No. 8

REPORT ON THE MINERAL EXPLORATION IN THE EASTERN BUKANTAU AREA THE REPUBLIC OF UZBEKISTAN

(PHASE I)

MARCH 1995

JAPAN INTERNATIONAL COOPERATION AGENCY

METAL MINING AGENCY OF JAPAN

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PREFACE

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

The JICA and MMAJ sent to the Republic of Uzbekistan a survey team headed by Mr. Katsuji Fukumoto from November 28, 1994 to February 17, 1995.

The team exchanged veiws with the officials concerned of the Government of the Republic of Uzbekistan and conducted a field survey in the Eastern Bukantau Area of the Republic of Uzbekistan. 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 development of the Project and contribute to promotion of the friendship between the two countries.

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

March 1995

Kimio Fujita
President
Japan International Cooperation Agency

Takashi Ishikawa
President
Metal Mining Agency of Japan

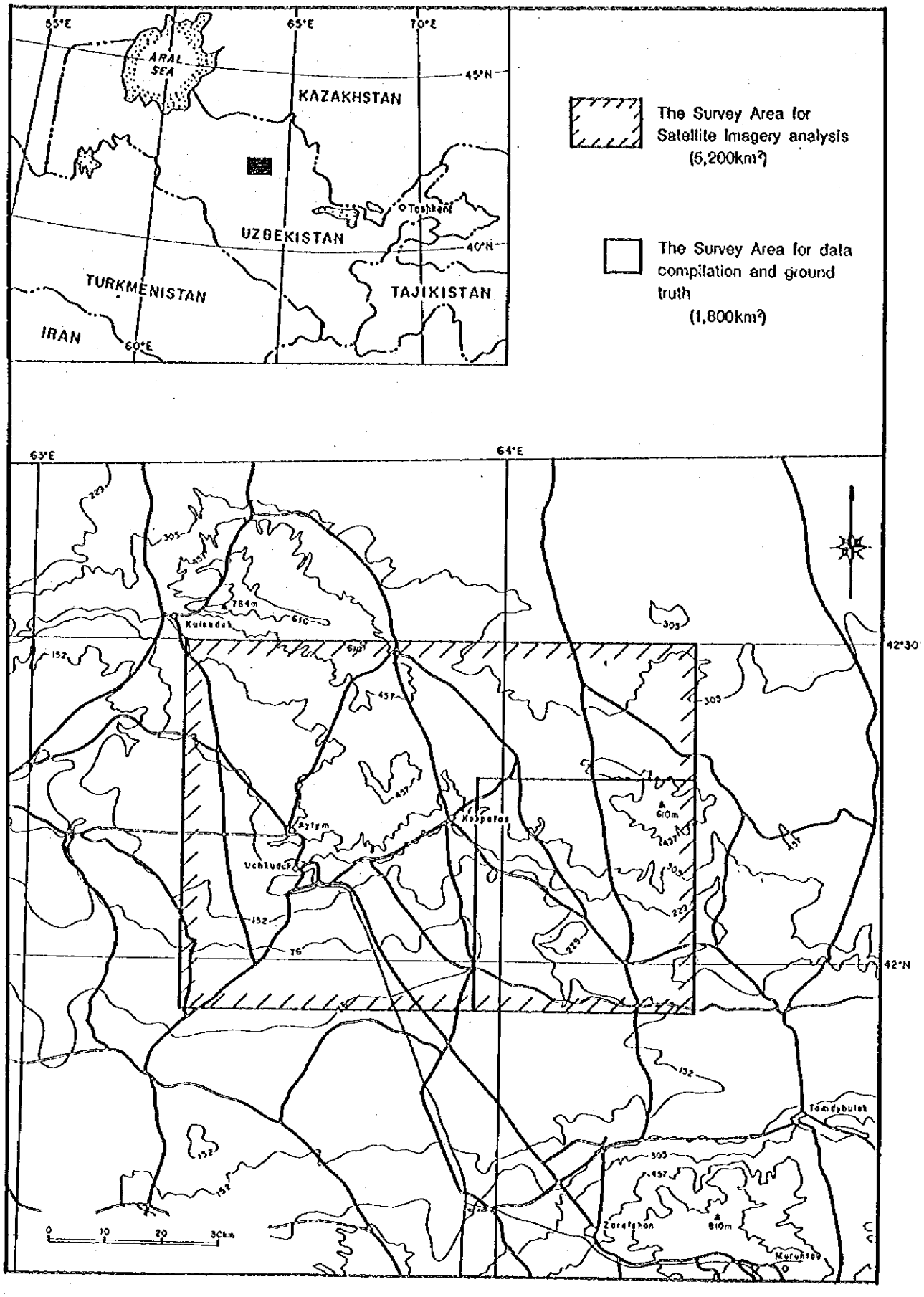

Fig. I –1 Location Map of the Survey Area

Р Е З Ю М Е

Настоящий отчет является сводом результатов фундаментального исследования по программе сотрудничества в освоении недровых ресурсов на первый год, которое было проведено в Восточно-Букантауской области Республики Узбекистан. Цель исследования, проводившегося с ноября 1994 г. по февраль 1995 г., заключалась в выяснении геологических условий и переоценке существующих рудных месторождений в названной области.

Исследование на первый год было проведено в пределах района площадью 6200 кв. км в Восточно-Букантауской области с осуществлением фотодешифрирования спутниковых (космических) снимков. По участку 1800 кв. км из общей площади района исследования были осуществлены со сбором существующих материалов и информации о геологии и месторождениях, а также о физических поисках, упорядочение собранных материалов и данных, их анализ, была изучена общая обстановка с производственными и перспективными месторождениями, расположением этих месторождений. В частности, для Саутбайского месторождения был проведен расчет запасов руды с целью предварительной оценки потенциала Саутбайского месторождения.

В результате расчета запасов на Саутбайском и Бургутском месторождениях выяснилось, что в случае среза $WO_3$0.05% запасы руды обеих месторождений составляют 25.885 тыс. т. При этом среднее содержание WO_3 - 0,27%, а Au - 0,24 г/т. Сравнение результатов данного расчета запасов с данными приготовленного узбекской стороной Сарыджойского отчета подтвердило, что в части планируемой открытой добычи руды (до глубины 150 м под поверхностью земли) запасы (срез $WO_3$0.05%) составляют прибл. 2600 тыс. т. при применении любого метода. Проведенный нами расчет, также, показал, что среднее содержание WO_3 и Au составляет 0,35% и 0,13 г/т., соответственно. Несмотря на то, что эти цыфры были на немного меньше, чем те, указанные в Сарыджайском отчете (WO_3 и Au - 0,38% и 0,16 г/т., соответственно), в целом результаты обеих расчетов были сходны между собой.

Однако расчет запаоов для обеих месторождений в целом выявил значительное расхождение от отчета узбекской стороны. Так, по проведенному нами расчету рудные запасы составляют 25.885 тыс.т. или 65% от 39.539 тыс.т. в Сарыджойском отчете. Среднее содержание WO_3 (0,27%) и Au (0,24 г/т.), также было ниже и составили, соответственно, 63% и 71% от значений, указанных в Сарыджойском отчете.

Отличие рудных запасов объясняется тем, что в нашем расчете не принимались в учет запасы на тех участках, о которых материалы к сведения отсутствовали, тогда как Сарыджойский отчет рассматривал такие запасы существующими, если узбекские исследователи сочли соответствующее рудное тело имевшим достаточное свидетельство о его геологической непрерывности даже при отсутствии конкретных данных. Сверх того, выяснилось, что общее повышение среднего содержания в Сарыд-

жойском отчете было вызвано взятием узбекскими исследователями максимальных значений среди множества данных, полученных из предварительно определенного контура полезных ископаемых.

В ходе исследования были выделены 24 существующих (уже найденных) и перспективных месторождений, которые разделяются на 7 групп по видам и типам, а именно на: ① месторождения с жилами золота и кварца; ② месторождения с жилами золота, серебра и кварца; ③ месторождения с жилами золота, серебра, меди и кварца; ④ месторождения с жилами серебра и кварца; ⑤ вольфрамовые и скарновые месторождения; ⑥ месторождения вольфрамовой и кварцевой тектуры; и ⑦ скарновые месторождения вольфрама и золота. Процесс минерализации в данном районе исходит из карашахской и кокпатасской формаций протерозойской эры, вмещивающих пород девонской и каменноугольной систем, и генно связан с действием гранитных пород, внедрившихся в период нижне-каменноугольной - верхне-пермской эры, и сдвигами по направлениям СЗ-ЮВ, СВ-ЮЗ и ССЗ-ЮЮВ.

В результате анализа существующих материалов и информации было выделено Булгуканское перспективное месторождение (Au), на разведку которого возлагаются большие надежды. На западном участке этого месторождения уже начаты работы по разведке и подтверждено одно минеральное тело. Предварительный расчет запасов показывает 342 тыс. т. при среднем содержании Au - 6,9 г/т., а золота - 2,4 т. Данное перспективное месторождение требует более подробную и дальнейшую разведку. Спектро-фотодешифрирование спутниковых снимков позволило выделить 17 зон изменения, которые, может быть, относятся к зонам изменения (зона железокислотных минералов), связанного с золоторудной минерализацией с высоким содержанием сернистых соединений. Однако с учетом того, что золоторудные месторождения с низким содержанием сернистых соединений характеризуются слабым развитием железокислых минералов, более целесообразным считается проведение геотектонического анализа таких месторождений за счет геофотодешифрирования.

В дальнейшем целесообразно осуществлять: ① пробуривание до глубины 300 м. на Саутбайском месторождении (W) для уточнения рудного тела №1, анализ данных о Сагенханском месторождении, оценку запасов Саутбайского месторождения, составление предварительного ТЭО для программы разведок для развития Саутбайского, Буругутского и Сагенханского месторождений; ② пробуривание до нижней части высокозолоторудного тела, траншейную разведку и геофизическую разведку для выяснения горизонтальное и вертикальное распространение процесса минерализации; ③ более подробное исследование Саутбай-Булутуханского и Окджетпесского районов, которые были выделены за счет спектрального дешифрирования космических снимков.

Summary

This report summarizes the result of the Phase I survey of Technical Cooperation for Mineral Exploration conducted in the Eastern Bukantau Area of the Republic of Uzbekistan. Purpose of the survey is to investigate the geology and mineral potential of the area, and to reassess the existing mineral deposits. The field survey was conducted from November 1994 to February 1995.

In the Phase I survey, an analysis of satellite image for the area of 5,200 km^2 in the East Bukantau Area was conducted. Then, existing data of geology, mineral deposits, geophysical survey were collected and analysed for the area of 1,800 km^2 in order to grasp the outline of geology and mineral deposits. Ore reserve estimate has been made for Sautbay deposits to assess the mineral potentiality.

Result of ore reserve estimate of Sautbay·Burgut ore deposits shows the total ore reserves of 25,885 thou.tons with average grade of 0.27%WO_3 and 0.24g/t Au with cut off grade of 0.05%WO_3. Comparing this result with the result of Sarydjoy report, the tonnage of scheduled open pit mining (above -150m level) is well coincide between two results that is about 2,600 thou. tons with cut off grade of 0.05%WO_3.

The average grade of ore in Sarydjoy report is 0.38%WO_3 and 0.16g/t Au, while our calculation is 0.35%WO_3 and 0.13g/tAu.

Although the average grade of ore is slightly lower in our calculation, the results of both calculation as a whole can be considered to be the same.

In case of the tonnage of total ore reserve, however, there is a considerable difference between two results. Our calculation is 25,885 thou.tons which is 65% of Sarydjoy report (39,539 thou.tons). The average grade of ore in our calculation is 0.27%WO_3 and 0.24g/t Au which correspond to 63% and 71% of Sarydjoy report.

Regarding to the difference of tonnage of ore, we did not calculate ore reserve in the block without data, while Sarydjoy report calculate ore reserve in such a block if the extension of orebody is geologically assumed. As to the average grade of ore, in case of more than two data are available in one P_1 ore block, Sarydjoy report adopt the data of maximum grade. That is the reason of the average grade becomes higher in Sarydjoy report.

Twenty four localities of ore deposits and showings are known in the Survey Area, and they are classifled into the following seven groups.

① Gold quartz vein
② Gold·silver quartz vein
③ Gold·silver·copper quartz vein
④ Silver quartz vein
⑤ Tungsten·skarn deposit
⑥ Tungsten·quartz stockwork deposit
⑦ Tungsten·gold skarn deposit

Mineralization of this area is hosted in Karashakh Formation and Kokpatas Formation of Proterozoic age, systems of Devonian to Carboniferous and related to the granitic intrusion of late Carboniferous to early Permian. Structurally the faults and fractures of NW-SE, NE-SW and NNW-SSE have played an important role in ore deposition.

Bulutkan ore showing(Au) is selected as a promising area for further exploration from the result of existing data analysis. The western part of the area has already been explored and an orebody was confirmed. Rough estimate shows 342 thou.tons of ore reserves with 6.9g/t Au containing 2.4 tons Au. There is a enough room for further exploration in this showing.

A spectral analysis of satellite image revealed 17 alteration zones. They are possibly related to the high sulfide type gold mineralization, containig abundant iron oxides. On the other hand an analysis of geological structure is more effective than the spectral analysis to the low sulfide type gold mineralization as they contain less iron oxides.

The follwing surveys shoud be conducted from the Phase II survey.

① Diamond drilling for Sautbay No.1 ore body in the level of -300m from the surface, data analysis of Saghinkan ore showing, ore reserve estimate of Sautbay deposits, pre-feasibility study of Sautbay , Burgut, Saghinkan deposits.
② Trenching, geophysical survey and diamond drilling for the high grade gold ore body of Bulutkan showing to investigate lateral and vertical extension of ore body.
③ Geological field check for the alteration zones of Sautbay-Bulutkan area and Okjetpes area which are detected by the spectral analysis of satellite images.

Contents

Part III CONCLUSION AND RECOMMENDATION

LIST OF FIGURES

LIST OF TABLES

LIST OF PLATES

LIST OF APPENDICES

Part I GENERAL REMARKS

Chapter 1 Introduction

1-1 Background of the Survey

The exploration for the mineral resources in the Eastern Bukantau Area of Uzbekistan is conducted by the Japanese Government based on the Scope of Work dated August 10, 1994 in response to the request of the Government of the Republic of Uzbekistan.

The main objective of the Survey is to explore and to assess the mineral potential of the survey area. In the Phase I, the existing data compilation, the satellite imagery analysis and geological ground truth were conducted.

1-2 The Survey Area

The survey area is 5,200 km2 for satellite imagery analysis. The existing data compilation and geological ground truth are concentrated within the area of 1,800 km2 shown in Fig.I-1.

1-3 Objective of the Survey

Purpose of the survey is to clarify the geology and possibility of mineral potential of the Eastern Bukantau Area of Uzbekistan and to explore new ore deposits and to re-evaluate the existing ore deposits.

1-4 Methods of the Survey

(1) Satellite imagery analysis

Satellite imagery analysis was carried out to reveal geological structure and to extract alteration zones. Firstly photogeological interpretation was conducted to reveal geological structure after a false color composite image was produced from CCT data. Secondary rationing analysis was selected to extract alteration zones after several trial of spectral analyses had been executed.

The data processing and analyses were done in Japan.

(2) Existing data compilation

Data compilation was carried out to assess known ore deposits and ore showings and to evaluate the potential of Sautbay deposit preliminary.

Existing geological and geophysical data was collected and analysed in the State Committee for Geology in Tashkent and Kokpatas Expedition.

Preliminary ore reserves calculations of Santbay deposit were carried out using personal computer and ore reserves calculation program (micro LYNX).

(3) Ground truth

Ground truth was carried out to check the result of the satellite imagery analysis and data compilation.

Topographical maps, a scale of 1/50,000 were used for the survey. The survey was carried out using a 4 WD car. The basement was set up in Kokpatas. 117 rock and ore samples were collecled for the laboratory test.

The details are as follows:

Laboratory test

Item	Quantity
Observation of thin sections	11 pcs
Observation of polished sections	10 pcs
Whole rock analysis	
-SiO2,TiO2,Al2O3,Fe2O3,FeO,MnO, CaO,Na2O,MgO,K2O,P2O5,LOI	35 pcs
Assay of ore samples	
-Au,Ag,Cu,Pb,Zn	15 pcs
-Au,Ag,Cu,Pb,Zn.WO3,Mo,Bi	30 pcs
X-Ray diffraction	16 pcs
	117 pcs

1-5 Organization of the Survey Team

(1) Planning and Negotiation

Japan side:	Jiro OSAKO	MMAJ
	Kenichi TAKAHASHI	JICA
	Taro KAMIYA	MMAJ
Uzbekistan side:	H.S. Islamkhodjaev	MFER

Remir V. Tsoi	SCG	
A.L. Ogarkov	SCG	
J.R. Karimov	SCG	
A.T.Zakirov	SKG	

(2) Survey Team

Japan side:	Katsuji FUKUMOTO	Leader	MINDECO
	Osamu MIYAISHI	Geologist	MINDECO
	YIN Jianhua	Geologist	MINDECO
	Manabu KOBAYASHI	Geophysist	MINDECO
Uzbekistan side:	A.L.Ogarkov	Geologist	SCG
	N.E.Kozarez	Geologist	SCG
	V.N.Ushakov	Geologist	SCG
	A.T.Zakirov	Geologist	SKG
	V.F.Gbizdon	Geologist	KE
	Lev.A.Seem	Geophysist	SCG
	A.A.Horsov	Geophysist	SCG
	V.D.Bravichev	Technical engineer	SCG
	V.S.Protopopov	Technical engineer	KE
	J.R.Karimov	Coordinator	SCG
	S.Musaev	Coordinator	SCG

(3) Field Inspection

Takahisa YAMAMOTO	MMAJ
Yoshihiro KUBOTA	MMAJ
Masayoshi KAMEYAMA	MMAJ

JICA:	Japan International Cooperation Agency
MMAJ:	Metal Mining Agency of Japan
MFER:	Ministry for Foreign Economic Relations
SCG:	State Committee for Geology
SKG:	Samarkandgeology
KE:	Kokpatas Expedition
MINDECO:	Mitsui Mineral Development Engineering Co.,Ltd.

(4) Period of the Survey

The year / The month	1994			1995	
	Oct.	Nov.	Dec.	Jan.	Feb.
Period of the contract	13----------	----------	----------	----------	----------28
Satellite imagery analysis	----	---------27			
Field survey		28----	----------	----------	-------17
Test and analysis				20----	--------20
Report making				20----	----------28

Chapter 2 Geography of the Survey Area

2-1 Location and Accessibility

The Eastern Bukantau Area is situated in the south-eastern part of the Bukantau Mountains in the Central Kizilkum desert. From administrative point of view, the area is situated in the territory of the Uchkuduk district of the Naboi region.

The survey area is located about 450 km of north-west of Tashkent City, the metropolis.

There is a settlement of the Kokpatas expedition with a population of about 1,200 people in the center of the area.

The largest settlement in the area is the town of Uchkuduk situated about 30 km westward from the Kokpatas expedition. A dirt road connects the settlement of Kokpatas and the town of Uchkuduk. It takes about 40 minutes by car.

The town of Zarafshan is situated about 80 km south-eastward from the survey area. 28 km eastward from Zarafshan, a gold extracting complex is operating based on the Muruntau gold deposit.

Three flights a week are operated between Tashkent and Uchkuduk.

2-2 Topography and Drainage System

The Bukantau mountains is a narrow hilly regions (width:30-50 km, length:230 km) stretching WNW-ESE direction in the Kizilkum desert. The peak near the town of Kulkuduk in the western mountains has maximum elevation of about 750 m. It decreases the elevation towards the east. Eastern part of the mountains near the Sautbay deposits shows gentle relief (200-300m).

There are many dry rivers. The rivers have water only in the Spring and Autumn periods from time to time.

2-3 Climate and Vegetation

Climate of the area is sharp-continental, desert-arid, characteristic of hot and dry summer and cold winter with strong wind.

Average annual air temperature is +12.3℃. January is the coldest month of -7.4℃ (minimum:-30℃) in average temperature. July is the hottest month of +34.5℃ (maximum:+45℃) in averege temperature.

Average annual precipitation is 118 mm.

Average air humidity by month varies from 18 to 74 %.

March-April: 40-48%

May-August : 18-24%

September-November: 27-38%

December-February: 61-74%

Wind direction is predominantly north-eastward, rarely north-westword and southward. Average annual speed of wind is 6 m/sec and maximum speed of the wind is 35 m/sec. Dust storms occur very often.

Desert climate determine development of particular biologic groups of plants closely related with the type of soil. In the areas covered with soils and sandy soils annual and perennial grasses prevail. In spring, there are many mushrooms in the area.

Shrubs and semi-shrubs with a deep root system are confined to the area of aeolian sands.

Chapter 3 General Geology

3-1 Geology of the Bukantau Region

The Bukantau mountains are divided by North Bukantau Deep Fractures Zone into two zones: Northern Bukantau zone and Southern Bukantau zone.

The Survey Area is located in the Southern Bukantau zone, the east of the settlement of the Kokpatas Expedition.

(1) Northern Bukantau zone

Northern Bukantau zone, which extends 75 km in east-west direction and 8 to 20km in north-south direction around Kulkuduk, is underlain by meta-volcanic rocks, sandstone, shale, dolomite, limestone, alternation of conglomerate and sandstone (molasse), schist, alteration of sandstone and shale of Proterozoic to middle Carboniferous age. The rocks trend east-west and dip north in general.

The Bokalin intrusive rocks occur in the area of about 26km length and 6 km width in north of Kulkuduk, having intruded into the lower to middle Carboniferous sedimentary rocks. The intrusive rocks consist mainly of tonalite and trondhjemite of early Permian age.

(2) Southern Bukantau zone

Southern Bukantau zone extends from northwest to southeast and the geological structure coincides with the trend in general. Geological structure is characterized by the Kokpatas antiform, axis of which runs from the east of Kokpatas and extends to the Okjetpes area. The core area of the antiform is underlain by limestone, shale and dolomite of early Carboniferous age which crop out within the fenster around Kokpatas, while limestone and chert of Devonian to Carboniferous age crop out in the Okjetpes area.

Schist, chert, shale, dolomite, limestone and quartzite of Proterozoic age are distributed in the area of more than 50km in axial direction and 20km in transversal direction, surrounding the Paleozoic rocks.

Proterozoic rocks are divided into four formations: the Karashakh, Kokpatas, Khodjaakhmet and Koksai formations. Micro-fossils that indicate late Proterozoic age are found from the Kokpatas and Khodjaakhmet formations. Therefore, Proterozoic rocks in the Southern Bukantau zone are correlated to Ripheian to Vend stages. Total thickness of the Proterozoic formations is estimated to be more than 3,000m.

Paleozoic rocks are correlated to the Silurian to Carboniferous. Silurian rocks crop out

in the narrow area southeast of Okjetpes, and consist of alternation of shale and sandstone. Middle Devonian to lower Carboniferous rocks expose mainly in the north of the Kokpatas, and Okjetpes areas, and consist mainly of limestone and dolomite. Continental sedimentary rocks of middle Carboniferous age crop out on the flanks of the Kokpatas antiform, consisting of shale, sandstone, schist and phyllite.

Surrounding Proterozoic and Paleozoic rocks exposed are the marine sediments consisting of shale and sandstone of Cretaceous to Eocene age, and continental sediments consisting of conglomerate, sandstone and mudstone of Oligocene to Quaternary age.

Dominant intrusive rocks are the Altyntau Intrusives (granite), the Kokpatas Intrusives (granite-adamellite), the Turbay Intrusives (granite), the Sarytau Intrusives (granodiorite), the Sautbay Intrusives(monzonite to grano-syenite). All intrusive rocks have intruded during late Carboniferous to Permian time.

3-2 Mineral Resourses of the Bukantau Region

In the Bukantau region four metallogenic zones are indentified: Northern, Central, Western and Eastern Bukantau zones.

(1) The Northern Bukantau and Central Bukantau metallogenic zones are characteristic of gold, silver and copper including mostly copper, molybdenum, gold for the first one and gold, silver, (copper) for the second one.

Copper occurs in pyrite deposits in volcanics (Karamurun), copper bearing skarns with molybdenum (Orazaly). Gold-silver mineralization in effusive and clastic rocks (Kokpatas, Okjetpes) is of most importance. Tungsten is practically absent, although heavy concentrations of geochemical anomalies are noticed in the Northern Bukantau zone. Possibility of partial accumulation of tungsten is not excluded as it is a common element in gold ore deposits (Kokpatas ore field). However its grade does not reach the level of a by-product economically.

(2) The Western Bukantau and Eastern Bukantau metallogenic zones are characteristic of tungsten-gold-silver together with copper, molybdenum and mercury. Wide spread tungsten occurrence is quite characteristic. At the early and latest stages of Hercynian orogeny in parallel with thermal metamorphism and batholithic granitoid magmatism in the Eastern Bukantau zone, stockwork gold-tungsten and tungsten metasomatite deposits (Turbay, Sarytau), and magnesian skarn and skarnoid deposits (Cholcharatau, Sautbay and Sarytau) were formed.

The ore zone of the Eastern Bukantau metallogenic zone corresponds to deep seated

granitoid intrusive.

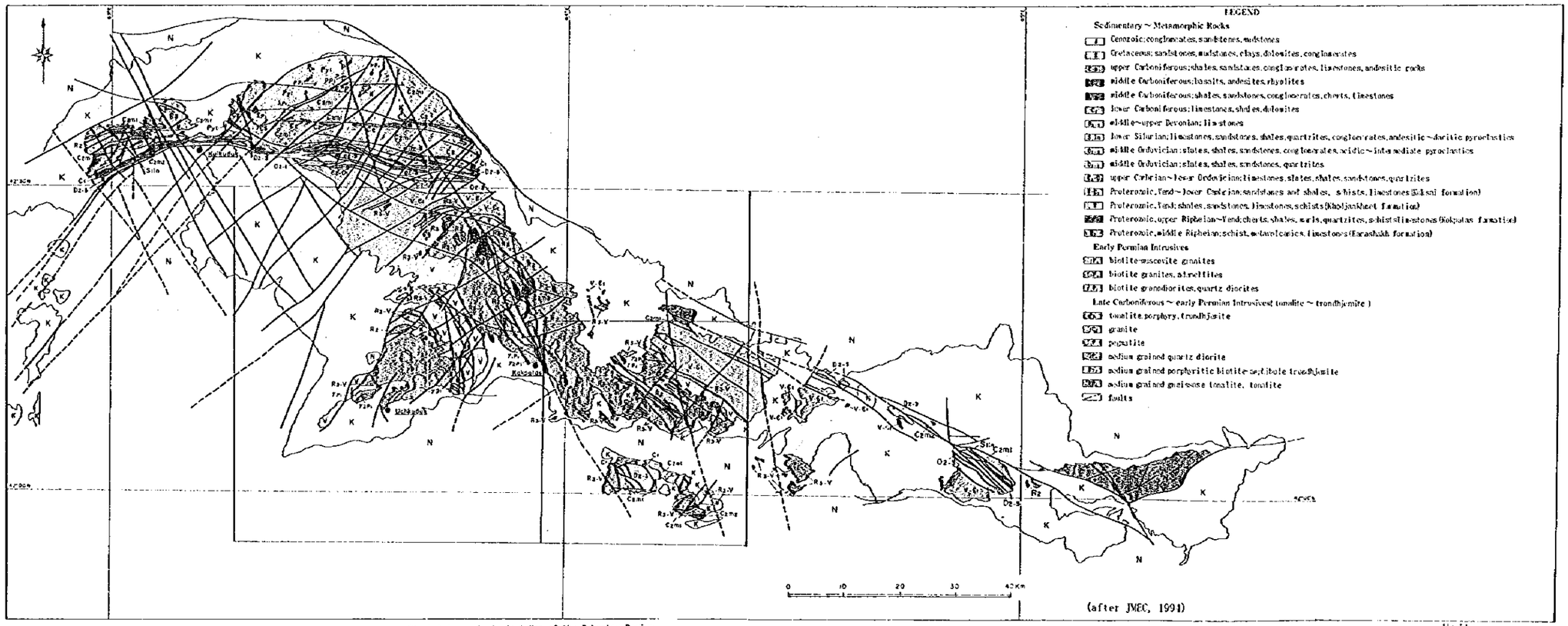

Fig I-3-1 Geological Map of the Bukantau Region

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

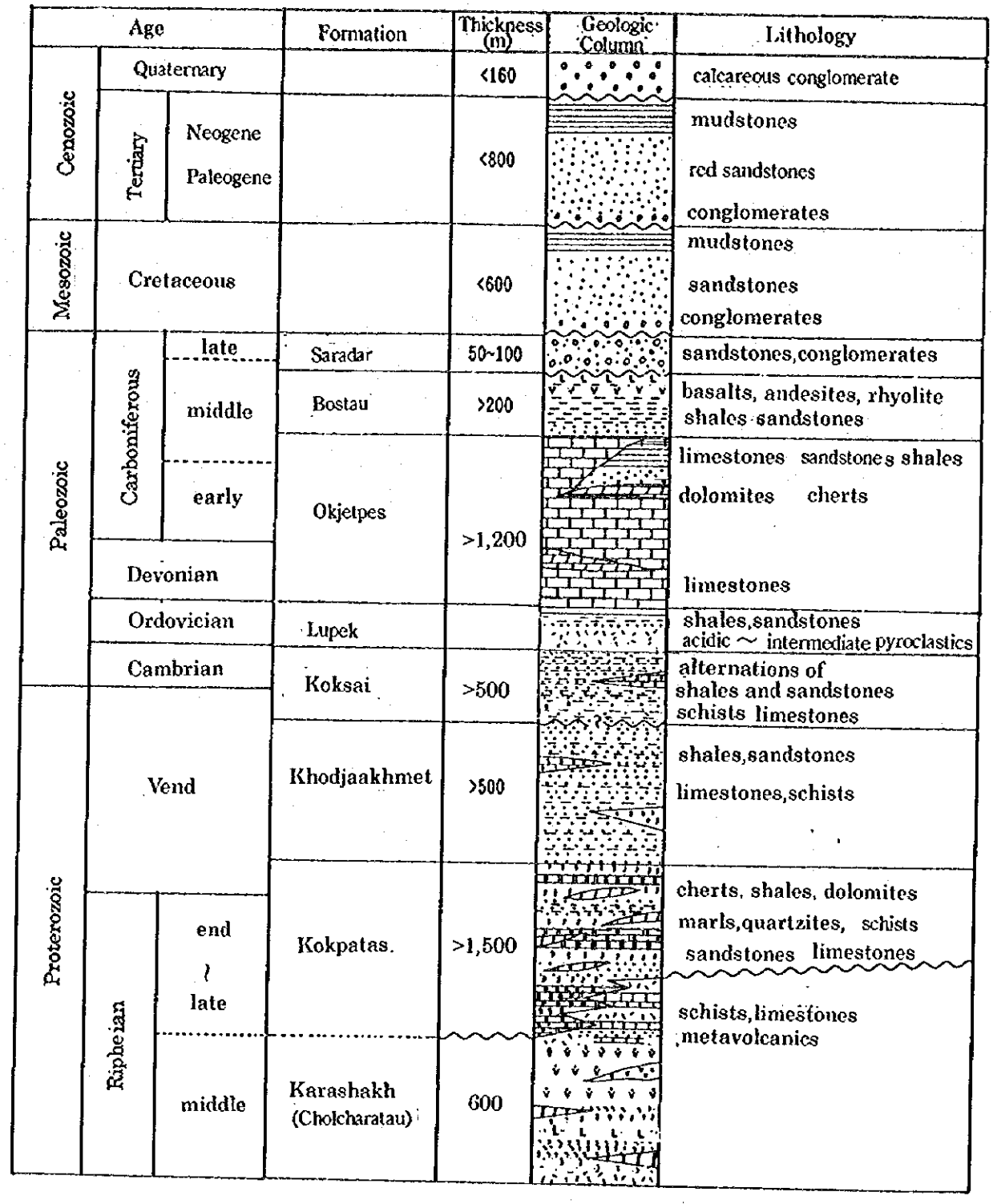

Fig. I-3-2 Shematic Geologic Columun of the Survey Area

Chapter 4 Conclusion and Recommendation

4-1 Conclusion

(1) Geology of the Southern Bukantau Area including the Survey Area is composed of the basement formation of Proterozoic Ripheian to Vendian Series, groups of Paleozoic and Mesozoic and Cenozoic which unconformablly overlay on the basement formation. Granites and dykes of late Carboniferous to late Permian intruded into the groups of Proterozoic and Paleozoic.

(2) Ore deposits and showings of tungsten, gold, silver and copper are located in the Survey Area.

Twenty four localities of ore deposits and showings are known in the Survey Area, and they are classified into the following seven groups; ① Gold quartz vein, ② Gold·silver quartz vein, ③ Gold·silver·copper quartz vein, ④ Silver quartz vein, ⑤ Tungsten·skarn deposit, ⑥ Tungsten·quartz stockwork deposit, ⑦ Tungsten·gold skarn deposit.

Mineralization of this area is hosted in Karashakh Formation and Kokpatas Formation of Proterozoic age, systems of Devonian to Carboniferous and related to the granitic intrusion of late Carboniferous to early Permian. Structurally the faults and fractures of NW-SE, NE-SW and NNW-SSE have played an important role in ore deposition.

Bulutkan ore showing(Au) is selected as a promising area for further exploration from the result of existing data analysis. The western part of the area has already been explored and a high grade ore body was confirmed. Rough estimate up to 70m deep shows 342 thou.tons of ore reserves with 6.9g/t Au containing 2.4 tons Au. There is a enough room for further exploration in this showing.

(3) The existing data about Sautbay and Burgut deposits were collected and ore reserves of two deposits were estimated by using personal computer.

Result of ore reserve estimate of Sautbay·Burgut ore deposits shows the total ore reserves of 25,885 thou.tons with average grade of 0.27%WO_3 and 0.24g/t Au with cut off grade of 0.05%WO_3. Comparing this result with the result of Sarydjoy report, the tonnage of scheduled open pit mining (above -150m level) is well coincide between

two results that is about 2,600 thou. tons with cut off grade of 0.05%WO_3.

The average grade of ore in Sarydjoy report is 0.38%WO_3 and 0.16g/t Au, while our calculation is 0.35%WO_3 and 0.13g/tAu.

Although the average grade of ore is slightly lower in our calculation, the results of both calculation as a whole can be considered to be the same.

In case of the tonnage of total ore reserve, however, there is a considerable difference between two results. Our calculation is 25,885 thou.tons which is 65% of Sarydjoy report (39,539 thou.tons). The average grade of ore in our calculation is 0.27%WO_3 and 0.24g/t Au which correspond to 63% and 71% of Sarydjoy report.

Regarding to the difference of tonnage of ore, we did not calculate ore reserve in the block without data, while Sarydjoy report calculate ore reserve in such a block if the extension of orebody is geologically assumed. As to the average grade of ore, in case of more than two data are available in one P_1 ore block, Sarydjoy report adopt the data of maximum grade. That is the reason of the average grade becomes higher in Sarydjoy report.

Comparing with the ore grade of workable skarn type tungsten mines in the western countries, the ore grade of Sautbay and Burgut deposits is considerably lower. The margiral workable ore grade, however, is variable depending upon the size of ore deposits and various factors of mining cost. Therefore it is necessary to make a prefeasibility study in order to find out the possibility of developing these ore deposits.

(4)As the densities of granitic rocks are lower than the other host rocks, granitic rocks form low gravity anomalies. Therefore gravity survey is effective to assume the location, depth and extent of intrusives including crypto-batholith.

Magnetic survey can effectively delineates the contacts of intrusive rocks with host rocks. Magnetic anomalies are often observed near the ore deposits and showings of both skarn type and vein type as they sometimes contain pyrrhotite. Magnetic survey will provide the useful information in mineral exploration of this area.

(5) Result of satellite imagery analysis revealed that the lineament of each area shows particular direction. The lineaments of E-W and NE-SW～ENE-WSW directions are dominant in the north to northwestern part of the area, and lineaments of E-W

direction are longer in length. The lineaments of N-S～NNW-SSE and NE-SW～NNE-SSW directions are dominant in the central to western part of the area. In the eastern part of the area lineaments of NE-SW and WNW-ESE～E-W directions predominate.

Turbay fault and Eastern Okjetpes fault are well coincide with a lineament which have been extracted by photogeologic interpretation of the images.

(6) Eighteen geologic units were identified in the Survey Area by satellite imagery interpretation.

Ground truth has revealed that the geologic units obtained by the image analysis had been correctly classified and reflect lithology.

Turbay Intrusives, however, was covered by Quaternary unconsolidated deposits. Therefore, the area does not show granitic features in topography, and the exposures of the granitic rocks are not enough to be identified as granite by the image analysis.

(7) Seventeen areas of alteration zone are selected by the spectral analysis of the images.

Ground truth has revealed that the alteration zones which have been extracted by satellite imagery analysis may indicate high sulfide type gold mineralization. Spectral analysis is effectively applied for high sulfide type gold ore deposit to extract iron oxides minerals accompanied by ore deposit.

(8) Judging from the distribution of ore deposits, ore showings and the alteration zones, an ore zone of NW-SE direction including the alteration zones near Sautbay deposit(W) and Bulutkan ore showing(Au) and the another ore zone of NNW-SSE direction from Kokpatas deposit(Au) to the south-western part of Okjetpes deposit(Ag) are expected as potential exploration areas for the high sulphide type gold deposit.

4-2 Recommendation for the Phase II Survey

The following surveys are to be conducted in Phase II survey.

(1) Diamond drilling should be carried out to No.1 ore body of Sautbay deposits in the level of -300m bellow the surface, as this section of the ore body can be the immediate target of the future mining.

Data compilation and calculation of ore reserve are to be conducted for Saghinkan

deposits(W) which is located in the northwest of Sautbay deposits

In Phase III survey, calculation of ore reserve estimate and prefeasibility study are to be conducted in order to study the possibility of developing Sautbay, Burgut and Saghinkan deposits.

(2) Diamond drilling should be carried out to the downward extension from -70m level of Bulutkan showing(Au), in which existence of high grade gold ore is already known, to confirm the shape, structure and mineral composition of the ore body and to provide useful information for further investigation.

Geophysical survey and trenching should be conducted to find out the horizontal and vertical extension of mineralization.

(3) An analysis of the satellite image has revealed the location of 17 alteration zones in which 4 are in Sautbay-Bulutkan area, and 5 are in Okjetpes area. In order to investigate mineral potential of these areas the field check surveys are to be conducted.

PART II PARTICULARS

Chapter 1 Existing Geological Data Compilation

1-1 Objective.

The objective of the existing geological data compilation are to evaluate existing deposits and ore showings in the Eastern Bukantau Area and to establish field work programme for the future in the area.

1-2 Outline of the previous Investigations.

A large number of geological surveys and prospecting activities have been undertaken since 1939 in the area. Principal investigation methods and periods are shown in Table II-1-1, and their investigation areas are shown in Fig.II-1-1.

The following prospecting activities have been carried out in the area: geological survey, trenching, geochemical survey(rocks, mercury), mapping drilling, non-coring drilling, coring drilling, exploration shaft with cross-cuts and drifts.

Prospecting acitvities have been concentrated especially in Sautbay deposit(W) and adjoining Burgut・Saghinkan ore showings(W), Sarytau deposit(W), Turbay deposit(Au), and Okjetpes deposit(Ag).

1-3 Geology and Geological Structure of the Survey Area.

Most of the Survey Area is located in the eastern part of Southern Bukantau zone, and narrow area of the north-east part of the Survey Area is located in Northern Bukantau zone. Geological structure of the survey area is characterized by an over thrust by which the group of Paleozoic is overlain by the group of Proterozoic, Kokpatas antiform and overfolding of Proterozoic group. The axis of Kokpatas antiform is extending in NNW-SSE direction from Kokpatas to Okjetpes. A series of Lower Devonian to Carboniferous are exposed in the axis as a window.

Meanwhile, Northern Bukantau is underlain by middle Carboniferous rocks which trends along North Bukantau Deep Fractures Zone.

(1) Stratigraphy

The Proterozoic rocks are divided into four formations: Karashakh, Kokpatas, Khodjaakhmet, and Koksai formations in ascending order.

Karashakh Formation crops out mainly on the flanks of the Kokpatas antiform in the

Sautbay area, in the Turbay area and around Altyntau Intrusives. It consists mainly of schists and meta-volcanics with intercalation of quartzite and limestone. The schists are mainly composed of chlorite-biotite-quartz, sericite-feldspar-quartz, or chlorite-biotite-feldspar-quartz. The total thickness is about 600m. Cholcharatau Formation in some literatures indicates the same formation.

Kokpatas Formation crops out widely in the Survey Area, and consists mainly of carbonaceous chert, quartzite and siliceous shale with intercalation of quartz-graphite schist, sericite-quartz and feldspar-quartz sandstone, dolomite and limestone. The total thickness is estimated to be more than 1,500m.

Khodjaakhmet Formation crops out east and northwest of Uchkuduk, and around the Turbay - Sarytau area. It consists mainly of shale and sandstone with intercalation of limestone and schist. It is characterized by lack of chert. The total thickness is estimated to be about 800m.

Karashakh Formation and Kokpatas Formation, and Kokpatas Formation and Khodjaakhmet Formation are thought to interfinger each other, although they often contact each other by faults. *Acritarch*, an unicellular microfossil, which is thought to indicate the late Ripheian, has been found from Kokpatas Formation and Khodjaakhmet Formation.

Koksai Formation crops out widely in northeast of the Sarytau-Turbay area, and consists of alternation of sandstone and shale, and schist. Age of the formation is considered to be late Ripheian to Vendian. Total thickness is more than 500m.

Paleozoic rocks which are distributed in the Survey Area consist of Ordovician, Devonian and Carboniferous rocks. The Ordovician crops out around the northwest border of the Survey Area, and consists of slate, shale, sandstone, conglomerate and acidic to intermediate pyroclastics. The Devonian crops out in the crest area of the Okjetpes anticline and mainly consists of limestone. Lower and middle Carboniferous rocks are exposed. The Lower Carboniferous crops out around the core area of the Kokpatas antiform and on the flanks of the Okjetpes anticline. It consists of limestone and dolomite. The middle Carboniferous crops out around the flanks of the Okjetpes anticline and north of Kokpatas, and consists mainly of limestone. The middle Carboniferous also crops out around the Boztau ore showings, and consists of shale, sandstone and intermediate volcanic rocks. Total thickness of the Paleozoic rocks are estimated to be more than 1,200m.

Cretaceous to Quaternary rocks crop out widely in the Survey Area, overlying discordantly Proterozoic to Paleozoic formations. They consist mainly of conglomerate, sandstone and mudstone. Cretaceous to Eocene formations are of marine and Oligocene

to Quaternary formations are of continental. The maximum thickness of Cretaceous, Tertiary and Quaternary formations near the Sautbay deposits area are 80m, 30m and 5m, respectively.

(2) Intrusive rocks

Intrusive rocks in the Survey Area are divided into four groups based on their ages.

① Late Carboniferous intrusive rocks consist of diorite, gabbro, lamprophire and diorite porphyry. Diorite and gabbro crop out extending 200 m in northeast strike direction in east of the Sautbay Intrusives. Lamprophire and diorite porphyry occur often as dikes.

② Late Carboniferous to early Permian intrusive rocks consist of syenite-diorite, granodiorite. The Sautbay Intrusives are one of the most dominant exposures of this group. They crop out in the area of 3km by 3km, and consist of gabbro, monzogabbro, quartz syenite and granodiorite.

The Katirtas Intrusives occur mostly under Cretaceous cover, and only the northwest and east parts of the intrusive crop out. They consist mainly of granodiorite, grano-syenite and syeno-diorite. The halo of thermal metamorphism extends 1,000m from the contact.

③ Early Permian Intrusive rocks consist of granodiorite, adamellite, granite and porphyries of the same compositions. They are widely distributed in the Survey Area, represented by the Altyntau Intrusives, Turbay Intrusives, and the Sarytau Intrusives. The Sarytau Intrusives, the Turbay Intrusives and the Kokpatas Intrusives are thought to be cupolas of the deep seated Southern Bukantau Batholith.

④ Late Permian Dikes occur widely in the Survey Area and consist of syeno diorite porphyry to granite porphyry, lamprophire, diorite porphyry and granite porphyry. The maximum size of the dikes is 5 m width and several hundreds meters length.

(3) Metamorphism and Alteration

Proterozoic rocks in the Survey Area underwent regional metamorphism of Baikal orogenic movement at the end of Proterozoic age. Pre-Permian rocks underwent more or less contact metamorphism by Carboniferous to Permian intrusive rocks.

The regional metamorphism shows green schist facies dominantly. Metamorphic rocks are characterized by development of schistosity and quartz veins, recrystallization and occurrence of porphyroblasts. They consist mainly of epidote, chlorite, sericite, amphibole, carbonate minerals, albite and quartz. The metamorphic rocks of volcanic origin show mainly the mineral assemblages of epidote-albite, epidote-albite-chlorite with

sericite, quartz and calcite. The rocks of sedimentary origin show quartz-albite-chlorite, and quartz-sericite-chlorite-albite.

The contact metamorphism shows muscovite subfacies and amphibolite facies and the pelitic hornfels occurs in the area up to 2,000m from the contact. The main mineral assemblages are chlorite-quartz-feldspar, quartz-biotite-sillimanite-chlorite, quartz-biotite-amphibole-plagioclase(albite), quartz-albite-chlorite, quartz-muscovite, and plagioclase-tremolite-albite-quartz.

Skarnization often occurs at the contact zone of intrusive rocks and surrounding sedimentary rocks. The skarns are mainly composed of hedenbergite, tremolite-actinolite with small amount of forsterite and garnet, spinel and magnetite.

Greisenization, propylitization and gumbaitization (to occur quartz-orthoclase-biotite assemblage) underwent up to 200m from the contact. Hedenbergite has been replaced into salite or amphibole,while skarn minerals rich in magnesian have rarely replaced.

(4) Geological Structure

The most prominent geological structure in the Survey Area is the Kokpatas antiform. Smaller scale of structures are the Turbay, the Sautbay, the Sarytau and the Okjetpes anticlines, and the North Turbay syncline.

① The Turbay anticline extends 20km in NW-SE direction from Turbay to Katirtas. Green schists of the Karashakh formation exposes in the width of 1.5 to 2 km along the axis. The Kokpatas Formation crops out on the northeast flank, while the southeast flank is covered with Cretaceous and Quaternary rocks.

② The Sarytau anticline extends 8km in NW-SE direction with 3 km width traversing the Sarytau stock and the Sarytau Intrusive. The northeast flank dips 45° ~60° , and the southwest flank is cut by thrust faults.

③ The Sautbay anticline extends in E-W direction passing on the Sautbay stock. The axial plane dips north and the core area consists of the Karashakh Formation.

④ The North Turbay syncline which is situated at north of the Turbay anticline extends in NW-SE direction and the Khodjaakhmet Formation exposes on the axial area, showing overturned syncline.

⑤ The Okjetpes anticline is located on the Okjetpes mountains, and has E-W axis plunging both directions.

The prominent directions of faults in the Survey Area are NW-SE, NE-SW and NNW-SSE, represented by the Turbay fractures zone, the Kokpatas fractures zone, Katirtas fault and East Okjetpes faults.

① The Turbay fractures zone shows NW-SE direction and extends about 50 km over 1 to 2.5 km width. The zone consists of abundant parallel fractures which show 5 to 100m in width and dip 70° N. The north block of the zone is underlain by the Khodjaakhmet and the Koksai formations, and the south block by the Karashakh and Kokpatas formations. It is estimated that the north block has been thrown down about 1 km against the south block.

② The East Okjetpes fault shows NE-SW strike and dips steeply southeast, traversing the Sarytau Stocks and Sarytau Intrusives. It cut the foldings, and is thought to be younger than NW-SE faults.

③ The Katirtas fault is located in the eastern part of the Survey Area and shows NE-SW strike. This fault is considered to separate the Turbay area in the west and Djelitau area in the east. It is considered that the Katirtas fault is related to the emplacement of the Sarytau Intrusives.

④ The Kokpatas fractures zone strikes NNW-SSE direction and forms the western boundary of the Turbay area.

1-4 Ore Deposits and Ore Showings of the Survey Area.

The Eastern Bukantau Area is characteristic of tungsten, gold-silver together with copper and molybdenum(Fig. II-1-2). Tungsten is quite characteristic because it is present to some extent in all hydrothermal mineralization.

Various types of ores of gold, silver and tungsten mineralization spread over the region are classified in the following ore formations.

① gold·quartz vein(Turbay deposit, Bulutkan·Barhanny ore showings)
② gold·silver·quartz vein(West Turbay·Central Sarytau ore showings)
③ Gold·silver·copper·quartz vein(North Sarytau ore showing)
④ Silver·quartz vein(Okjetpes deposit)
⑤ Tungsten·Skarn (Sautbay·Sarytau deposits)
⑥ Tungsten·quartz stockwork(Sarytau deposits)
⑦ Tungsten·gold·skarn (South Sarytau ore showing).

1-4-1 Sarytau Ore Field

The ore field is occupied by late Proterozoic metavolcanogenic-terrigenious sediments of Karashakh Formation setting up the core of anticline and siliceous-carbonate-terrigenous sediments of Kokpatas Formation setting up the limbs. Late Proterozoic

rocks are intruded by intrusives of late Hercynic granitoids and numerous dykes. The most significant role in ore field is played by two structures: Central Turbay zone of high permeability and Eastern Okjetpes fault. Sarytau tungsten deposit and Turbay gold deposits are controlled by Central Turbay zone of permeability. Its knot of intersection with Eastern Okjetpes fault was quite favourable structural space for the Sarytau granodiorite-adamellite-porphyry stock controlling in its location of stockwork tungsten mineralization(Fig. II-5-1).

The main type of ore mineralization is tungsten, represented by the Sarytau deposit and a number of ore showings (Kazgan, East Kazgan, West Kazgan, Bektash, Katirtas). There are also occurrences of gold mineralization - South Sarytau, gold-silver - Central Sarytau, copper - North Sarytau.

(1) Sarytau ore deposit (W)

The Sarytau deposit is situated in the south-east part of the Bukantau Mountains, 35 km east from the settlement of Kokpatas. It was identified in 1980 as a tungsten ore showing of quartz stockwork. From 1980 to 1990 exploration and prospecting evaluation of the deposit were undertaken in the area which allowed to evaluate the reserves by category C_2+P_1.

The deposit occupies a territory of 2 km long and from 300 m to 1,200 m wide(PL.II-1-1). The host rocks are metavolcanogenic-carbonate-siliceous-clastic rock of Riphean intruded by the Sarytau stock of granitoids (granodiorite-adamellite) and numerous dykes of late Hercynic magmatism.

The Sarytau stock of linear shape (2.0 x 0.5 km) has a complex structure and is characterized by numerous comb - like protrusions(PL. II-1-2).

Contact-metamorphic influence of stock on host rocks spreads 300-800 m and is expressed by formation of hornfels, magnesia skarns and quartzites.

There are two leading types of tungsten mineralization in the deposit: stockwork and skarn-skarnoid. The first type is situated in the central part of the deposit in the stock of granodiorite-adamellite-porphyries. Stockwork type of tungsten mineralization is confined to the Central Turbay zone of permeability and represents a linear vein-veinlet zone in the granitoid stock and host rocks. The stockwork ore is traced to the north-west direction 2km long at a width of 300-800m. It spreads up to 350-400 m deep.

By outlining ore at 0.08% cutoff of WO_3 grade there were four bodies. They are flattened, steeply dipping (60-80°) lens-like bodies elongated by strike to the direction of WNW - ESE at 140-1,230 m and by dip to the north-east at 25-300 m and wide range of thickness - from 5 - 20 to 50 - 150 m. Average WO_3 grade is 0.153%. Main stockwork

ore are fluorite-scheelite-kalifeldspar-quartz association.

Ore body No.1 is the largest one. Main reserves of stockwork tungsten mineralization are concentrated there (more than 95%). Ore veinlets thickness ranges from several mm to 1-3 cm, more rarely to 10-15 cm. The most common by-component in the stockwork is molybden with average grade of 0.01%.

Skarn-skarnoid type of tungsten mineralization is developed in the north-east flank of the deposit. The most favourable interlayers of carbonate rocks for selective metasomatic development extended on stratigraphic levels covering more than 600 m by vertical section. Ore-bearing levels thickness ranges from 10-15 to 50-70 m at a distance of from 20-40 to 100-150 m between them. There are 10 skarn-ore bodies of 60 to 590 m long by dip and 60 to 690 m by strike.

Contact and bed-type bodies (stratiformal) stand out among skarn-skarnoid formations depending on their mode of occurrence. The former ores are developed at a distance of approximately up to 100 m from the contact of granitoid, stratiformal ores - at a distance of 300-400 m away from granitoid stock.

The major part of tungsten mineralization is located in the contact skarn-ore deposits. Average WO3 content ranges from 0.35 to 0.42%; as for stratiformal ores it usually does not exceed 0.2-0.3%.

The main ore minerals are scheelite, molybdenite, pyrrhotite, marcasite. As for non-ore minerals they are diopside-hedenbergite, quartz, orthoclase.

The most common by-component in the skarn-skarnoid is gold with average grade of 0.36 g/t.

Phosphorus is a harmful admixture with average grade of 0.11-0.18%.

Zone of oxidation is poorly developed and goes not further than 30-40m deep.

The following activities were carried out in Sarytau deposit in 1978 -1988: geologic mapping of 1:2,000 scale - 2 km2, gravity and magnetic survey of 1:50,000 scale, trenching - 10,806 m3, survey of 80m x 80m, 160 m grid, exploration shafts (about 30m deep) - 261 m, cross cuts in one level - 2,000 m, non-coring drilling - 20,383 m and coring drilling - 11,621 m.

Feasibility calculation (1990) was carried out for the possibility of the deposit development by combined methods: open pit and under ground.

Method of Development / Type of mineralization	Category of reserves	Ore reserves (thou.t)	Grade WO_3(%)	Contents WO_3(t)	Au(t)	Mo(thou.t)
1. Open pit						
Stockwork	C_2	17,654.4	0.153	27,009.4		1.8
Skarn-skarnoid	C_2	1,168.6	0.232	2,710.3	0.4	0.1
C_2 total	C_2	18,823.0	0.158	29,719.7		
Stockwork	P_1	1,018.5	0.147	1,501.2		0.1
Open pit total	C_2+P_1	19,841.5	0.157	31,220.9	0.4	2.0
2. Underground						
Skarn-skarnoid	C_2	7,666.8	0.409	31,356.6	2.8	0.8
Skarn-skarnoid	P_1	21,666.6	0.340	73,596.6	7.8	2.2
Underground total	C_2+P_1	29,333.4	0.358	104,953.2	10.6	3.0
Total	C_2	26,489.8	0.230	61,076.3	3.2	2.7
	P_1	22,685.1	0.331	75,097.8	7.8	2.3
	C_2+P_1	49,174.9	0.277	136,174.1	11.0	5.0

Cut off grade : Open pit WO_3 = 0.08%

Underground WO_3 = 0.10%

Prospecting was suspended in this ore deposit.

(2) Bektash ore showing (W)

Bektash ore showing is situated 2 km east from the Sarytau deposit in the contact part of granitoid stock. Its length is 2.5 km, width - about 1.0 km (Fig. II-5-1). Lens-like bodies of scheelite-bearing skarn have been identified in the Kokpatas Formation with WO_3 grade of 0.02-0.03% and only in single case - 0.43%.

According to the general geologic-structural situation and gravimagnetic data comb-shaped protrusion of granitoid stock of the Sarytau complex was expected at a depth of 200-400 m, but it was not discovered up to 500 m deep.

Single drill holes in the central part of the showing discovered sheelite-bearing skarn-skarnoid bodies of 3.5-4.5 m thickness and 0.15- 0.33% grade of WO_3. Prospecting

works are suspended in this ore showing.

(3) Katirtas ore showing (W)

Katirtas ore showing is identified in the western part of the ore field in the area of the eastern contact of the intrusive massif of the same name (Fig. II-5-1). Abnormally high grade of WO_3 (0.15-0.21%) has been identified in hornfels by single mapping-geochemical drill holes. Ribbon-like tungsten haloes are outlined in the contact zone.

The basement rocks in this area are covered by thick Cretaceous Syotem (about 40 m thick). About 150 mapping drill holes have been carried out on a grid of 100 x 5 m.

Prospecting works(drillings) are scheduled in 1995.

(4) Kazgan ore showing (W)

Kazgan ore showing is situated in the southern part of the Sarytau ore field and confined to the western contact of the buried Sarytau intrusive (Fig.II-5-1). Tungsten anomalies have been identified by mapping-geochemical drill holes. All the three tungsten haloes are characteristic of ribbon-like shape at various width. Areas with WO_3 grade of 0.03 to 0.12% stand out within their boundary.

Thin intervals with WO_3 grade of 0.24-0.48% at average grade of 0.32% per 6 m interval have been identified within haloes limits in carbonate-quartz-biotite hornfels in the area of the south-west contact of the Sarytau granitoid massif. Mineralization also penetrates granitoids of WO_3 grade from 0.12 to 0.85% at average grade of 0.14% to the interval of 24 m thickness.

It is admitted (Shaakov and others, 1990) that Kazgan ore showing in the deeply eroded granitoid intrusive is a zone of mineralization dispersion.

Prospecting works are suspended in this area.

(5) East Kazgan ore showing (W)

East Kazgan ore showing has been discovered 4 km south-east from the Sarytau deposit and covers the area contact of two granitoid massives - Sarytau and Katirtas (Fig.II-5-1). The host rocks of the Kokpatas Formation are crossed by a wide dyke belt. In the granitoids of the Katirtas massif tungsten mineralization zone has been found at a level of 0.18% in 8 m interval.

Wide development of tungsten mineralization was identified by drill holes at grade of WO_3 0.04-0.36% in the granitoids and 0.07-0.27% in skarnized rocks. East Kazgan ore showing is recomended for detailed exploration. But prospecting works are suspended at present.

(6) Central Sarytau ore showing (Ag, Au)

Central Sarytau silver and gold ore showing is the only occurrence of gold-silver-sulphide type in the Eastern Bukantau Area. It is situated 2 km south-west from the Sarytau deposit (Fig.II-5-1). Gold-silver mineralization is confined to the intensively ferruginized dykes of lamprophyre and transformed host rocks which are intruded by quartz-arsenopyrite veins and veinlets. There is an ore body traced in the dyke of 0.3-5.0 m thickness of 2.0-4.0 g/t average gold grade and 18.0-55.0 g/t silver grade. Faint mineralization is noticed in the altered rocks developed in the near - dyke space although intervals of maximum gold concentration reaching 20.2 g/t and silver - 37.8 g/t. Mineralization has been traced for more than 200 m.

At a depth of to 100 m intervals of 2-4 m thickness and 0.4-1.0 g/t gold grade have been discovered.

Geochemical forecast evaluation of lower levels of the show where tungsten haloes were discovered suggesting it is not worth prospecting for gold.

(7) South Sarytau ore showing (W, Au)

South Sarytau ore showing was identified 3.5 km south-west from the Sarytau deposit in the area of northern contact of the buried Sarytau massif (Fig.II-5-1). The ore showing is recognized in hornfels, quartzites, skarnized dolomites and skarns.

In the territory of the ore showing thin (2-4 m) and short (40-120 m) lens-like bodies of skarn of WO_3 grade not more than 0.05% were stripped. Two levels of metasomatites of 4-10 m thickness have been identified in two drill holes at an interval of 34-60 m deep. WO3 grade ranges within the limits of 0.03 to 0.8%.

Gold-skarn type of mineralization with tungsten has been identified for the first time in Eastern Bukantau. Gold grade of 0.2-0.6 g/t at intervals from 2 to 5 m has been identified in the amphibole skarns.

Prospecting works are suspended.

(8) North Sarytau ore showing (Au, Ag, Cu, Sn)

North Sarytau ore showing is situated 6 km north away from the Sarytau deposit (Fig.II-5-1) and represents a number of local structures with polymetalic mineralization (gold, silver, copper, tin and arsenic). These structures have been formed by steeply dipping (50-70°) quartz, quartz-feldspar veins of WNW-ESE strike among granitoids of the Sarytau stock. Their average thickness is 3-5 m. They have been identified by drill holes in the intervals of depths from 19 to 250 m. Total length is about 500 m. Quartz

veins are impregnated by the pyrite-arsenopyrite-chalcopyrite aggregate. Average grade of gold - 1.5- 2.0 g/t, silver - 19.5-34.2 g/t, copper - 0.265-0.612%, tin -0.012-0.187%, bismuth - 0.064-0.068%.

Prospecting works are suspended.

1-4-2 Sautbay Ore Field

Geology of the Sautbay ore field is set up by the sediments of the Karashakh and Kokpatas Formations. The former occupies the core of the Sautbay anticline, the latter occupies its limbs. The Karashakh Formation is represented by schists with interbeds of greenstone altered volcanites, quartzites, dolomites and limestones. The thickness is more than 500m. The basement of the Kokpatas Formation is composed of dolomites and limestones with interbeds of siltstones, slates, microquartzites of 100 m thickness. Upper along the cross-section a thick quartzites with interbeds of dolomites and limestones occur. The upper part of the formation is formed by sandstones, siltstone with rare interbeds of dolomites and flints. Total thickness of the formation is more than 1000 m.

The main folded structure is the large Sautbay anticline. The Sautbay stock of granodiorites controlling skarn-skarnoid metasomatites with tungsten mineralization is confined to the core of the fold.

Initial carbonate-bearing rocks occur at different stratigraphic levels in the ore field. Vertical scope of mineralization is about 500 m. The main ore-controlling level is upper part of Karashakh - lower part of Kokpatas Formation. The main type of mineralization in the ore field is tungsten which is concentrated in the Sautbay deposit and in the neighbouring areas (Saghinkan, Burgut, Kizilkashkar, East Saridjoy, West Saridjoy). There is also gold concentration being of practical interest in the Bulutkan ore showing.

(1) Sautbay ore deposit (W)

The Sautbay deposit is situated 15 km to the east from the settlement of Kokpatas Expedition(Fig.II-5-1). Prospecting and prospecting evaluation have been undertaken in the area since 1985; exploration started 1993. The ore reserves have been evaluated by category $C_1+C_2+P_1$ and correspond to a large deposit for the ore of this type.

Sautbay tungsten deposit is situated in the eastern contact of granitoid stock of the same name (Fig.II-1-).

There are 2 types of ore bodies: layer, layer-stockwork ore body of skarns and skarnoids along carbonate-bearing rocks and stockwork ore body in granitoid intrusive, skarns, propylites and hornfels.

21 skarn-ore bodies of various thickness and length have been intersected by drill holes (PL.II-1-3, PL.II-1-4). The main skarn-ore deposit (No.1) has a layer shape with dip to the east at the angle of 40-80° . Its thickness reaches 60 m, length by strike is about 800 m. It is traced by dip to 600 m. Thickness of some ore sections ranges from 1.0 to 33 m being on average about 15 m. WO3 grade in ore ranges from 0.15 to 1.29% being on average about 0.5%; average gold grade is 0.3 g/t, bismuth is about 0.01%.

Mineral composition of ore is as follows: amphibole-pyroxene and amphibole-pyroxene-pyrrhotite skarn with scheelite. Ore usually contains quartz, pyrite, pyrrhotite, chalcopyrite. Zone of oxidation is practically not shown.

Stockwork ore body is developed predominantly in the body of granitoid stock.

It is represented by vein-veinlet formed by quartz with a small portion of feldspar. It is also superposed on the layer skarn-skarnoid and contact types of metasomatites. From the commercial point of view stockwork mineralization in granitoids is not of practical interest in Sautbay deposit.

The exploration works are now underway and shall be continued until 1998.

The following activities were carried out in Sautbay deposit and neighbouring Burgut ore showing during the period of 1985 - 1993: magnetic survey of 1:10,000 scale - 70 km^2 and 1:5,000 scale - 10 km_2, trenching - 9,044 m^3, non-coring drilling - 4,440 m, coring drilling 300m deep on average - 42,030 m, exploration shaft with drifts and cross-cuts - 3,294 m.

Feasibility calculation (1993) was carried out for the possibility of deposit development by open pit (up to 150m deep) and underground (up to 600m) methods.

Method of Development	Category of reserves	Ore reserves (t)	Average grade		Contents	
			WO_3(%)	Au(g/t)	WO_3(t)	Au(kg)
1.Open pit	C_1	2,455,905	0.40	0.17	9,744.9	407.7
	C_2	150,345	0.14	0.02	215.6	3.7
	C_1+C_2	2,606,250	0.38	0.16	9,960.5	411.4
2.Under ground	C_2	11,797,260	0.49	0.39	57,282.8	4,600.7
	P_1	25,135,842	0.40	0.34	101,682.7	8,421.9
	C_2+P_1	36,933,102	0.43	0.35	158,965.5	13,022.6
Total	C_1	2,455,905	0.40	0.17	9,744.9	407.7
	C_2	11,947,605	0.48	0.39	57,498.4	4,604.4
	C_1+C_2	14,403,510	0.47	0.35	67,243.3	5,012.1
	$C_1+C_2+P_1$	39,539,352	0.43	0.34	168,926.0	13,434.0

Cut off grade : Open pit $WO_3 = 0.05\%$

Underground $WO_3 = 0.08\%$

(2) Burgut ore showing (W)

Burgut ore showing has been identified 0.5 km south-east from the Sautbay deposit in the contact of the granitoid stock elongated in the WNW-ESE direction. It is the eastern continuation of the Sautbay deposit(PL.II-5-1, PL.II-1-4). Gold-tungsten is confined to skarns and skarnoids selectively developed in carbonate-bearing siliceous-clastic sediments of the Kokpatas Formation. The ore-bearing area is traced by drill holes 600 m by strike and 340 m by dip. Thickness of ore is 2.1-13.8 m (average 1 m), WO_3 grade ranges from 0.18 to 0.53% being on average 0.3%; gold - from 0.15 to 2.3 g/t which is about 1 g/t on average.

A big part of ore bodies is represented by pyroxene, pyroxene-garnet skarns and skarnoids and are located on different stratigraphic levels. Thus there were 10 skarn-scheelite ore bodies intersected by drill holes.

Stockwork quartz-feldspar with scheelite is developed in carbonate rocks, skarns, granodiorites, hornfels and quartzites.

The ore showing is being explored by core drilling. Ore reserves of Sautbay deposit

were evaluated including Burgut ore showing in 1993.

(3) Saghinkan ore showing (W)

Saghinkan ore showing is situated 1 km west from the Sautbay deposit and adjoins it (Fig.II-5-1). It was identified in the process of sorting out magnetic anomalies.

Mineralization has been identified at the interval of 110 to 400 m in the sediments of the Karashakh and Kokpatas Formations intruded by the Sautbay stock(PL.II-1-5, PL.II-1-6). They are covered by the mantle of Mesocenozoic sediments of 30-50m thickness.

In total 10 ore bodies are identified. They are bed-like bodies sub-concordant with host rocks. The deposit occurs sub-horizontally and are traced by strike from 460 to 960m at thikness from 1 to 30-40m. WO_3 grade is from 0.1 to 2% and makes 0.3% on average.

For the present time prospecting activities on the area are fully completed. Activities carried out in the area are as follows: trenching - 1,152 m^3, mapping drilling - 3,456 m, coring drilling up to 400 - 500 m deep by 160 x 80 m and 80 x 80 m grid - 19,051 m.

Prospecting evaluation on the area was finalized in the end of 1994. Reserves have been calculated by category C_2, P_1 and correspond to the medium size deposit.

Category of reserves	Ore reserves (mil.t)	Grade WO_3(%)	Contents WO_3(thou.t)
C_2	9.63	0.35	33.31
P_1	3.27	0.25	8.13
C_2+P_1	12.90	0.32	41.44

Cut off grade : WO_3= 0.10%

(4) Bulutkan ore showing (Au)

Bulutkan ore showing was discovered in 1993. It is situated 5.5 km east of Sautbay ore deposit and confined to the northern contact of Sautbay syenite-diorite massif(Fig.II-5-1). The area is occupied by altered siltstones, sandstones with quartzites lenses and dolomites of Kokpatas Formation. Dikes of aplitic granites, syenite-porphyry, diorite porphyrites and lamprophyres are widely developed.

From the result of route prospecting, distribution of 4 elongated zones (width of 20-150 m) of brecciated, ferruginizated quartzitic metasomatites with oxidized formations of jarosite-ferruginous-siliceous ore are presumed in the contact zone of Sautbay intrusive(PL.II-1-7). These oxidized formations form the zone at a width of 600 - 700 m and length of 4.5 km in north-eastern and south-western directions.

As a result of sampling on trenches and coreless drilling holes in the western part of the ore showing one ore body is traced to the north-west direction more than 100 m at a thickness of maximum 30 m. It spreads more than 70 m deep.

Gold grade ranges 1-420 g/t and is 6.9 g/t on average. The ore body is studied by drill holes to the depth of 70 m where gold ranges from 1.5 to 6.9 g/t. Ferruginous oxidized formation are developed to the depth of 15 m where gold grade reaches 100 g/t.

The main minerals are quartz and jarosite together with pyrite and arsenopyrite. Occurrence of gold is unknown

Exploration work aiming at high grade gold ore is underway in the area by trench and non coring drilling. And further prospecting works such as trenches, drill holes (depth 70-300 m), geophysical survey, shaft and cross cuts are schduled until 1998.

(5) Southeast Sautbay ore showing (W)

Southeast Sautbay ore showing is situated 5 km south-east from the Sautbay deposit (Fig. II-5-1).

General geology of the area is composed by metavolcanogenic-clastic sediments of the Karashakh Formation in the contact of granitoids in the nuclear part of the anticline.

Host rocks are represented by hornfels developed along metavolcanogenic formations. Igneous rocks are represented by dykes of gabbro-diorite and granitoid intrusives.

Presence of dykes with scheelite mineralization as well as levels of skarnized dolomites and carbonatized quartzites with lenses of skarns with scheelite are confirmed in this area.

Expected type of mineralisation is layer-stockwork similar to Saghinkan.

Prospecting works are suspended in this area.

(6) Kizilkashkar ore showing (W)

Kizilkashkar ore showing has been found 7 km south-east from the Sautbay deposit (Fig. II-5-1). Host rocks are represented by green slates of the Karashakh Formation which are overlapped by siliceous rocks of the Kokpatas Formation including intercalations of slates and siltstones.

Igneous rocks are represented by syenite-diorites, granosyenites and dykes.

The structure of the area is an anticlinal limb complicated by small isoclinal folding.

Assumed type of mineralization is skarn-skarnoid with possible superposition of stockwork.

Prospecting works are suspended in this area.

(7) Saridjoy ore showing (W)

Saridjoy ore showing is situated 13-15 km east from Sautbay (Fig.II-5-1). Its general geology is as follows: metavolcanogenic-clastic and carbonate-siliceous rocks of the Karashakh and Kokpatas Formations in the contact of intrusive of adamellites.

Potentially prospective lithologic facies is determined by development of carbonate levels in both formations which reminds lithologic facies of Sarytau and Sautbay.

In this area skarn-skarnoid and layer-stockwork mineralization are expected.

Prospecting works are suspended in this area.

1-4-3 Turbay Ore Field

Turbay ore field occupies central part of the Turbay mountains and is situated between the Sautbay and Sarytau ore fields. A large granitoid intrusive of the same name is situated in the north-west part of the ore field (Fig.II-5-1). The main structure is the Turbay anticline and Central Turbay area of high permeability. The latter is characteristic of wide development of fractured structures and controls the location of quartz-vein formations, small intrusive and dykes. Turbay gold deposit, West Turbay gold-silver ore showing, East Turbay gold ore showing are confined to it.

Metalogenic characteristic of the ore field is gold and silver, tungten is a by - element.

(1) Turbay ore deposit (Au)

The Turbay deposit is situated 50 km east from the town of Uchkuduk and 30 km south-east from the open pit in the Kokpatas ore field(Fig.II-1-2). Prospecting evaluation was undertaken in the area in 1977-1978 and resulted in reserves evaluation of some ore bodies in category C_2. Prospecting activities were resumed in 1990 for the purpose of its re-evaluation and consideration of open pit development with gold extraction by heap leaching.

Turbay deposit is confined to the north-east limb of Turbay anticline.

The geology of the deposit consists of carbonaceous-siliceous-clastic sediments (hornfelses, siltstones, shales, microquartzite) of Kokpatas Formation intruded by stock and dykes of granodiorite, lamprophyre and diorite-porphyrites. By geophysic data at a depth of 500-600 m comb-shaped protrusion of the Turbay granitoid massif is expected. Quartz stockwork and metasomatic silicification of WNW-ESE direction which contains the biggest part of gold ore is widely developed in the area(PL.II-1-8, PL.II-1-9). Gold occurs mostly (85-87%) as native gold in quartz veinlets partially in sulphides hosted in granodiorite and hornfels. It is usually accompanied by indistinct sulphide polymetallic mineralization. Pyrite has relativery widespread occurrence together with small amount of

arsenopyrite, sphalerite, galena, chalcopyrite and pyrrhotite.

There are three mineralized zones (Northern, Central and Southern) in the deposit of up to 1,200 m long and from 100 to 400 m wide each; 22 ore bodies have been identified so far within its limits. The ore bodies are echelon-like deposits steeply dipping to the north whose boundary have been marked by sampling data. Thickness of ore bodies is about 1-12 m, length is up to 600 m along the strike and 370 m along the dip. Gold grade in the ore bodies is extremely uneven: from 0.5 to 27.5 g/t. Average grade for the deposit ranges from 0.8 to 1.9 g/t.

The following activities were carried out in 1974 - 1994: trenching - 13,570 m^3, detailed survey of 60m x 20m grid, 3 exploration shafts(40 m) deep and cross cuts - 2,165 m, non-coring drilling up to 100 m deep - 31,794 m, coring drilling - 6,347m.

Reserves of the ore deposit up to 200 m deep are evaluated to be 20-25 million tonnes. Total reserves (1994) of category P_1 and C_2 have been calculated in the Southern zone.

Cut off grade Au(g/t)	Ore reserves (thou.tones)	Grade Au(g/t)	Contents Au(kg)
0.8	4,191.12	1.51	6,339.86
0.5	8,231.53	1.11	9,148.95
0.3	10,943.89	0.94	10,255.57

Technological tests proved efficiency of gold extraction by heap leaching. Recovery is expected to be 80-82% at 50 mm of size of feed ore. The deposit has not been outlined yet and prospecting evaluation is going and to be finalized in 1995.

(2) West Turbay ore showing (Ag, Au)

West Turbay ore showing is situated 2 km north-west from Turbay deposit in the north-east side of Turbay anticlinal limb(Fig.II-5-1). Metavolcanogenic-clastic rocks of Karashakh Formation occur in its core while its limbs are formed by siliceous-carbonaceous-clastic sediment of Kokpatas Formation.

Distribution of the showing is controlled by the Central Turbay zone of high permeability presence of which is clearly fixed by wide development of small dykes, fault clay, breccia, metasomatic alteration of host rocks and quartz-veins.

Two mineralized areas - Northern and Southern - have been identified in the area. They are extended in the north-west direction.

Northern mineralized area is mostly explored. It contains 8 ore deposits. There are

several ore bodies of 1.2 to 16 m thickness in each deposit. Deposit No 1 is the largest one: 40 m wide, 260 m long by strike, vertical range of mineralization is 170 m.

The ore bodies of the deposit are steeply dipping. They consist of brecciated, silicified, albeitized siltstones, sandstones, slates, granodiorite-porphyries with veins of quartz. Metasomatites are represented by albite-quartz and feldspar-quartz-sericite vein formations.

Gold-silver mineralization is characterized by a number of ore minerals: argentite, pyrargyrite, native silver, native gold, sternbergite forming micro-ingrowths in pyrite as well as independent accumulations in host rock. Main silver-bearing minerals are freibergite, chalcocite and bornite.

Presence of considerable amount of sulphide minerals (up to 5-6%) allows to classify silver mineralization as (gold)-silver-polysulphide-quartz ore.

Prospecting works are suspended in this area.

(3) Central ore showing (Ag)

Central ore showing is situated 5 km west from gold-ore deposit Turbay and adjoins the southern boundary of the Central Turbay ore bearing structure (area of high permeability) (Fig.II-5-1). It was discovered in the process of geochemical survey. Area of stockwork and quartz veins is confined to tuff of andesite-dacite composition, hosting intercalations of phyllitic slates and microquartzites of lower Kokpatas Formation. Length of the area is a few hundred metres, width of 50-70 m. Gold grade ranges from 0.1 to 1.0 g/t., silver from 2 to 10 g/t.

Prospecting works are suspended in this area.

(4) Daikovoe ore showing (Au)

Daikovoe ore showing has been revealed 9 km north-west from the Turbay deposit (Fig.II-5-1) in the sandstone and slate of upper Koksai Formation intruded by dykes of granodiorite-porphyries, diorites, lamprophyres and rare bodies of gabbro-diorites. Gold grade in hornfels is 0.1-0.9 g/t. Thickness of alteration zones is 1-5 m.

Prospecting works are suspended in this area.

(5) Kayansai ore showing (Au)

Kayansai ore showing is situated 4 km south from the Turbay deposit (Fig.II-5-1). It was identified in the process of geologic survey of 1:50,000 scale. It is confined to the south-west of the Turbay anticlinal limb formed by siliceous-clastic rocks of the Kokpatas Formation. A quartz vein of 26 m thickness and 250 m length has been traced in the area

in the north-east direction. Gold grade is 0.1-1.2 g/t.

The ore showing is classified as quartz-vein type.

Prospecting works are suspended in this area.

(6) East Turbay ore showing (Au)

East Turbay ore showing has been identified 3 km east from the Turbay ore deposit (Fig.II-5-1). It is confined to the North-East Turbay anticlinal limb. It is determined in the structure produced by Central-Turbay area of high permeability and bodies of granodiorite-porphyries of 200-500 m long and 20-50 m thick.

Gold mineralization is concentrated in the three mineralized ore areas: Northern, Central and Southern.

Northern ore area is traced 500 m by strike in the WNW-ESE direction. The host rocks are: sandstones, phyllitic slates, quartzites with dolomite intercalations. They are exposed to silicification. Mineralization is confined to the quartz stockwork and distributed extremely unevenly. It reaches 4.5-9.3 g/t in the most enriched part. Thickness of the mineralized zone is 10-15 m, rarely to 40 m. Gold is free disseminated (0.01-0.1 mm).

Southern mineralized area has WNW-ESE direction; its length reaches 500-600 m, thickness - 30-50 m. It is a elongated quartz stockwork steeply dipping to the north. The host rocks are: qurtz-feldspar-micaceous metasomatites along sandstones, slates, dykes of granodiorite-porphyries and diorite-porphyrites. The highest gold grade (12.1 g/t) has been marked in quartz veinlets developed in granodiorite-porphyries.

Prospecting works are suspended in this area.

(7) South Turbay ore showing (Au)

South Turbay showing has been identified in the central part of Turbay mountains (Fig.II-5-1). It is confined to the north-east part of Turbay anticlinal limb.

Gold mineralization is located in quartz veins and zones of stockwork silicification of WNW-ESE direction. There were three ore zones of vein-stockwork mineralization identified: Northern, Central and Southern.

Southern mineralized zone is formed by quartz veins, veinlets and metasomatic silicification of host rocks. The parameters of the mineralized zone are: length by strike - about 1000 m, length by dip - up to 200 m, thickness - more than 150 m., gold grade is extremely uneven and on average is 1.8-2.22 g/t. The ores are low- sulphide. The leading ore minerals are pyrite, arsenopyrite, galena, chalcopyrite and native gold; the accessary minerals are scheelite, bismuthinite, native bismuth, pyrrhotite, sphalerite.

Gold is situated in quartz and sulphide minerals.

Prospecting works are suspended in this area.

(8) Taraubay ore showing (Au)

Taraubay showing is confined to a horst-anticlinal structure of the Kokpatas Formation among the Koksai Formation (Fig.II-5-1). The geology of the area is composed of sandstones and siltstone with elongated thin (3-12 m) intercalations of microquartzites, siliceous and phyllite-like slates. Igneous rocks have not been identified.

Contacts of siliceous rocks and sand-slate are tectonically released and in most cases represented by veinlet zones of silicification and ferrugination. Thickness of quartz veins is 0.2-0.5 m, length - several metres. In the eastern part of the area a thick (6-8 m) and long (350 m) quartz vein was mapped. In the south-western part of the area an ore dot in silicified sandstone was identified of 0.6 g/t gold and 13.4 g/t silver grade.

Values of geochemical zonation ratios showed under ore level of anomaly which caused negative evaluation of the showing.

Coreless drilling (up to 100 m) are scheduled in this area in 1995.

1-4-4 Okjetpes Ore Field

The Okjetpes ore field is situated in the southern slopes of the Bukantau mountenous massif (the Okjetpes mountains)(Fig.II-1-2). The Okjetpes mountains are dome-like Paleozoic structure outstanding on the desert and hilly plain. The central uplifted part of the territory is formed by limestone and has maximum elevation of + 334 m.

About 30 km north-westward from the ore field, there is a settlement of the Kokpatas expedition.

The ore field is situated in the south-eastern part of the Kokpatas antiform and is occupied by the rocks of lower member of the Kokpatas Formation, Devonian and Carboniferous(PL.II-1-10). The Lower Kokpatas Formation is distributed in the western part of the ore field and represented by microquartzite, quartzite, siliceous jaspar-like rocks, sandstones and mudstones.

Devonian System is spread in the cores of dome-shaped anticlinal structures and represented by fine-grained limestones with interlayers of marbles and dolomitized limestones. Thickness of the system is more than 500 m.

Sediments of the Carboniferous System form limbs of anticlinal fold. They concordantly occur on the rocks of Devon. They are represented by limestone with lens-shaped intercalations of siliceous rocks in the lower and middle divisions. The upper division is represented by unconsolidated sandstones and mudstones with interlayers of

siliceous rocks and limestone.

The all of the above mentioned rocks are intruded by dykes.

Silver and gold mineralization are known in the ore field.

Mineralization is associated with quartz and carbonate-quartz veins and stockwork in faults.

There are 10 mineralized zones in the area. Silver deposit of Okjetpes is located in one of them (mineralized zone No.1). There is also gold mineralization in the Barhanny ore showing.

(1) Okjetpes ore deposit (Ag)

The Okjetpes silver deposit is localized within mineralized zone No.1 along the main fault which is traced about 6 km in ENE - WSW direction(PL.II-1-11). Rocks of various composition and age - Carboniferous sandstone and limestones in the west and Devonian limestones in the east - are put in contact along the main fault (PL.II-1-).

The mineralized zone is accompanied by a number of dykes predominantly of diorites and more rarely lamprophyre along its whole length.

Rocks in the fault zone are intensively crushed into fault breccia; they are also silicified and ferruginized.

Quartz veins of 8-10 m or more thickness formed in the area of the fault is traced 1,050 m by strike.

Thickness of the fault zone rather quickly decreases by strike. And abrupt pinching out of the quartz vein takes place at a depth of 100-120 m together with decrease of the fault thickness(PL.II-1-12).

All the rocks (limestone, dyke, sandstone, schist) regardless of their mineral and chemical composition underwent hydrothermal alteration. The main ore minerals are pyrargyrite, pyrite and limonite.

Gold mineralization is localized in mineralized zone No.2 where a small size ore body of 200 m long was distingnished. It is concentrated in brecciated quartz containing sulphide minerals of pyrite-arsenopyrite association. Native gold was found in the quartz in a trench. The ore body is of 1.0 m average thickness on the surface and of 21.3g/t grade. The identified depth of ore body is 50 m, and its thickness at this depth is 0.7 m, gold grade drops to 2.0 g/t.

Zone of oxidation is developed and goes about 80 m deep.

Prospecting activities in the area were completed in 1985 and further development works were abandoned because of its small scale.

The following activities were carried out in 1974 - 1982: detailed survey of 40m x 20-

30 m grid, tunnels on 3 levels with elevation of +245 m, +225 m and +205 m, trenching - 43,400 m3, 2 exploration shafts (50m deep) and cross cuts - 3,078 m, mine shaft - 94 m, horizontal tunnels - 2,942 m, raises - 165 m, coring drilling - 22,333 m and non-coring drilling - 24,383 m.

The calculations of silver and gold ore reserves of the category C_1 were made by method of vertical - parallel sections in 1982.

Total reserves of C_1 category at the Okjetpes deposit are as follows.

Ore reserves	Average grade		Contents	
(t)	Ag(g/t)	Au(g/t)	Ag(kg)	Au(kg)
2,968,240	135.9	0.17	403,309.1	495.5

Cut off grado : Ag = 30g/t

(2) Barhanny ore showing (Au)

Barhanny ore showing is situated in the north-eastern part of Okjetpes ore field(PL.II-1-2).

Gold mineralization is confined to quartz, dolomite and (ankerite) veins located in 3 zones of fault traced in north-eastern direction and in the fructures striking north-western direction(PL.II-1-13). Host rock are limestones of Lower Carboniferous age. The distribution of gold mineralization are extremely uneven within the area. Gold grades are from 1.5 up to 34.0 g/t. Ore zones were investigated by strike 500 m and to the depth 100 m. They have thickness in some sections up to 100 m.

In this area rout investigation, totally 7,000 m of core drilling (100-150 m each hole), trenches and 2 vertical shafts were carried out in 1978 - 1986. Prospecting was accompanied by geochemical (at a scale of 1:10,000) and geophysical (ground magnetic prospecting) works.

The prospecting will be resumed in 1995 for the investigation on the north-eastern and south-western continuation of mineralized zone.

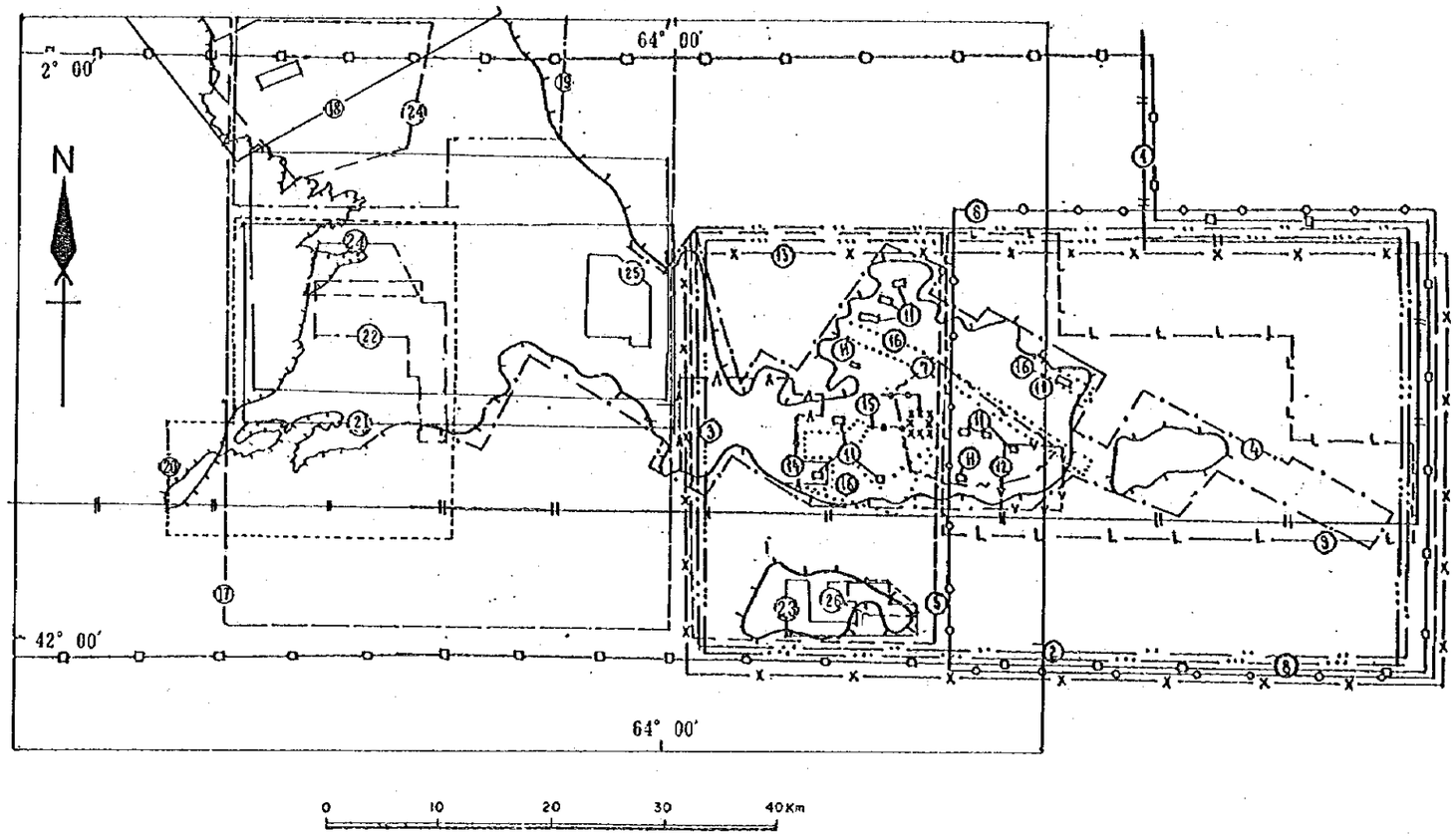

Fig. II-1-1 Area of Existing Geological Data

Exsisting Geological Data

No.	Years	Activities	Scale of Maps
1	1939	Geologic Survey	1:100,000
2	1953-57	Geologic Survey & Prospecting	1:100,000
3	1957	Geologic survey & Prospecting	1:200,000
4	1962	Geochemical Survey	1:50,000
	1970-74	Geologic Survey & Prospecting	1:50,000
5	1970-72	Mineralogical & Geochemical Survey	1:50,000
6	1970-75	Aerial Photogeologic Study	1:50,000
7	1972-74	Prospecting	1:50,000 1:25,000
8	1972-74	Aerial Photogeologic Survey	1:10,000 1:200,000
9	1974-77	Geologic Survey & Prospecting	1:50,000
10	1977-79	Prospecting Evaluation	1:10,000 1:200
11	1977-83	Detailed Exploration	1:10,000
12	1980-89	Detailed Exploration, Evaluation	1:25,000 1:10,000 1:2,000 1:1,000
13	1981-83	Aerial Photogeological Map	1:50,000
14	1981-89	Prospecting	1:10,000
15	1984-89	Detailed Exploration	1:5,000
16	1990-93	Vericus Prospecting & Mapping	1:25,000
17	1954	Geologic Survey & Prospecting	1:200,000 1:100,000
18	1950-51	Prospecting	1:50,000
19	1969-72	Geologic Survey	1:50,000
20	1972-75	Geologic Survey & Prospecting	1:50,000
21	1981	Prospecting	1:10,000 1:25,000
22	1971-72	Geologic Survey & Prospecting	1:10,000 1:50,000
23	1972-75	Geologic Survey & Prospecting	1:25,000 1:10,000
24	1967-72	Prospecting	1:10,000
25	1963-	Detailed Exploration	1:10,000 1:5,000 1:1,000
26	1980-83	Detailed Exploration	1:10,000

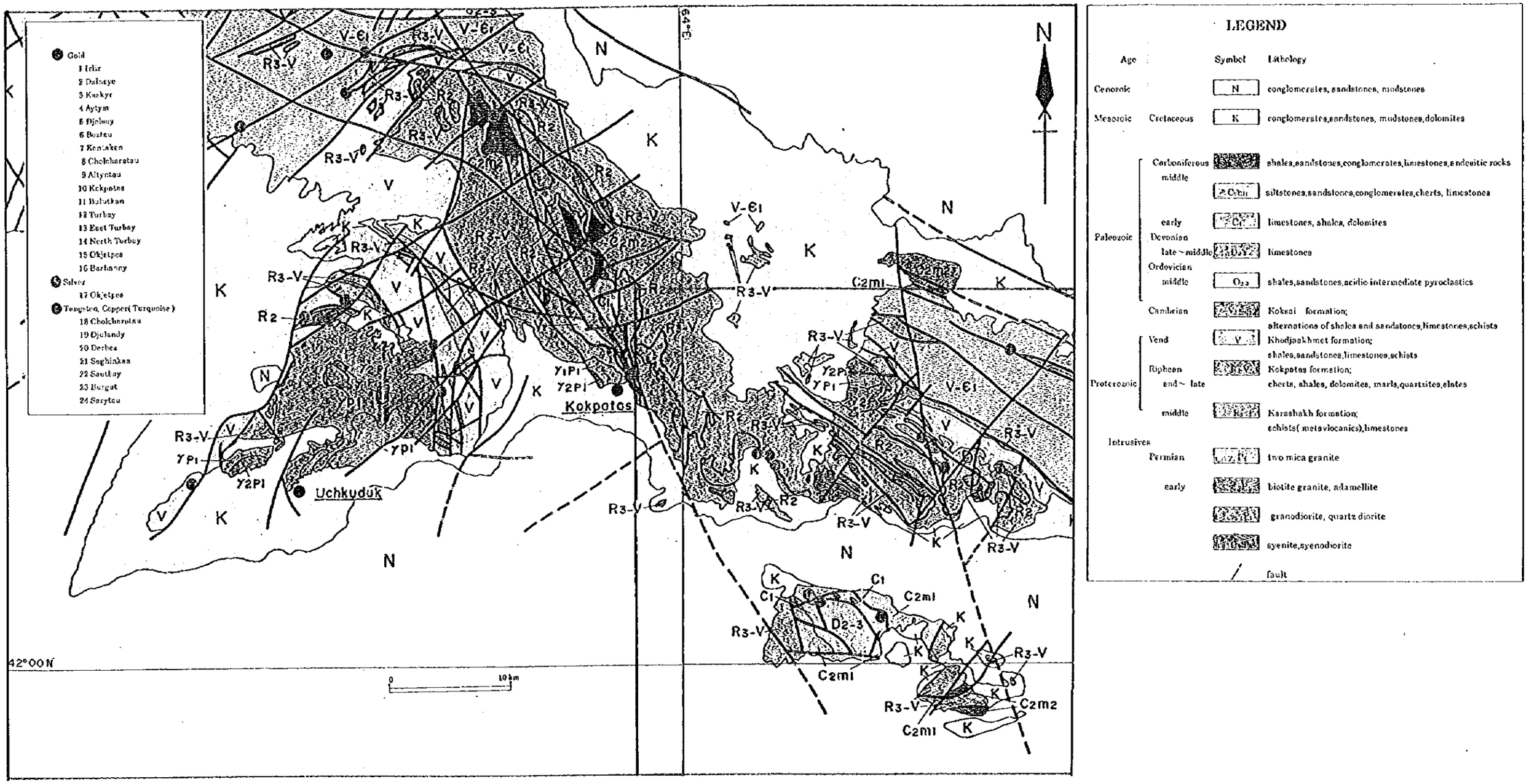

Fig. II-1-2 Ore Deposits and Showings in the Eastern Bukantau Area

Table II- 1-1 Exsisting Geological Data

No.	Years	Activities	Area	Scale of Maps
1	1939	Geologic Survey	The Bukantau mountains	1:100,000
2	1953-57	Geologic Survey & Prospecting	East of Kokpatas(Kokpatas antimony showings)	1:100,000
3	1957	Geologic survey & Prospecting	East of Kokpatas(Kokpatas antimony showings)	1:200,000
4	1962	Geochemical Survey	East of Kokpatas	1:50,000
	1970-74	Geologic Survey & Prospecting	East of Kokpatas	1:50,000
5	1970-72	Mineralogical & Geochemical Survey	Turbay, Central Kayansai, Near Contact, Dyke, .Oguztau, North and South Aidym gold showings	1:50,000
6	1970-75	Aerial Photogeologic Study	The Turbay mountains	1:50,000
7	1972-74	Prospecting	Sarytau ore field	1:50,000 1:25,000
8	1972-74	Aerial Photogeologic Survey	Sarytau,Razrezhaya,East Sarytau,North .Turbay,Djetintau,	1:10,000 1:200,000
9	1974-77	Geologic Survey & Prospecting	Sarytau,Djetintau	1:50,000
10	1977-79	Prospecting Evaluation	Turbay deposits	1:10,000 1:200
11	1977-83	Detailed Exploration	Karatau,Kensai,Central,Dyke,Oguztau,Near .Contact,Taraubay,Aytym,Sautbay	1:10,000
12	1980-89	Detailed Exploration, Evaluation	Sarytau ore field (Sarytau ore deposits, West Turbay ore .showing)	1:25,000 1:10,000 1:2,000 1:1,000
13	1981-83	Aerial Photogeological Map	The Bukantau mountains	1:50,000
14	1981-89	Prospecting	Sautbay deposits and Sarydjoy, .Kizilkashar,Koktash,South Turbay area	1:10,000
15	1984-89	Detailed Exploration	West Turbay	1:5,000
16	1990-93	Various Prospecting & Mapping	Taraubay and other ore showings	1:25,000
17	1954	Geologic Survey & Prospecting	North Bukantau to Uchkuduk, Kokpatas	1:200,000 1:100,000
18	1950-51	Prospecting	North Bukantau	1:50,000
19	1969-72	Geologic Survey	North bukantau to Aytym	1:50,000
20	1972-75	Geologic Survey & Prospecting	Altyntau	1:50,000
21	1961	Prospecting	Altyntau to Cholcharatau	1:10,000 1:25,000
22	1971-72	Geologic Survey & Prospecting	Uchkuduk	1:10,000 1:50,000
23	1972-75	Geologic Survey & Prospecting	Okjetpes area	1:25,000 1:10,000
24	1967-72	Prospecting	Okjetpes area	1:10,000
25	1963-	Detailed Exploration	Kokpatas	1:10,000 1:5,000 1:1,000
26	1980-83	Detailed Exploration	East of Okjetpes	1:10,000

Name	Ore Field	Host Rock	Mineralization	Type of Ore bodies	Size	Grade	Ore Reserves	Exploration
Sarytau ore deposit	Sarytau	Kokpatas Formation Granodiorite-Adamellite	W	Stockwork Skarn-Skarnoid	Stockwork (4 ore bodies): l=2km, w=300-800m, d=350-400m Skarn-Skarnoid (10 ore bodies): l=60-690m, w=from 10-15m to 50-70m, d=60-590m	stockwork: WO_3=0.153% on average Skarn-Skarnoid: WO_3=0.2-0.4% on average	(1990) cut off WO_3=0.08, 0.1% C_1+P_1: 49,175 thou.t WO_3= 0.277% WO_3= 136,174t Au = 11t Mo = 5 thou.t	Suspended Prospecting activities(1978-1988): Geological mapping-2km², gravity and magnetic survey, trenching-10,806m³, exploration shaft(about 30m deep)-261m, cross cuts(one level)-2,000m, non-coring drilling-20,383m, coring drilling-11,621m, survey of 80m×80m, 160m grid.
Sektash ore showing	Sarytau	Kokpatas Formation	W	Skarn-Skarnoid	w=3.5-4.5m	WO_3=0.15-0.33%	—	Suspended Prospecting activities: 2 drilling holes(up to 300m).
Katirtas ore showing	Sarytau	Kokpatas Formation	W	metasomatite	Unknown	WO_3=0.15-0.21% (In one mapping hole)	—	Underway Prospecting activities: 150 mapping drillings(100m×5m grid).
Kazgan ore showing	Sarytau	Kokpatas Formation Granitoid	W	metasomatite	w=6m	WO_3=0.32% on average	—	Suspended Prospecting activities: mapping drilling.
					w=24m	WO_3=0.14% on average		
East Kazgan ore showing	Sarytau	Kokpatas Formation Granitoid	W	Skarnoid-Stockwork	w=8m	Granitoid WO_3=0.18%	—	Suspended Prospecting activities: drilling.
						Skarnoid WO_3=0.07-0.27%		
Central Sarytau ore showing	Sarytau	Kokpatas Formation Lamprophyre dyke	Au,Ag, Sulphide	Vein, Veinlets	w=0.3-5.0m	Au=2.0-4.0g/t, Ag=18.0-55.0g/t	—	Suspended Prospecting activities: drilling.
					w=2-4m	Au=0.4-1.0g/t		
South Sarytau ore showing	Sarytau	Kokpatas Formation	W,Au	Skarn-Skarnoid	l=40-120m, w=2-4m	WO_3=not morethan 0.05%	—	Suspended Prospecting activities: drilling.
					w=4-10m	WO_3=0.03-0.8%		
					w=2-5m	Au=0.2-0.6g/t		
North Sarytau ore showing	Sarytau	Granitoid	Au,Ag, Cu,Sn	Vein	l=500m, w=3-5m	Au=1.5-2.0g/t, Ag=19.5-34.2g/t, Cu=0.265-0.612 %, Sn=0.012-0.18%, Bi=0.064-0.068%	—	Suspended Prospecting activities: drilling.
Sautbay ore body, Burgut ore showing	Sautbay	Kokpatas Formation Karashakh Formation Granitoid	W (Au)	Skarn-Skarnoid Stockwork	21 Skarn ore bodies l=1,600m(total) w=0.5-33m d=5-600m	WO_3=0.20-0.87% (Grade of blocks)	(1993) cut off WO_3=0.05, 0.08% $C_1+C_2+P_1$: 39,539,352t WO_3=0.43%, Au=0.34g/t (MMAJ,1995) cut off WO_3=0.05% Reserves: 25,885,000t WO_3=0.27%, Au=0.24g/t	Underway Prospecting activities(1985-1993): magnetic survey 70km² and 10km², trenching-9,044m³, non-coring drilling-4,440 m, coring drilling 300m and deep on average-42,030m, exploration shaft with drifts and cross-cuts-3,294m.

Table II-1-2 List of Ore Deposits and Ore Showings in the East Bukantau Area(2)

Name	Ore Field	Host Rock	Mineralization	Type of Ore bodies	Size	Grade	Ore Reserves	Exploration
Saghinkan ore showing	Sautbay	Kokpatas Formation Karashakh Formation	W	Skarn-Skarnoid	10 ore bodies l=460-960m w=from 1m to 30-40m	WO_3=0.1-2% (average 0.3%)	(1994) cut off WO_3=0.1% C_2+P_1: 12.90 mil.t WO_3= 0.32%	Completed Prospecting activities; trenching-1,152m³, mapping drilling-3,456m, coring drilling by 160m×80m and 80m×80m grid-19,051m.
Sulutkan ore showing	Sautbay	Kokpatas Formation	Au	metasomatite	l=more than 100m w=30m d=more than 70m	Au=1-420g/t (average Au=6.9g/t)	-	Underway Prospecting activities(1993-1994); trenching, 70 non-coring drillings(depth up to 70m). Further prospecting works such as trenches, drill holes, geophysical survey, shaft and cross cuts are scheduled until 1998.
					Another 4 zones of metasomatite are presumed. l=more than 4.5km w=600-700m	-		
Southeast Sautbay ore showing	Sautbay	Kokpatas Formation	W	Skarn-Skarnoid	Unknown	-	-	Suspended
Kizilkashkar ore showing	Sautbay	Kokpatas Formation Karashakh Formation	W	Skarn-Skarnoid, Stockwork (?)	Unknown	-	-	Suspended
Sarydjoy ore showing	Sautbay	Kokpatas Formation Karashakh Formation	W	Skarn-Skarnoid	Unknown	-	-	Suspended
Turbay ore deposit	Turbay	Kokpatas Formation	Au	Stockwork, metasomatite	3 mineralized zones (Northern,Central,Southern) l=1,200m(total) w=100-400m each d=more than 400m Ore body l=up to 600m w=1-12m d=370m	Au=0.5-27.5g/t (average Au=0.8-1.9g/t)	(1994) Southern zone C_1+P_1: 8,232 thou.t Au=1.11g/t (cut off Au=0.5g/t)	Will be finalized in 1995. Prospecting activities(1974-1994); trenching-13,570m³, 3 exploration shafts(40m deep) and cross cuts-2,165m, detailed survey of 100m×20m grid, non-coring drilling up to 100m deep-31,794m, coring drilling-6,347m.
West-Turbay ore showing	Turbay	Kokpatas Formation Karashakh Formation	Au,Ag	Vein, metasomatite	Northern mineralized area 8 ore deposites Deposite No.1: l=260m, w=40m, d=170m	-	-	Suspended Prospecting activities; drilling.
Central ore showing	Turbay	Kokpatas Formation	Ag	Vein, Stockwork	l=few hundred meters w=50-70m	Au=0.1-1.0g/t Ag=2-10g/t	-	Suspended
Daikovoe ore showing	Turbay	Koksai Formation	Au	metasomatite	Alteration zone w=1-5m	Au=0.1-0.9g/t	-	Suspended

Table II-1-2 List of Ore Deposits and Ore Showings in the East Bukantau Area(3)

Name	Ore Field	Host Rock	Mineralization	Type of Ore bodies	Size	Grade	Ore Reserves	Exploration
Kayansai ore showing	Turbay	Kokpatas Formation	Au	Vein	l=250m w=26m	Au=0.1-1.2g/t	-	Suspended
East Turbay ore showing	Turbay	Kokpatas Formation Granodiorite porphyries	Au	Stockwork	Northern mineralized area w=10-15m(rarely 40m)	Au=4.5-9.3g/t (most enriched part)	-	Suspended Prospecting activities; drilling.
					Southern minerarized area l=500-600m w=30-50m	Au=12.1g/t (highest grade)		
South Turbay ore showing	Turbay	Kokpatas Formation	Au	Vein, Stockwork	Southern minerarized zone l=about 1,000m w=more than 150m d=up to 200m	Au=1.8-2.22g/t	-	Suspended
Taraubay ore showing	Turbay	Kokpatas Formation	Au	Vein	l=several meters w=0.2-0.5m l=350m, w=6-8m	Au=0.6g/t, Ag=12.4g/t (one sample)	-	Mapping drillings are scheduled in 1995. Prospecting activities; mapping drilling and geochemical prospospecting(Hg).
Okjetpes ore deposit	Okjetpes	Carboniferous Devonian	Ag (Au)	Vein	minerarized zone No.1(Ag) l=1,050m w=8-10m d=100-120m	-	(1982) C.: 2,968,240t Ag=135.9g/t Au=0.17g/t (cut off Ag=30g/t)	Suspended Prospecting activities(1974-1982); detailed survey of 40 m×20-30m grid, tunnels on 3 levels, trenching-43,400m³, 2 exploration shafts(50m deep) and cross cuts-3,078m, mine shaft-94m, horizontal tunnels-2,942m, raises-165m, coring drilling-22,333m and non-coring drilling-24,383m.
					minerarized zone No.2(Au) l=200m w=1.0m d=more than 50m	Au=21.3g/t(surface) Ag=2.0g/t(-50m)		
Barkhanny ore showing	Okjetpes	Carboniferous	Au	Vein	l=500m w=up to 100m d=100m	Au=1.5-34.0g/t (uneven)	-	Non core drillings and One coring drilling are scheduled in 1995. Prospecting activities(1978-1986); geochemical and geophysical(ground magnetic prpspecting) works, core drilling(100-150m)-7,000m, trenches and 2 vertical shafts.

l : length
w : width
d : depth

Chapter 2. Analysis of Existing Geophysical Information

2-1 Objective

The purpose of the study is to develop a future exploration program by clarifying physical features of ore deposits and the areas which surround them. This study includes collection, compilation and analysis of existing geophysical information.

2-2 Geophysical Survey History

Many geophysical surveys have been performed in the eastern Bukantau area since 1958. The primary survey methods and dates of surveys performed in this area are listed in Table II-2-1 and the location of survey lines or areas covered by these surveys are shown in Figure II-2-1. The numbers on Figure II-2-1 refer to the survey numbers listed in Table II-2-1.

While the majority of the work done in this area has been gravity and magnetic surveys, a number of electrical surveys, such as self potential (SP), direct current resistivity (DC), induced polarization (IP) and electromagnetics (EM) have been performed and gamma ray, seismic and geoelectrochemical studies have also been carried out. These data sets are stored separately in many places, but the results of these surveys have been compiled and summarized into two reports published since 1990.

One of these is a study of the Kokpatas ore deposit, which is west of Bukantau, published by A.A.Horsov in 1991. The other report covers the Sautbay, Turbay and Sarytau deposits and was written by A.P.Cheshuin in 1994. Figure II-2-2 shows the areas covered by these reports. The Okjetpes region is south of the areas covered by these reports, but a four year plan of compilation of data from the Okjetpes region was begun in 1994. This work is not yet finished and data from that area is not included in this report.

The results presented in this report are drawn primarily from A.P.Cheshuin's paper of 1994. This work covers most of the area of interest to this report and also describes geophysics related computer systems and software of the State Committee of Geology and Mineral Reserves (SCGMR) of the Republic of Uzbekistan.

2-2-1 Geophysical Survey Methods

(1) Gravity

In this area, the primary methods used have been gravity and magnetics. The density

which has been used for Bouguer gravity corrections is $2.67 g/cm^3$, which is the average density in the survey area. Both long and short wave anomaly maps have been prepared of the area. There are five regional Bouguer anomaly maps for wavelengths of 500 to $10{,}000m$ and four maps of residual Bouguer anomalies for wavelengths of 1500-$10{,}000m$. Two dimensional inversions have been done along profile lines cutting ore deposits normal to their trends. This report also includes three major sections.

In order to have access to gravity plan maps, permission from the defense ministry is required. This procedure is time consuming and permission could not be gotten during the course of this project.

(2) Magnetics

Both air and surface magnetic work have been done in the survey area. The aeromagnetic equipment which was used is manufactured by McPhar Geophysics of Canada. This data was filtered to derive long and short wavelength maps. This report includes the total and residual magnetic anomaly maps derived from $10{,}000m$ wavelength filtering. Two dimensional modeling has also been done along major section lines. Also included are total, regional and local magnetic anomaly maps.

(3) Seismic

Seismic studies have been done on the west side of the area where dense gravity observations have been made. The p-wave velocities derived from these studies are given on the inferred geological sections in the interpretation sections of Plates II-2-3 through II-2-5.

(4) Electrical

SP, DC, IP and EM surveys have been performed in the study area. A.P.Cheshuin's paper includes only the SP map, however. The array used in collection of the DC resistivity data was the Schlumberger array and the DC data was graphically interpreted. The IP data was collected with a gradient array, rather the a dipole-dipole array. While the gradient IP data was taken, Schlumberger DC soundings were also made. This Schlumberger data was interpreted by computer. Frequency domain EM soundings were made in a bandwidth from 0.1 to $200Hz$ and have a depth of penetration (skin depth) of about $400m$.

(5) Gamma Radiation

Air and ground gamma ray surveys have been done in the study area. A.P.Cheshuin's

report gives only anomaly locations on the maps and not the location of observation stations or flight lines.

(6) Geo-Electro Chemical

Geo-Electro Chemical methods known as the KSPK and BSKP methods have been used in this area. The former method is a boreholes method, while the later is a surface method.

In the KSPK method, current is passed through sulfide bodies in a manner similar to the mise-a-la-messe resistivity method to charge the interface between the sulfides and the host rock are made on the surface. Measurements of the chemical reaction between sulfides and the host rock. When this is done the mineral type and quantity can be determined (A.A.Horsov,1992).

In the BSKP method excitation of the target ore body is done from the surface. This is said to be very effective if silver, gold or tungsten mineralization is present in sulfide ore. The equipment which was used in this work was taken back to Russia and is not presently available to Uzbekistan.

2-2-2 Computer System Environment

(1) Hardware

The computer currently being used by the SCGMR is a desktop personal computer manufactured in Korea by the Hyudai corporation. This computer is a Super 286E Plus with a 15" color monitor and is linked to a Hyudai printer.

(2) Computer Software

The geophysical analysis system was developed by the government of the former U.S.S.R. and the system which Uzbekistan has is the first version of that system. In Russia the seventh version of that system is now in use.

- COSCAD system

The COSCAD system is a software package developed for spectral, statistical and correlation analysis. This software is used to draw maps, filter data, extract anomalies from data sets (remove regional trends) and perform multidimensional data analysis. The data presented in Plate II-2-2 has been filtered and two dimensionally analyzed. This calculation took one hour.

- RAZREZ system

The RAZREZ software system performs two dimensional analysis of gravity and magnetic data. A mouse is used to enter a candidate earth model and a forward calculation is performed. The resulting curve is visually compared to the observed data and the earth model is then interactively modified to improve the fit to the observed data. By this procedure interactive iterative inversions are performed. The earth model must be corrected manually and the inversion is not automatic.

- METALLORESURS system

Quantitative evaluation of the metallic mineral resource potential of ore deposits is performed by the use of this software system. This reserve estimation package has four subsystems as in the COSCAD system.

- VEZ-IPI system

This software can be used to invert induced polarization and direct current electrical sounding data by RMS curve matching techniques.

-SIGMA complex

SIGMA is an interactive gravity and magnetics software system which can be used to determine density or magnetic susceptibility distributions from field data sets.

-SuperCalc version 04 and version 05

SuperCalc is spreadsheet software. Version 4 can accommodate a two dimensional spread sheet and the newer version 5 has three dimensional graphics representation capability.

-BOELING GRAPH 3-D system

This is mapping and graphics software which can produce 100 different types of graphs and maps.

-SURFER version 4.06

Surfer is a package containing software which can be used in spreadsheet form to manipulate and grid data. The gridded data can then be contoured to produce plan contour maps or fit by a three dimensional surface and presented as an orthographic projection of a surface. Utility programs handle tasks such as plotting, viewing plots, computing surface volumes and areas and producing arbitrary cross section through

surfaces.

- MATHCAD version 3.00 system
  MATHCAD is mathematical computation software.

- CHIWRITER version 4.0 package
  This is a word processing software package.

-CORRECTOR version 4.02
  CORRECTOR is a Russian language word processor.

- PROMPT
  This is software which can be used to translate from the English to Russian languages.

2-3 Interpretation of Existing Data

Two dimensional interpretation software has been used to interpret existing gravity and magnetics data. No software was available for the interpretation of gradient IP data so no further work was done on this data.

(1) Personal Computer

The computer used in this work was a notebook personal computer manufactured by Dell in the U.S.A.. It is an *i*80486 DX50 model with a 50*MHz* central processor, 8 megabytes (*Mb*) of random access memory and 320*Mb* of hard disk storage space.

(2) Gravity and Magnetics Computer Software

The software which was used for interpretation of the gravity and magnetics data was the MAGIX XL program by INTERPEX, Ltd. of the U.S.A.. This program is a two dimensional inversion program which automatically fits observed data by iterative Inman-style ridge regression. It can accommodate 1,000 data points and earth models can be composed of up to 200 prisms with a maximum of 2,000 vertices. Inversion can be performed with up to 40 of the variables unknown.

(3) Basic Inversion Procedure

1) Profile observed data along a line normal to structural trends so that subsurface structure is approximately two dimensional.