existence of a promising ore deposit was expected due to the 1976 Kyrghyz survey estimated potential ore reserves (C2+P1 ore reserves) of 33 tons Au with an average grade of 3.85 g/t Au in the central and northern mineralization zones in the Kichi-Sandyk district. However, it was revealed that the extension of the ore body is very limited both laterally and vertically, and the ore gold grade suddenly decreases underground. Therefore the existence of a promising ore deposit is hardly expected in both mineralization zones.

1-1 Characteristics of geological structure and mineralization

1) Geology

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

2) Geological structure

The limestone is intruded by the granodiorite porphyry. The contact plane between the limestone and granodiorite porphyry gently dips north or west and layered skarns often occur near the contact.

Conglomerates of Miocene are tectonically overlain by the granodiorite porphyry and limestone with a thrust fault that gently dips SW in the eastern part of the district. Topographic features indicate the presence of parallel faults trending NW-SE.

3) Mineralization

(1) Types of mineralization

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

① Endoskarn: A number of fissures and joints striking NW-SE and steeply dipping SW were formed within the granodiorite porphyry. Along these fractures near the boundary of limestone, vein-like skarns containing copper and gold, closely associated with calcite-quartz veinlets were often formed. These endoskarns occur in the central mineralization zone and below the layered skarns in the northern mineralization zone.

② Exoskarns: Layered skarns were formed in limestone at the contact with intrusives. This type of skarn occurs in the northern mineralization zone. In addition, pale green or pale brown limestone containing minor skarn minerals such as wollastonite, (weakly skarnized limestone) is widely distributed in the survey district, although they are barren.

(2) Minerals

Garnet, clinopyroxene and wollastonite are the main skarn minerals, which are accompanied with minor amounts of prehnite. Chrysocolla, malachite and minor amounts of chalcopyrite, bornite, chalcocite, covelline and electrum are identified as ore minerals. Also iron minerals of goethite, hematite and minor amount of pyrite are observed.

(3) Size of ore body

Width of individual vein-like skarns is on the order of 10-40 cm, and in the aggregate, they form several copper gold ore bodies with a width of a few meters to a maximum of 25 m. Deep ore bodies have a width on the order of 10-40 m. Ore bodies appear to be stockwork type as a whole, trending NW-SE, parallel to the major fracture system. The extent of the central mineralization zone as the aggregate of the above described ore bodies is presumed to be 300 m by 300 m. The downward extension of the mineralization zone is inferred to be on the order of 10-20 m and a maximum of 30 m. Mineralized part of 1.29 g/t Au was detected in the 7.0 m drill core from 90m depth of MJKK-2, although it is not expected to extend to the surface.

Outcrop of the layered skarns extends intermittently for 2 km in the NE-SW direction along the contact of limestone and granodiorite porphyry. The layered skarns are presumed to extend to a considerable depth and their width is on the order of 10-40 m.

(4) Ore grade

In the northern mineralization zone, the highest assay results in this year's survey are detected as 0.62 g/t Au in sample K904 of drill hole MJKK-9, and 0.34% Cu in sample K032 of drill hole MJKK-10. Assay result of this year was generally low

grade.

On the surface in the central mineralization zone, three ore bodies total 4,944 m^2, 1.94 g/t Au on average were calculated. However these ore bodies is inferred not to continue to a sufficient depth.

4) Model of mineralization

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

① As a result of intrusion of the granodiorite porphyry into the limestone, the layered skarns of 5-40 m thick were formed in the limestone along the contact plane. On the other hand, 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. At the same time, wollastonite was formed widely in the limestone.

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

③ The Kichi-Sandyk district was then tectonically deformed and divided into small blocks by thrust faults, striking N-S or NW-SE and dipping gently.

④ In the central mineralization zone, the vein-like skarns were exposed on the surface due to intense erosion of limestone which was laying on the intrusives having a 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 in oxidized zones at shallow depths.

1-2 Potential for ore deposits

Taking the three years survey results into consideration, potential for ore deposit in the central and northern mineralization zones in the Kichi-Sandyk district is as follows.

1) Central mineralization zone

- On the surface, three ore bodies of total 4,944 m^2, 1.94 g/t Au on average were calculated, adopting a cut-off grade of 1 g/t Au.
- As a result, the following probable ore reserves (C1 or C2) are calculated.

  (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

- The layered skarns are distributed near the contact of the granodiorite porphyry and limestone. The vein-like skarns same as that of the central mineralization zone are

also distributed in the granodiorite porphyry under the contact.

- In layered skarns in the trenches on the surface, 1.33 g/t Au in 16.2 m and 1.10 g/t Au in 9.8 m were detected.
- The existence of copper-gold bearing layered skarns is expected in the area of 1.5 km by 0.7 km.
- Drilling survey revealed that the ore grade of the downward extension of these ore bodies were very low, 0.25 g/t Au (9K044) was the highest and most of the assay were reported as less than 0.1 g/t Au in layered skarns. In vein-like skarns, two samples of 36.77 g/t Au (8K510) and 0.62 g/t Au (9K904) were detected, but other mineralized parts were low grade less than about 1 g/t Au.
- According to the results of the drilling survey, the ore grade of the northern mineralization zone is inferred as lower than 1 g/t Au. Although ore reserves can not be calculated, there is the possibility of the existence of high-grade ore bodies because the previous exploration was done in a very limited area of the vast mineralization area.

3) Discussion on potential ore reserves in 1976 study

- Initially, the existence of a promising ore deposit was expected due to the 1976 Kyrghyz survey estimated potential ore reserves (C2+P1 ore reserves) of 33 tons Au with an average grade of 3.85 g/t Au in the central and the northern mineralization zones in the Kichi-Sandyk district.
- However, it was revealed that the extension of the ore body is very limited both laterally and vertically, and the ore gold grade suddenly decreases underground.
- Therefore the existence of a promising ore deposit is hardly expected in both mineralization zones.

CHAPTER 2 RECOMMENDATIONS FOR THE FUTURE

Concerning the results of these three years' survey, we recommend the following for the future:

(1) The ore body (vein-like skarn) is low grade (about 1 g/t Au) and small in the central mineralization zone of the Kichi-Sandyk district, so that the presence of a minable ore deposit is not expected. Accordingly, a further detailed survey in this zone is not necessary.

(2) In the northern mineralization zone of the Kichi-Sandyk district, the gold grade of the layered skarn deposits was low, less than 1 g/t Au. Although the previous exploration for this vast area is very limited, the existence of an economical high-grade ore deposit is not expected. The ore grade is required to be at least 6-8 g/t Au in the case of mining in this district. Therefore, a further survey in this zone is not required.

(3) In the Turpac-Tushty district, the existence of high-grade but small-scale ore bodies are possible in Turpac-Tushty and Ak-Kamou ore manifestations along the NE-SW faults. Further exploration aiming at high-grade ore bodies is recommended in this district and its surrounding area. Also clarifying of conditions on the existence of high-grade ore bodies is necessary. However, since the infrastructure of this mineralization zone is poor same as that of Kichi-Sandyk district, considerably higher ore grade is demanded for economically minable ore deposit.